
FRESNO CITY COLLEGE

Prerequisite Validation Study

Examination of Math-101 as a Prerequisite to GEOL-1

Office of Institutional Research, Assessment, and Planning
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Executive Summary

Target class and prerequisite class:

- Target class : GEOL-1
- Prerequisite class: Math-101

The following met the prerequisite criteria for GEOL-1:

- Successfully completing Math-101 or placed into Math-103 or higher.

Conclusion:

- For the current prerequisite validation study, three measures were examined in the target class GEOL-1: GPA in GEOL-1, success rate, and correlation between grades in target class (GEOL-1) and prerequisite class (Math-101). T-test, chi-square, and correlation analysis were performed. All three measures were statistically significant and met the Chancellor's Office established criteria. Therefore, it is concluded that sufficient evidence exists to enforce Math-101 as a prerequisite for GEOL-1.

Further research determined the following:

- Successfully completing Math-101 or higher or placed into Math-103 or higher
 - 42% of the GEOL-1 students met the prerequisite
 - The success rate of those who met the prerequisite was 66%, compared to 45% for those who did not meet the prerequisite
 - The current GEOL-1 success rate is 54% and would increase to 66% with Math-101 as a prerequisite
 - Disproportionate impact did occur when students 19 years or younger or ages 30-34 were compared with students age 20-24.
 - Disproportionate impact was not observed by gender, ethnic groups, or disability.

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Background

As stated in Title 5 Matriculation regulations (rev. March 1998), Section 55201(a), “the governing board of a community college district may establish prerequisites, corequisites, and advisories on recommended preparation (defined in Section 55200), but must do so in accordance with the provisions of this Article (Matriculation Regulations Article 2.5).” At a minimum, “...prerequisites, corequisites, and advisories on recommended preparation shall be based on content review (Title 5, Section 55201(b)(2).” Content review, “...is conducted by faculty to identify the necessary and appropriate body of knowledge or skills students need to possess prior to enrolling in a course, or which students need to acquire through concurrent enrollment in a corequisite course.” Beyond content review, in some instances additional evidence is required before a district can enforce prerequisites, corequisites, or advisories. As stated in Title 5, Section 55201(3)(e), “a course in communication or computation skills may be established as a prerequisite or corequisite for any course other than another course in communication or computation skills only if, in addition to conducting a content review, the district gathers data according to sound research practices and shows that a student is highly unlikely to succeed in the course unless the student has met the proposed prerequisite or corequisite.”

To assist districts in identifying and establishing “sound research practices,” the California Community College Chancellor’s Office, Academic Senate for California Community Colleges, the California Association of Community Colleges (CACC) Commission on Research, the Research & Planning (RP) Group (at the time divided into two entities – the Northern California Community College Research Group (NORCAL) and the Southern California Community College Institutional Research Association (SCCCIRA)), and the Matriculation Regional Advisory Committee all worked diligently throughout the late 1980s and 1990s to develop a number of seminal documents that have served as blueprints for researchers engaged in matriculation evaluation. Influential publications include:

- “The Model District Policy for Prerequisites, Corequisites, and Advisories on Recommended Preparation, and Other Limitations on Enrollment” (September, 1993)
- California Community College Chancellor’s Office “Matriculation Regulations” (rev. March 1998)
- “Prerequisites, Corequisites, Advisories, and Limitations on Enrollment” (Fall 1997) – A questions-and-answers document prepared by the California Community College Chancellor’s Office and the Academic Senate of California Community Colleges that provides technical assistance and interpretation of Title 5 regulations.

- “Are Prerequisites Really That Hard to Establish?” – A short follow-up document prepared by Bill Scroggins
- “Matriculation Standards” – Prepared by the Chancellor’s Office, this document identifies the various components of matriculation and provides cross-references to Title 5 and AB-3 (Seymour-Campbell Matriculation Act of 1986)
- “Matriculation Local Research Options Project” (November, 1989) – the initial document prepared by the California Community College Chancellor’s Office, CACC, SCCCIRA, NORCAL, and the Matriculation Regional Advisory Committee to assist districts in developing and conducting local matriculation research
- “Assessment Validation Project Local Research Options” (February, 1991)
- “Matriculation Evaluation: Monographs on Designs from the Local Research Options Project” (February, 1992) – the second series of matriculation research studies presented by the aforementioned groups
- “Matriculation Evaluation: Phase III Local Research Options” (June, 1992) – the third series of matriculation research designs addressed by the CCCCCO, CACC, SCCCIRA, and NORCAL

The Fresno City College (FCC) Office of Institutional Research, Assessment, and Planning reviewed the various documents and incorporated a number of identified best practices into this study. In this study, the prerequisite and target course are interdisciplinary, therefore, Title V requires the college gather data according to sound research practices and shows that a student is highly unlikely to succeed in the course unless the student has met the proposed prerequisite (Title 5 §55201). The purpose of this research study is to use “sound research practices” to examine what extent reading proficiency is a valid predictor of success in GEOL-1.

