



UNIVERSITY OF
ARKANSAS

Department of Mathematical Sciences

Pre/Post Analysis of the Change in Learning
Objective Competency of College Algebra Students

Fall 2016

Data

Data were collected on all students enrolled in College Algebra (MATH 1203) and College Algebra with Review (MATH 1204) from the fall semester of 2010 through the spring semester of 2016. During these terms students were given a Pre-Assessment (pre-test) of ten items at the beginning of the semester which were also included in the final exam (post-test) at the end of the semester. These items measured one or more of the following learning objectives:

- (MATH LO 1) Demonstrate an understanding of college-level mathematical concepts and tools.
- (MATH LO 2) Be able to analyze and critique logical arguments.
- (MATH LO 3) Develop models to solve real-life problems.
- (MATH LO 4) Formulate and solve a problem in mathematical terms, using appropriate tools and methods.
- (MATH LO 5) Demonstrate fluency with the language and notation of mathematics.
- (MATH LO 6) Express quantitative and logical ideas with precision.

Courses

- MATH 1203 face-to-face: Three credit hour course which meets three days per week for students scoring at least 23 on the math section of the ACT (or 540 on the SAT math section)
- MATH 1203 online: Three credit hour completely online course for students scoring at least 23 on the math section of the ACT (or 540 on the SAT math section)

- MATH 1204 face-to-face: Four credit hour course which meets four days per week for students scoring 19-22 on the math section of the ACT (or 460-530 on the SAT math section)
- MATH 1204 online: Four credit hour completely online course for students scoring 19-22 on the math section of the ACT (or 460-530 on the SAT math section)

Student Numbers

All students were to be required to take both the pre-test and post-test, though some, due to extenuating or unusual circumstances, did not. In addition, students who withdrew from the course did not take the post-test. In total, 14,116 students took either the pre-test or the post-test during these semesters broken down as follows:

MATH 1203 face-to-face – 8097 students

MATH 1203 online – 220 students

MATH 1204 face-to-face – 5647 students

MATH 1204 online – 152 students

Analyses

Paired t-tests were conducted on each item of the pre-test/post-test by course. These results are included in the tables below the highlights. These tables contain which learning objectives are measured by the items, the t statistic, p-value, Cohen's d effect size, the percentage of students who answered the item correctly in the pre-test, and the percentage of students who answered the item correctly in the post-test. With ten statistical analyses per course, the overall alpha value is set at 0.05 for each course and $0.05/10 = 0.005$ for each item within each course.

Highlights:

- For both face-to-face classes, students were significantly more likely to answer the item correctly in the post-test compared with the pre-test for all ten items indicating a positive effect of the courses on competency in all learning objectives.
- For MATH 1203 face-to-face, the effect size was small for two items, medium for four items, and large for four items.
- For MATH 1204 face-to-face, the effect size was medium for five items and large for five items.
- For MATH 1203 online, students were significantly more likely to answer the item correctly in the post-test compared with the pre-test for all but item 3. The effect size was medium for 8 items and large for 1 item.
- For MATH 1204 online, students were significantly more likely to answer the item correctly in the post-test compared with the pre-test for all but items 1, 3 and 8. The effect size was small for five items and medium for four items.

1203 Face-to-Face

Question Number	Learning Objectives	t	p-value	Cohen's d	Pre-Test Percentage Correct	Post-Test Percentage Correct
1	LO1, LO4	37.0	<0.0001	0.44	72.2%	93.0%
2	LO2, LO3	50.3	<0.0001	0.60	37.9%	71.6%
3	LO1, LO4	30.7	<0.0001	0.37	43.4%	67.3%
4	LO4, LO5	53.2	<0.0001	0.64	36.3%	73.9%
5	LO2, LO3, LO5	74.3	<0.0001	0.89	14.3%	65.5%
6	LO4	63.5	<0.0001	0.76	6.9%	46.2%
7	LO1, LO3	93.2	<0.0001	1.11	7.2%	64.8%
8	LO1, LO4	54.7	<0.0001	0.65	3.2%	34.2%
9	LO2, LO5	82.7	<0.0001	0.99	28.5%	82.0%
10	LO1, LO4	84.9	<0.0001	1.02	37.8%	91.3%

