



Prerequisite Validation Study

Examination of Reading and English as
Prerequisites to RELIG-100 (Introduction to
Religious Studies) and RELIG-101
(Introduction to World Religions)

Executive Summary

The following met the prerequisite criteria for **RELIG-100**:

- Successfully completing READ-925 or placement into ENGL-914 or higher
- Successfully completing ENGL-914 or placement into ENGL-015 or higher
- Successfully completing ENGL-015 or placement into ENGL-101
- Successfully completing ENGL-101

Further research determined the following about the two prerequisites most likely to increase the success rate in **RELIG-100**:

- Successfully completing ENGL-015 or placement into ENGL-101 or higher
 - 49% of the RELIG-100 students met the prerequisite
 - The success rate of those who met the prerequisite was 72%, compared to 57% for those who did not meet the prerequisite
 - The current RELIG-100 success rate is 64% and would likely increase to 72% with ENGL-015 as a prerequisite
 - Disproportionate impact did not occur
- Successfully completing ENGL-101
 - 38% of the RELIG-100 students met the prerequisite
 - The success rate of those who met the prerequisite was 80%, compared to 54% for those who did not meet the prerequisite
 - The current RELIG-100 success rate is 64% and would likely increase to 80% with ENGL-101 as a prerequisite
 - Disproportionate impact did occur when students 24 years or younger were compared with students age 25 or older
 - The success rate differential between the two age groups would decrease from 8.9% to 0.3%, an 8.6% gain with ENGL-101 as a prerequisite.

The following met the prerequisite criteria for **RELIG-101**:

- Successfully completing READ-925 or placement into READ-956 or higher
- Successfully completing READ-956 or placement into READ-078 or higher
- Successfully completing READ-078 or placement into READ-MET
- Successfully completing READ-925 or placement into ENGL-914 or higher
- Successfully completing ENGL-914 or placement into ENGL-015 or higher
- Successfully completing ENGL-015 or placement into ENGL-101
- Successfully completing ENGL-101

Further research determined the following about the two prerequisites most likely to increase the success rate in **RELIG-101**:

- Successfully completing ENGL-914
 - 53% of the RELIG-101 students met the prerequisite
 - The success rate of those who met the prerequisite was 73%, compared to 61% for those who did not meet the prerequisite
 - The current RELIG-101 success rate is 67% and would likely increase to 73% with ENGL-914 as a prerequisite
 - Disproportionate impact did occur when students 24 years or younger were compared with students age 25 or older
 - The success rate differential between the two age groups would decrease from 8.9% to 6.0%, a 2.9% gain with ENGL-914 as a prerequisite.
- Successfully completing ENGL-015 or placement into ENGL-101 or higher
 - 52% of the RELIG-101 students met the prerequisite
 - The success rate of those who met the prerequisite was 72%, compared to 62% for those who did not meet the prerequisite
 - The current RELIG-101 success rate is 67% and would likely increase to 72% with ENGL-015 as a prerequisite
 - Disproportionate impact did occur when students 24 years or younger were compared with students age 25 or older
 - The success rate differential between the two age groups would decrease from 8.9% to 6.3%, a 2.6% gain with ENGL-015 as a prerequisite.

Crafton Hills College Prerequisite Validation Studies

Background

Title V Education Code regulations for prerequisites prior to February 2011 prohibited colleges from establishing prerequisites unless the college uses “...sound research practices and shows that a student is highly unlikely to succeed in the course unless the student has met the proposed prerequisite....” Specifically, Title 5, Section 55201(3) (e) stated that “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 had 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

However, in 2010 the California Community College Board of Governors expressed concern about the effects of requiring sound research practices to establish prerequisites on students (Russell, 2011). It was argued that the requirements prior to 2011 prohibited districts from establishing prerequisites unless students had a high failure rate. Accordingly, the emphasis has been on failure rather than success. In addition, the Academic Senate and other observers have argued for changes in this area to make it easier for colleges to establish prerequisites, thereby increasing the likelihood of student success.