Sample

One thousand two hundred twenty two students (n=1,222) made their first attempt in GEOL-1 and earned a grade on record during Fall 2008, Spring 2009, Fall 2009, Spring 2010, Fall 2010, and Spring 2011. Of those, 657 (54%) students were successful. To meet the proposed prerequisite, students must successfully complete Math-101 or be placed into Math 103 or higher prior to taking GEOL-1. Among the total 1,222 students in the sample, 514 (42%) of them met the prerequisite.

Methodology

Comparison of Performance in the Target Course of Students Who Did and Did Not Meet the Prerequisite:

Using the RP Group definitions that have been adopted by the Chancellor’s Office, the FCC Office of Institutional Research, Assessment, and Planning used student data to initially identify

all students who earned a grade on record (A, B, C, CR, D, F, FW, NC, I, or W) in the target course, GEOL-1, for Fall 2008, Spring 2009, Fall 2009, Spring 2010, Fall 2010, and Spring 2011. While a student may have taken the target course multiple times, for purposes of prerequisite validation, only the first attempt in the target course was examined. Further coding was created to identify students who were successful (earned an A, B, C, or P or CR grade) or unsuccessful (earned a grade of D, F, FW, NC, I, or W) in the target course. Successful grades were divided by total grades earned on record to compute success rate.

Once this step was completed, course outcomes for students who successfully completed the prerequisite course, or tested at an equivalent math assessment level prior to completing GEOL-1 were merged into the target course file. For prerequisite courses, the best attempt (i.e., the highest grade earned in the prerequisite course) was identified and merged into the target file. Using the aforementioned definitions, a student was identified as having met the prerequisite if he/she earned a successful grade on record in the prerequisite course or the student earned a sufficiently high placement recommendation on the assessment test. Conversely, students who did not meet the prerequisite were identified as students who: a) did not take the prerequisite course; b) the highest grade earned on record in the prerequisite courses was a non-successful grade; or c) did not score at an equivalent level on the assessment test.

Once the target course outcome of prerequisite completers and non-completers was identified, the Office of Institutional Research, Assessment, and Planning conducted independent samples of the t-test and chi-square test to determine whether statistically significant differences in target course outcome existed between prerequisite completers and non-completers. This study will examine the overall success rates and grades in the target courses, the success rates and grades of students who met the prerequisites, the success rates of students who did not meet the prerequisites, the percentage of students in the target courses who met the prerequisite, and whether the success rates of completers/non-completers were identified as statistically significantly different ($p < .05$).

Effect Size and Average Percent Gain

Recognizing that statistically significant differences are often an artifact of sample size (with large samples, only minimal differences can produce statistically significant results; conversely, with small samples large outcome differences may not be identified as statistically significantly different), effect size and average percent gain were also examined. In essence, effect size measures the strength of a relationship between two variables, controlling for the influence of sample size.

Since t-tests were initially used to explore whether statistically significant differences existed between prerequisite completers and non-completers, the logical measure employed by the Office of Institutional Research, Assessment, and Planning to determine effect size was Cohen's *d*. Cohen's *d* is defined as the difference between the two means divided by the pooled standard deviation for the two means. Obtaining basic statistical data about the populations in question (means and standard deviations) researchers can easily calculate effect size. While interpretations vary, the most commonly accepted interpretations suggest that a *d* of 0.20 indicates a small effect, 0.50 a medium effect, and 0.80 or higher a large effect. Recognizing the difficulty in identifying a relationship between two variables in a quasi-experimental environment like post-secondary education, for the purposes of the current study, sufficient evidence was considered to exist if an effect size of 0.20 or higher was observed.

