

# Evaluation of Math Boot Camp (MATH 83)

**CRC Research Office**

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## Background

Starting in fall 2012, the math department at Cosumnes River College (CRC) has offered a Math Boot Camp (MATH 83) – a three-week long independent study math course. Students enroll Math Boot Camp in order to improve their performance in subsequent math courses and to brush up on fundamental math concepts. They also enroll in Math Boot Camp because they are permitted to retake their math placement exam and could potentially place into a higher level math course. Thus, the goal of the Math Boot Camp is (1) to promote student success in math courses and (2) to accelerate students to higher levels of math. The Research Office – in conjunction with key faculty – sought to investigate whether or not Math Boot Camp achieves the aforementioned goals and to identify any equity differences therein. This evaluation project also sought identify one reason *why* Math Boot Camp might result in higher success beyond knowledge/learning. Specifically, the Research Office tested to see if the Math Boot Camp reduced math anxiety of students which then resulted in increased success in math courses.

## Methodology

Students who completed the Math Boot Camp and then enrolled in a math course at CRC by the *first subsequent major term* following the course were identified through records in the LRCCD PeopleSoft SQL database. The grades of these students were collected in addition to demographic and course information. The same data were collected for students who enrolled in the *same* classes as the Math Boot Camp students. These students were the comparison group for the present investigation. If Math Boot Camp students were more successful (e.g., more likely to receive an A, B, C, or P in a subsequent math course) than their peers, then evidence would suggest that Math Boot Camp promotes student success in math.

Additionally, math placement exam data were gathered for students who retook the exam during the Math Boot Camp. If students significantly improved their exam placement in math, then evidence would suggest that Math Boot Camp accelerates students.

Finally, Math Boot Camp students in summer 2015 were asked to rate their math anxiety at the start and again at the end of the Math Boot Camp on a standardized ten-point anxiety scale. The math anxiety scores at the end of the Math Boot Camp were then associated with student success in math in fall 2015. If math anxiety was reduced *and* correlated with subsequent success in math, then evidence would suggest that Math Boot Camp improves student success in part by reducing math anxiety.

## Summary of Findings

- 1) Math Boot Camp students ( $N = 225$ ) had a higher success rate in subsequent math courses compared to their peers ( $N = 2636$ ) who took the same math courses (56.4% vs. 52.8%). However, this difference was only significant after controlling for ethnicity, age, gender, course level, and instructor. This means that a student who completed the Math Boot Camp will on average have a higher success rate than a student who did not complete the Math Boot Camp with the same age, gender, ethnicity, course level, and instructor. This finding replicates results from an earlier evaluation.
- 2) The effect of Math Boot Camp does not appear to be constant for all ethnic groups. While Math Boot Camp appears to have improved the success of African American and Hispanic/Latino(a) students, API and White students did not see statistically significant changes in success. Math Boot

Camp is therefore a possible mechanism for reducing equity gaps in math course success for African American and Hispanic/Latino(a) students.

- 3) Of the students who retested during the Boot Camp ( $N = 52$ ), a total of 51.92% ( $N = 27$ ) improved their exam placement by an average of about one placement level. This improvement was statistically significant. However, it should be noted that nearly all African American students who retook the exam did not increase their placement.
- 4) In summer 2015, students who took the Math Boot Camp saw reductions in math anxiety. This reduction in math anxiety was, however, not significant for Hispanic/Latino(a) students.
- 5) Math anxiety did not predict *end of semester* enrollment or success in a subsequent math course.

### **Limitations**

The non-significant effect of math anxiety on student success may partially be explained by low sample sizes. Further investigation is required in order to link math anxiety and success in math courses. The findings regarding student placement should also be interpreted with caution given the low sample sizes. Additionally, the complexity of the statistical model for comparing performance in subsequent math courses increases the probability of false conclusions. Nevertheless, given that this study replicates some findings from a previous evaluation, the likelihood of false conclusions is reduced. With this said, the differential effectiveness of Math Boot Camp for African American and Hispanic/Latino(a) students, although promising, still needs to be replicated.

### **Recommendations**

The findings from this evaluation are promising and suggest that the Math Boot Camp improves student success, has the potential to accelerate students, and has the potential to reduce equity gaps in math course performance for African American and Hispanic/Latino(a) students. However, on the basis of the findings described within this report, the Research Office makes the following (non-exhaustive recommendations):

- 1) In order to accelerate a more substantial portion of the student population, increase outreach for Math Boot Camp to students who have recently taken a placement exam and have not started their math sequence.
- 2) Develop ways of providing assistance designed to help improve test placement for African American students. If the current trend in exam improvement persists, then Math Boot Camp could potentially increase equity gaps in course placement for African American students. A larger proportion of students will be accelerated to higher placement levels in other groups, whereas the placement level of African American students may remain unchanged.

### **Analyses**

#### ***Student Demographic Information and Summary Data***

*Table 1* provides a demographic and success rate breakdown of both students in the Math Boot Camp and their peers in the comparison group. African American, Hispanic/Latino(a), and female students constituted the majority of the Math Boot Camp students. Interestingly, the success rates of Hispanic/Latino(a) and African American students were substantially higher than their non-boot camp peers.