In 2010 a Prerequisite Task Force was organized to include representatives from the Academic Senate, Chief Instructional Officers, Chief Student Services Officers, and the Chancellor’s Office (Russell, 2011). The recommendation of the Prerequisite Task Force was that Title 5 be changed to be “permissive.” This would allow colleges to use content review if they choose, rather than requiring “sound research practices” for prerequisites that provide skills in reading, writing, or mathematics for courses other than those in communication or computation. Moreover, the Prerequisite Task Force also felt that Title 5 regulations needed to continue to require colleges to examine the

disproportionate impact of any prerequisite. According to Russell (2011), “The primary goal of this regulation change is to increase *student success* throughout the California Community Colleges.”

The Research and Planning Group (RP Group, 2010) responded to the newly proposed regulations amended to Title 5 and did not support the amendment. Namely, the RP Group (2010) argued that “Without [the] statistical validation of prerequisites, it is virtually impossible to demonstrate that the establishment of prerequisites leads to an improvement in student success.” The RP Group (2011) and the Crafton Hills College Office of Research and Planning (ORP) is committed to ensuring that decision-making is evidence-based. The RP Group does not support the establishment of prerequisites based solely on a content review, and believes that decisions need to be supported by multiple forms of research. The mission of the CHC ORP “...is to collaborate with faculty, administration, staff, and students to provide high quality educational programs and services by integrating institutional research, planning, analysis, and systematic assessment to inform evidenced-based decision making and learning.” Consequently, the CHC ORP supports providing multiple forms of evidence to help inform decision-making with the ultimate goal of helping to increase student success.

The CHC ORP has thoroughly reviewed the referenced documents and has incorporated a number of the identified best practices into Matriculation research projects. Specific to the studies referenced in this document, the Crafton Hills College Office of Research and Planning has developed a consistent methodology for examining prerequisites, corequisites, and advisories courses that uses multiple forms of statistical evidence to inform decision-making. The purpose of this research study is to use “sound research practices” to examine what extent reading or writing proficiency is a valid predictor of success in RELIG-100 or RELIG-101.

Sample

Two hundred and sixty-one students earned their first GOR in RELIG-100 from 2008 – 2009 to 2010 – 2011. Of those, 167 (64%) successfully completed RELIG-100 with a “C” grade or better. In addition, 450 students earned their first GOR in RELIG-101 from 2008 – 2009 to 2010 – 2011. Of those, 303 (67%) successfully completed RELIG-101 with a “C” grade or better.

Methodology

Working with the Crafton Hills College Dean of Arts and Sciences, Assessment Office, and the Psychology faculty member who teaches and coordinates religion – the ORP studied the effect of adding a reading and English competency pre-requisite as a requirement for enrolling in Introduction to Religion (RELIG-100) or Introduction to World Religions (RELIG-101). The ORP explored the following reading and English courses as possible prerequisites for RELIG-100 and RELIG-101; READ 925 (Introduction to Reading), READ 956 (Intermediate Reading), READ 078 (Advanced Reading), ENGL-914 (Basic English Skills), ENGL-015 (Preparation for College Writing), and ENGL-101 (Freshman Composition). The research is intended to measure the strength of the relationship between students reading or writing level and the successful completion of RELIG-100 or RELIG-101. In this study reading and English assessment placement and course completion are being treated as equivalent to one another. Table 1 below shows how the reading assessment placements are equivalent to successfully completing a reading course and Table 2 illustrates how the reading assessment placements are equivalent to successfully completing an English course.

Table 1: Reading Course Successful Grades and Equivalent Corresponding Reading Placements.

Successful Grade in Following Course	Corresponding Reading Placement
NA	READ-925
READ-925	READ-956
READ-956	READ-078
READ-078	NO READ

Table 2: English Course Successful Grades and Equivalent Corresponding English Placements.