Correlation Coefficient

Correlation coefficients are another method of examining the strength of a relationship between two variables. For the purposes of the current study, researchers employed what is probably the most frequently used correlation coefficient, Pearson's Product Moment Correlation Coefficient, more commonly known as Pearson's *r*. Pearson's *r* employed in the current study examined the relationship between performance in the prerequisite course and performance in the target course. Again, recognizing the quasi-experimental nature of post-secondary education, the Chancellor's Office has established a rule of thumb for obtaining what are considered to be valid correlation coefficients. While usually considered a moderate association, the Chancellor's Office has established a positive correlation coefficient of .35 as sufficient evidence that a relationship exists between a prerequisite course and a target course, assuming that $p < .05$.

Appropriateness of Prerequisites:

Three measures were examined between prerequisite completers and non-completers:

1. GPA in GEOL-1
2. Success rate in GEOL-1
3. Correlations between GEOL-1 GPA and Math-101 GPA

Following is the summary of the results.

GPA in GEOL-1

Table 1. Grades in GEOL-1

	Successfully Completed Math-101 or Higher	Did Not Successfully Completed Math-101 or Higher
A	85	58
B	125	99
C	129	161
D	43	58
F	70	198
W	62	134
Total	514	708
Mean GPA	1.98	1.28
T-Value	8.542	
Sig (P-value)	0.000	
Cohen's <i>d</i>	0.50	

To determine if student's GPA in GEOL-1 is significantly different by the two groups, a t-test of independent groups was performed. Data indicated that students who successfully completed Math 101 had a statistically significantly higher GPA in GEOL-1 than those who did not complete Math 101 ($p < 0.001$). The effect size was 0.50 indicating a sufficient impact on success if students successfully completed Math-101 prior to enrolling in GEOL-1.

Success Rate in GEOL-1

Table 2. Success Rate in GEOL-1

	Completed Prerequisite Math-101 or Higher		Total
	Yes	No	
Successful	339	318	657
Unsuccessful	175	390	565
	514	708	1222
Success Rate	66%	45%	54%

Chi-square = 53.023, df = 1, p = 0.000

To determine if student's success rate in GEOL-1 is significantly different by the two groups, a chi-square test was performed. Data showed that students who successfully completed Math-101 or higher had a statistically significantly ($p = .000$) higher success rate (65%) in GEOL-1 than students who did not successfully complete Math-101 (45%). The current GEOL-1 success rate is 54% and would increase to 66% with Math-101 as a prerequisite (an 11% increase).

Correlations between GEOL-1 GPA and Math-101 GPA

Table 3. Correlations between GEOL-1 GPA and Math-101 GPA

		Math-101 GPA	GEOL-1 GPA
Math-101 GPA	Pearson Correlation	1	.365**
	Sig. (2-tailed)		.000
	N	1221	151
GEOL-1 GPA	Pearson Correlation	.365**	1
	Sig. (2-tailed)	.000	
	N	151	151

** . Correlation is significant at the 0.01 level (2-tailed).

Pearson's r employed in the current study examined the relationship between performance in the prerequisite course (Math-101) and performance in the target course (GEOL-1). The Chancellor's Office has established a positive correlation coefficient of .35 as sufficient evidence that a relationship exists between a prerequisite course and a target course, assuming that $p <$

.05. Pearson's r was 0.365 for this study, indicating sufficient evidence that a relationship exists between the performance in Math-101 and performance in GEOL-1.

Conclusion

For the current prerequisite validation study, three measures were examined in the target class GEOL-1: GPA in GEOL-1, success rate, and correlation between grades in target class and prerequisite class. T-test, chi-square, and correlation analysis were performed. All three measures were statistically significant and met the Chancellor's Office established criteria. Therefore, it is concluded that sufficient evidence exists to enforce Math-101 as a prerequisite of GEOL-1.

Disproportionate Impact Analysis

In addition to providing evidence that the proposed prerequisite is "necessary and appropriate" (i.e., "a strong rational basis exists for concluding that a prerequisite or corequisite is reasonably needed to achieve the purpose that it purports to serve" (Title 5, Section 55200(e)), Title 5 regulations also state that the district should conduct, "...an evaluation to determine whether the prerequisite or corequisite has a disproportionate impact on particular groups of students described in terms of race, ethnicity, gender, age or disability, as defined by the Chancellor. When there is a disproportionate impact on any such group of students, the district shall, in consultation with the Chancellor, develop and implement a plan setting forth the steps the district will take to correct the disproportionate impact." (Title 5, Section 55201(e)(2)(B)). To clarify, the Chancellor's Office has operationally defined disproportionate impact, stating that it occurs when, "...the percentage of persons from a particular racial, ethnic, gender, age or disability group who are directed to a particular service or placement based on an assessment instrument, method or procedure is significantly different than the representation of that group in the population of persons being assessed and that discrepancy is not justified by empirical evidence demonstrating that the assessment instrument, method or procedure is a valid and reliable predictor of performance in the relevant educational setting."