Note: As suggested by Cohen: $d=0.2$ is a "small" effect size, $d=0.5$ "medium", and $d=0.8$ "large"

1203 Online

Question Number	Learning Objectives	t	p-value	Cohen's d	Pre-Test Percentage Correct	Post-Test Percentage Correct
1	LO1, LO4	6.3	<0.0001	0.53	52.2%	85.9%
2	LO2, LO3	6.3	<0.0001	0.53	29.9%	61.1%
3	LO1, LO4	2.2	0.0320	0.18	36.8%	55.0%
4	LO4, LO5	6.8	<0.0001	0.57	26.9%	62.4%
5	LO2, LO3, LO5	9.7	<0.0001	0.82	15.4%	59.1%
6	LO4	7.2	<0.0001	0.61	8.5%	38.9%
7	LO1, LO3	9.3	<0.0001	0.78	7.0%	54.4%
8	LO1, LO4	5.9	<0.0001	0.50	6.0%	29.5%
9	LO2, LO5	6.9	<0.0001	0.58	29.9%	69.1%
10	LO1, LO4	7.4	<0.0001	0.62	41.8%	81.9%

Note: As suggested by Cohen: $d=0.2$ is a "small" effect size, $d=0.5$ "medium", and $d=0.8$ "large"

1204 Face-to-Face

Question Number	Learning Objectives	t	p-value	Cohen's d	Pre-Test Percentage Correct	Post-Test Percentage Correct
1	LO1, LO4	40.0	<0.0001	0.57	51.0%	82.8%
2	LO2, LO3	42.8	<0.0001	0.61	17.2%	50.6%
3	LO1, LO4	42.6	<0.0001	0.61	26.0%	63.7%
4	LO4, LO5	48.7	<0.0001	0.70	17.9%	57.4%
5	LO2, LO3, LO5	69.5	<0.0001	1.00	7.4%	61.3%
6	LO4	59.3	<0.0001	0.85	2.4%	44.9%
7	LO1, LO3	75.8	<0.0001	1.09	2.7%	57.2%
8	LO1, LO4	43.8	<0.0001	0.63	0.6%	28.2%
9	LO2, LO5	71.3	<0.0001	1.02	12.5%	67.0%
10	LO1, LO4	85.5	<0.0001	1.22	25.8%	87.5%

Note: As suggested by Cohen: $d=0.2$ is a "small" effect size, $d=0.5$ "medium", and $d=0.8$ "large"

Question Number	Learning Objectives	t	p-value	Cohen's d	Pre-Test Percentage Correct	Post-Test Percentage Correct
1	LO1, LO4	2.2	0.0270	0.24	58.6%	80.0%
2	LO2, LO3	4.9	<.0001	0.51	21.1%	51.0%
3	LO1, LO4	-0.9	0.3871	0.09	33.8%	33.0%
4	LO4, LO5	4.1	0.0001	0.43	27.1%	56.0%
5	LO2, LO3, LO5	3.6	0.0005	0.39	12.8%	35.0%
6	LO4	4.3	<.0001	0.45	7.5%	30.0%
7	LO1, LO3	7.0	<.0001	0.74	7.5%	49.0%
8	LO1, LO4	2.0	0.0517	0.21	3.0%	12.0%
9	LO2, LO5	6.6	<.0001	0.70	18.8%	58.0%
10	LO1, LO4	5.4	<.0001	0.57	21.8%	62.0%

Note: As suggested by Cohen: d=0.2 is a "small" effect size, d=0.5 "medium", and d=0.8 "large"