Successful Grade in Following Course	Corresponding Reading Placement
READ-925	ENGL-914
ENGL-914	ENGL-015
ENGL-015	ENGL-101
ENGL-101	NA

When examining how well the reading assessment test is a valid predictor of student outcomes in RELIG-100 or 101 there are five possible Criterion/Outcome measures of student course performance:

1. Points or scores
2. Midterm grade
3. Final grade
4. Only Credit/No Credit
5. Successful/Not Successful

The most common measure used is final grade. From a research perspective, use of a final grade is attractive because final grades are accessible from a computer database; however, one difficulty with using final grades as a criterion measure is that students who withdraw may not be included (Rasor, 1991). In addition, grades represent a limited five-point scale of performance and using a five point-scale does not control for instructor variation in evaluation procedures. In establishing sufficient evidence to enforce prerequisites that have a communication or computational skills component, the Crafton Hills College Office of Research and Planning has taken a three-pronged approach:

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

Using RP Group definitions that have been adopted by the Chancellor's Office, the Crafton Hills College Office of Research and Planning used the District's Management Information System (MIS) 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 courses, RELIG-100 and 101

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 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 reading or writing assessment level prior to completing RELIG-100 or 101 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 student earned a sufficiently high enough 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 Research and Planning conducted an independent samples t-test to determine whether statistically significant differences in the target course outcome existed between prerequisite completers and non-completers. The table on page 13 illustrates the overall success rates in the target courses, the success rates 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 the 95% confidence interval (CI) for the effect size 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 Research 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 postsecondary 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. In addition, the 95% effect size confidence interval was to indicate when the relationship between meeting the prerequisite and successfully completing the target course was more likely to lead to an increase in the success rate. Specifically, a lower effect size limit higher than 0 indicates that the effect of the prerequisite has a 95% probability of increasing the success rate in the target course.

Restricted Bivariate Correlation Coefficient and Corrections for Restriction of Range:

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 . The 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 postsecondary education, the Chancellor's Office had previously established a rough rule-of-thumb for obtained correlation coefficient. While usually considered a moderate association, the Chancellor's Office had established a positive correlation coefficient of .35 as sufficient evidence that a relationship exists between a prerequisite course and a target course, assuming that $p < .05$.

While the Pearson's r provides an initial measure of the association between two variables, an important consideration is the restricted distribution of prerequisite course grades. In practical terms, only students who *successfully* complete the prerequisite course will be permitted to enroll in the target course. While both distributions (prerequisite and target course grades) represent continuous data, the prerequisite course grades are restricted to students who were successful in the prerequisite course ("C" grade or higher). Consistent with methodology cited in one of the local research options documents, the Crafton Hills College Office of Research and Planning recalculated the correlation coefficient between the prerequisite and target courses, correcting for restriction of range. The excel spreadsheet on page 13 identifies the restricted bivariate correlation coefficients, the number of cases examined in the correlation generated, the p value of the correlation, and the correlation after a correction for restriction of range is applied. Again, a correlation coefficient of .35 or higher is considered sufficient evidence when examining the correlation corrected for restriction of range.

For local validation efforts, the Crafton Hills College Office of Research and Planning has developed a simple color-coding scheme to indicate whether sufficient evidence existed to implement the proposed prerequisite:

- **Green** – Sufficient evidence exists to enforce prerequisite (at least two out of three measures supported)

- **Yellow** – Although evidence exists, only one out of three measures supports the prerequisite. Further discussion should occur within the department and the Curriculum Committee before the prerequisite is enforced
- **Red** – Data does not exist to support enforcement of the prerequisite. None of the measures explored meet pre-established criteria
- **Insufficient Data** – While evidence may point to the efficacy of the prerequisite, the sample size is too small to render a reliable decision.

The table on the following page presents evidence for the interdisciplinary prerequisites that were examined and the color-coded recommendation generated by the Office of Research and Planning based upon the data examined.

The Target Course Includes the Following Semesters: Fall 2008, Spring 2009, Fall 2009, Spring 2010, Fall 2010, and Spring 2011.

The Prerequisite Course Includes the Following Semesters: Summer 2006 through Fall 2010.

