Office of Research & Planning

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Research Brief: Comparison of Student Success in Math-250 2009-2010 and 2010-2011 Primary Terms

Overview: The purpose of this study was to determine if the Crafton Hills College (CHC) Math-250, Single Variable Calculus course success[1] differs based on how students met the pre-requisite eligibility requirement to enroll in the course. According to the CHC catalog, students are eligible to take Single Variable Calculus I (Math-250) if they meet the pre-requisite by successfully completing the course Math-160, Pre-calculus (formerly Math-151), or as determined through Accuplacer assessment and placement testing. In addition, Math faculty may elect to waive a student's pre-requisite requirement if the student completes College Algebra (Math-102) and Plane Trigonometry (Math-103) receiving an A in one course and an A or B in the other course.

Methodology: The relationship between students success in Math-250 and on the student's method of eligibility used to enroll in the course was examined. A file with all students who earned a grade on record[2] (GOR) in Math-250 at CHC in Fall 2009, Spring 2010, Fall 2010 and Spring 2011 was created. Those students were categorized and divided into five groups based on eligibility criteria[3]:

- It is unknown how the student's met the pre-requisite requirement (Group 1).
- Students successfully completed pre-requisite course Pre-Calculus (Math-160 (formerly Math-151)) (Group 2).
- Students earned an "A" in College Algebra (Math-102) or Plane Trigonometry (Math-103) and an "A" or "B" in other course and received a pre-requisite waiver from a Math faculty member (Group 3).
- Students successfully completed the pre-requisite course Pre-Calculus (Math-160 (formerly Math-151)) and students earned an "A" in College Algebra (Math-102) or Plane Trigonometry (Math-103) and an "A" or "B" in the other course (Group 4).
- Students met the pre-requisite requirement as determined by the Accuplacer assessment and placement exam (Group 5).

The P-Value is an indication of statistical significance which exists when the P-value is less than .05 indicating that the difference between the groups is likely to be due to chance only 5 out of 100 times. It is important to note that when statistical significance is calculated, the number of students in each group does influence the significance level (i.e. "p" value being lower than .05).

Effect Size, developed by Jacob Cohen is not influenced by the number of students in each group. Effect size is calculated by dividing the difference of the two means by the pooled standard deviation. Jacob Cohen defined "small," "medium," and "large" effect sizes. He explained that an effect size of .20 can be considered small, an effect size of .50 can be considered medium, and an effect size of .80 can be considered large. Using an effect size increases the likelihood that the difference is not only statistically significant but practical as well.

[1] Success is a grade of A, B, C, or CR/P; Unsuccessful is a grade of D, F, NP, or W

[2] Grade on Record (GOR) is a grade of: A, B, C, D, F, CR/P, NC/NP, I, or W.

[3] One student met the pre-requisite by both assessment testing placement and successfully completing the pre-requisite course Math-160 and was excluded from these results.

Findings: Each group was compared by their success in Math-250. A one-way ANOVA was used to determine if there was a significant difference within any of the comparisons of the five groups. A post-hoc LSD (least significant difference) test compared the groups to determine if significant differences occurred between the groups. No significant differences were found. Table 1 and Figure 1 illustrate students included in this study by how they met the enrollment eligibility requirement and their success in Math-250.

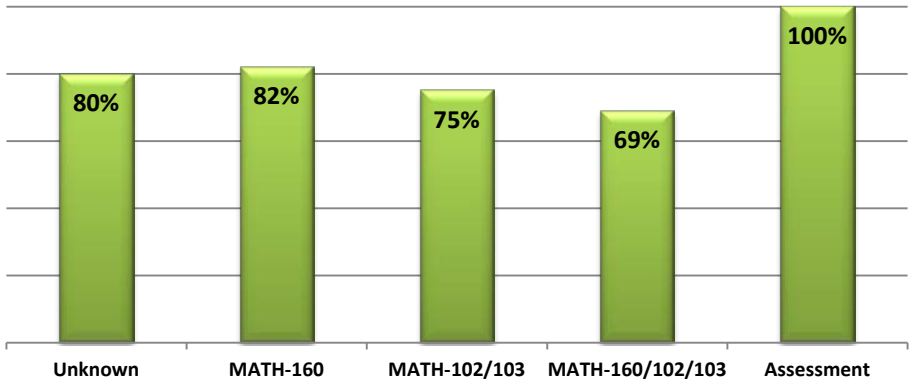
- 54% of the total number of students who earned a grade in Math-250 during the 2009-10 and 2010-11 primary terms met the eligibility requirement to enroll by successfully completing the pre-requisite course Math-160.
- 3% of the students who earned a GOR in Math-250 during the 2009-10 and 2010-11 primary terms met the eligibility requirement to enroll as determined by the Accuplacer assessment exam.
- 82% of Math-250 students were successful when they met the eligibility requirement to enroll by successfully completing the pre-requisite course Math-160.
- 100% of the students who met the eligibility requirement for Math-250 through their scores on the Accuplacer exam were successful in Math-250.
- Overall, regardless of how students met the eligibility requirement, 80% successfully completed the Math-250 course.