Table 1. *Demographic Breakdown of Math Boot Camp and Comparison Group Students (Fall, 2012 – Fall, 2015)*

Student Demographics	Boot Camp			Non-Boot Camp		
	N	%	% Successful	N	%	% Successful
<b>Gender</b>						
Female	145	64.4%	59.3%	1487	56.4%	55.4%
Male	74	32.9%	51.3%	1111	42.1%	49.7%
Unknown	6	2.7%	50.0%	38	1.4%	44.7%
<b>Ethnicity</b>						
African American	65	28.9%	50.8%	448	17.0%	36.2%
API	36	16.0%	55.6%	605	23.0%	64.0%
Hispanic/Latino(a)	73	32.4%	68.5%	745	28.3%	50.5%
Multi-Race/Unknown/Other	16	7.1%	43.8%	228	8.6%	45.6%
Native American	3	1.3%	0.0%	21	0.8%	57.1%
White	32	14.2%	53.1%	589	22.3%	59.8%
<b>Age</b>	23			21		
<b>Total</b>	<b>225</b>		<b>56.4%</b>	<b>2636</b>		<b>52.8%</b>

Note. “% Successful” presents success rates in subsequent courses, after the Boot Camp.

Table 2. *Test Placement and Math Anxiety Summary Data*

Demographic	Placement (Fall, 2012 – Fall, 2015)				Math Anxiety (Summer, 2015)	
	N Total	N Increased	% Increased	Avg. Increase	N	Change
<b>Gender</b>						
Female	27	16	59.3%	1.11	52	-0.93
Male	23	10	43.5%	0.43	21	-0.43
Unknown	2	1	50.0%	1.00	2	-4.50
<b>Ethnicity</b>						
African American	8	1	12.5%	0.00	18	-0.97
API	10	5	50.0%	1.00	14	-1.35
Hispanic/Latino(a)	22	13	59.1%	0.91	31	-0.2
Multi-Race/Unknown/Other	1	1	100.0%	1.00	4	0.25
Native American	0	0				
White	11	7	63.6%	0.91	8	-3.12
<b>Total</b>	<b>52</b>	<b>27</b>	<b>51.9%</b>	<b>0.81</b>	<b>75</b>	<b>-0.89</b>

Note. Math anxiety was measured on a ten-point scale. “Avg. Increase” refers to the average number of levels increased after retaking the placement exam. Placement data are from fall 2012 to fall 2015. Math Anxiety data are from students enrolled in summer 2015.

Table 2 provides summary data on math placement exam retakes as well as changes in math anxiety within differing demographic groups. Notably, of the small sample of African American students who retested during the Boot Camp, only one improved their course placement. Moreover, Hispanic/Latino(a) students had a much smaller decrease in math anxiety.

### **Analysis Technical Specifications**

A binomial regression model, assuming a quasibinomial error term (commonly used to test for differences in a binomial/two-level outcome variable), was used to test for differences in success between the Math Boot Camp and comparison group. Although Math Boot Camp students had a higher average success rate (56.4%) than the comparison group (52.8%), this difference was not significant,  $t(1) = 1.037$ , *ns*. However, when controlling for ethnicity, age, gender, course level, and instructor, Math Boot Camp students were significantly more successful,  $t(1) = 2.270$ ,  $p < .05$ . This means that a student who took and passed Math Boot Camp was more likely to succeed than another student who did not take Math Boot Camp with the same ethnicity, age, gender, course level, and instructor. An additional exploratory test was performed to see if the effect of Math Boot Camp was significant within all student ethnic groups. This “interaction” effect was significant,  $\Delta\chi^2(5) = 17.22$ ,  $p < .01$ . Specifically, Math Boot Camp improved success for African American and Hispanic Latino Students relative to their African American and Hispanic/Latino(a) peers who did not enroll in Math Boot Camp ( $t(1) = 2.528$ ,  $p < .05$ ,  $t(1) = 3.10$ ,  $p < .01$ , respectively). Conversely, Math Boot Camp did not have a significant effect for White/API students, and the sample sizes were too small to test effects for Native American students. This finding suggests that Math Boot Camp has the potential of reducing equity gaps for African American and Hispanic/Latino(a) students.

Additionally, a repeated measures *t*-test was used to test whether or not students who retook the math placement exam significantly improved their placement. Students who retested significantly improved their placement level on average,  $t(51) = 4.90$ ,  $p < .001$ . Further analyses were performed to see if Math Boot Camp differentially improved the placement within specific student groups. Math Boot Camp did not differentially improve placement for males or females,  $F(2,49) = 2.13$ , *ns*. Nevertheless, it should be noted that male students had a smaller average increase than females. Moreover, sample sizes were too low to perform statistical analyses within each ethnic group. However, it should also be noted that only one African American student improved their test placement.

Finally, a repeated measures *t*-test was used to test whether or not students who took the math Boot Camp in summer, 2015 significantly reduced their math anxiety. This test was significant,  $t(69) = 3.15$ ,  $p < .01$ , suggesting that students had lower levels of math anxiety at the end of Math Boot Camp. Notably, Hispanic/Latino(a) students did not have significant reductions in Math Anxiety,  $t(1) = 0.48$ , *ns*. The changes in math anxiety observed in the Math Boot Camp have limited implications, however. Math anxiety did not predict success or enrollment at the end of the fall, 2015 semester. Thus, although the Math Boot Camp might improve psychological comfort with math, the reductions in math anxiety may not translate to student performance. It should nevertheless be noted that all the effects of math anxiety were in the expected direction (e.g., students with higher math anxiety had lower success rates), but these effects were not significant, possibly due to low sample sizes.