To assess if there is a disproportionate impact for this study, a combination of the chi-square test and Glasnapp and Poggio's (2001) 80% method were utilized. To determine if there is a statistically significant differences between groups, the chi-square test was applied. If the difference was statistically significant, then the 80% rule (Glasnapp and Poggio, 2001) was used to identify where the difference exists.

According to Glasnapp and Poggio (2001), "Evaluation for impact is accomplished by dividing the minority percent placement rate (African American, Hispanic, female, Spanish speakers, etc.) by the majority (white, or male, etc.) percent in specific courses. If this ratio is less than 80%, then there is evidence of disproportionate impact."

The “80% Rule”, as it is sometimes called, traces its origin back to the Equal Employment Opportunity Commission (EEOC) which includes that rule in its uniform selection guidelines. Following the examples given by Glasnapp & Poggio, the 80% rule was applied to the data from the current study to evaluate potential disproportionate impact of a Math-101 prerequisite on groups defined by gender, ethnicity, age, and disability.

To examine whether a disproportionate impact existed, data were generated for prerequisite course/target course combination. The last column in the following tables (“Disproportionate Impact”) identify whether a disproportionate impact was observed (“Yes” if disproportionate impact was observed).

Table 4. Disproportionate Impact by Age

Age	Completed Math-101 or higher		Total	% of Completed Math-101	Disproportionate impact
	YES	NO			
19 or Younger	98	243	341	29%	YES
20-24	309	328	637	49%	49%*80%=39%
25-29	59	77	136	43%	NO
30-34	16	27	43	37%	YES
35-39	13	8	21	62%	Sample too small
40-49	15	18	33	45%	NO
50+	4	7	11	36%	Sample too small
Total	514	708	1222	42%	

Chi-square = 39.908, df =6, p=0.000 (significant at p<.05)

Table 5. Disproportionate Impact by Ethnicity

Ethnicity	Completed Math-101 or higher		Total	% of Completed Math-101	Disproportionate impact
	YES	NO			
African-American/non-Hispanic	32	47	79	41%	NO
American Indian/Alaskan Native	2	7	9	22%	NO
Asian/Pacific Islander	94	94	188	50%	
Hispanic	203	273	476	43%	NO
Race/ethnicity unknown	37	66	103	36%	NO
White/non-Hispanic	146	221	367	40%	NO
Total	514	708	1222	42%	

Chi-square = 8.836, df =5, p= 0.116 (not significant at p<.05)

Table 6. Disproportionate Impact by Gender

	Completed Math-101 or higher		Total	% of Completed Math-101	Disproportionate impact
	YES	NO			
Female	223	314	537	42%	NO
Male	239	390	679	43%	NO
Unknown	2	4	6	33%	
Total	514	708	1222	42%	

Chi-square = .224, df =2, p= 0.894, (not significant at p<.05)

Table 7. Disproportionate Impact by Disability

DSPS	Completed Math-101 or higher		Total	% of Completed Math-101	Disproportionate impact
	YES	NO			
NOT DSPS	494	664	1158	43%	NO
DSPS	20	44	64	31%	NO
Total	518	704	1222	42%	

Chi-square = 3.24, df =1, p= 0.072, (not significant at p<.05)

Results on Disproportionate Impact

Tables 4 to 7 in the previous pages identify the disproportionate impact when Math-101 is the prerequisite for GEOL-1.

Chi-square tests revealed there is a significant difference between age groups. Overall, 42% of students who enter GEOL-1 successfully complete the Math-101 prerequisite. However, 29% of students age 19 years or younger who entered GEOL-1, successfully completed the Math-101 prerequisite. Conversely, 49% of students age 20-24 years (the majority group) who entered GEOL-1, successfully completed the Math-101 prerequisite. When applying the 80% rule, $49\% \times 80\% = 39\%$. According to Glasnapp and Poggio’s (2001) 80% rule, any group which falls below 39% indicates a disproportionate impact. Table 4 shows that two groups (19 or younger and 30-34) fell below 39%. **This finding represents an observed disproportionate impact by age.**

Chi-square tests indicated no statistical differences between groups by ethnicity, gender, and/or disability; therefore, no observed disproportionate impact exists by ethnicity, gender, and/or disability.

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