Table 1: Successful/Non-Successful Students in Math-250 Grouped by Eligibility Criteria

Eligibility Criteria	MATH 250				Total	
	Not Successful		Successful			
	N	Row %	N	Row %	N	Column %
Group 1: Unknown	7	20.0	28	80.0	35	**21.2**
Group 2: Math-160	16	18.0	73	**82.0**	89	**53.9**
Group 3: Math-102 & 103	5	25.0	15	75.0	20	12.1
Group 4: Math-160 and Math-102 & 103	5	31.3	11	68.8	16	9.7
Group 5: Assessment	0	0.0	5	**100.0**	5	**3.1**
Total	33	20.0	132	**80.0**	165	100.0

Note: "N" refers to the number of unduplicated students. "Row %" refers to the number of unduplicated students divided by the total number of students in each group. "Column %" refers to the number of unduplicated students in each group divided by the total number of students in this study.

Figure 1: Success rate* of students in Math-250 grouped by eligibility criteria



* Success rate is defined as the number of A, B, C, or CR/P grades divided by the number of grades on record.

Next, at the request of Crafton Hills College math faculty, the students were categorized into three groups to examine further if significant differences occurred in student success for Math-250 based on the following eligibility criteria.

- Students who successfully completed the pre-requisite course Math-160 (Pre-req)
- Students who earned an "A" grade in Math-102 or Math 103 and an "A" or "B" grade in the other course and had the pre-requisite requirement waived by a faculty member (Waiver)
- Students met the pre-requisite requirement as determined by the Accuplacer assessment and placement exam (Assessment).

Students who met the eligibility requirement in multiple ways were grouped by the most recent criteria. For example, if a student placed into Math-250 by assessment testing in fall of 2009 and completed Math-160 in fall of 2010, they were placed in the Pre-req group. Students who earned a GOR in Math-250 and it is unknown how they met the pre-requisite requirement (formerly Group 1) were excluded from further analysis. Table 2 illustrates the success of students in Math-250 grouped by these eligibility criteria.

Table 2: Successful/non-successful students in Math-250 grouped by eligibility criteria

Eligibility Criteria	MATH 250				Total	
	Not Successful		Successful			
	N	Row %	N	Row %	N	Column %
Pre-req	21	20.0	84	80.0	105	80.2
Waiver	5	25.0	15	75.0	20	15.3
Assessment	1	16.7	5	83.3	6	4.5
Total	27	20.6	104	79.4	131	100.0

Table 3 illustrates the relationship between student's success in Math-250 depending on the student's method of eligibility to enroll in the course when grouped by pre-req, waiver, or assessment. A one-way Anova and post-hoc LSD (least significant difference) test compared the groups within and between to determine if significant differences occurred.

No significant differences were found in Math-250 course success based on how students met the pre-requisite eligibility requirement to enroll in the course.

Table 3: Significance testing of student success in Math-250 when compared by eligibility criteria

Pre-req			Waiver				
#	N	%	#	N	%	P-value	Effect Size
105	84	80.0	20	15	75.0	.617	-0.12
Pre-req			**Assessment**				
#	N	%	#	N	%	P-value	Effect Size
105	84	80.0	6	5	83.3	.846	0.08
Waiver			**Assessment**				
#	N	%	#	N	%	P-value	Effect Size
20	15	75.0	6	5	83.3	.662	0.19