#	Selected Students who made their First Attempt in Target Course where a GOR was Earned				Selected Students Best Grade in the Pre-Requirement Course	Success Rate in Target Course of Students who met the Prerequisite by successfully completing course or placing into equivalent course			% of Target Course GOR Earners who Met Prereq	Success Rate in Target Course of Students who DO NOT Meet the Pre-requirement			P Value of the Success Rate Difference between those who meet and do not meet the Prerequisite	Effect Size	95% Confidence Interval for Effect Size		Restricted Bivariate Correlation Coefficient	Restricted Bivariate Correlation Coefficient N	Restricted Bivariate Correlation Coefficient P	Correlation Corrected for Restriction of Range	Meets Threshold	Disp. Impact
	Course	Success	GOR	%		Prereq. Course	Success	GOR		%	Success	GOR			%	Lower						
1	RELIG-100	167	261	64.0	READ-925X2	21	35	60.0	13.4%	146	226	64.6	0.599	-0.096	-0.45	0.26	0.469	13	0.106	0.689	ID	ID
	RELIG-100	167	261	64.0	READ-956X2	16	25	64.0	9.6%	151	236	64.0	0.999	0.000	-0.41	0.41	-0.144	8	0.733	-0.258	ID	ID
	RELIG-100	167	261	64.0	READ-078X2	11	19	57.9	7.3%	156	242	64.5	0.568	-0.136	-0.60	0.33	0.170	12	0.598	0.275	ID	ID
	RELIG-100	167	261	64.0	ENGL/READ-925X2	97	138	70.3	52.9%	70	123	56.9	0.025	0.280	0.04	0.52	0.469	13	0.106	0.689	t-Test and ES	No
	RELIG-100	167	261	64.0	ENGL-914	97	137	70.8	52.5%	70	124	56.5	0.016	0.301	0.06	0.54	0.268	32	0.138	0.447	t-Test and ES	No
	RELIG-100	167	261	64.0	ENGL-015	91	127	71.7	48.7%	76	134	56.7	0.012	0.314	0.07	0.56	0.228	74	0.050	0.428	t-Test and ES	No
	RELIG-100	167	261	64.0	ENGL-101	80	100	80.0	38.3%	87	161	54.0	0.000	0.558	0.30	0.81	0.135	116	0.149	0.233	t-Test and ES	Yes
2	RELIG-101	303	450	67.3	READ-925X2	36	47	76.6	10.4%	267	403	66.3	0.153	0.221	-0.08	0.52	0.371	9	0.326	0.630	ES	No
	RELIG-101	303	450	67.3	READ-956X2	31	39	79.5	8.7%	272	411	66.2	0.091	0.284	-0.05	0.61	0.090	9	0.818	0.249	ES	No
	RELIG-101	303	450	67.3	READ-078X2	24	30	80.0	6.7%	279	420	66.4	0.126	0.289	-0.08	0.66	0.447	18	0.063	0.639	ES	No
	RELIG-101	303	450	67.3	ENGL/READ-925X2	175	240	72.9	53.3%	129	210	61.4	0.012	0.237	0.05	0.42	0.371	9	0.326	0.630	t-Test and ES	Yes
	RELIG-101	303	450	67.3	ENGL-914	174	239	72.8	53.1%	129	211	61.1	0.009	0.250	0.06	0.44	0.331	35	0.052	0.569	t-Test and ES	Yes
	RELIG-101	303	450	67.3	ENGL-015	168	233	72.1	51.8%	135	217	62.2	0.026	0.212	0.03	0.40	0.198	117	0.033	0.372	t-Test, ES, & Corr.	Yes
	RELIG-101	303	450	67.3	ENGL-101	138	191	72.3	42.4%	165	259	63.7	0.056	0.183	-0.01	0.37	0.279	229	0.000	0.474	Correlation	Yes

Green - Sufficient evidence to enforce pre-requisite (TWO or more)

Yellow - Further discussion required (Only 1 of 3 measures supported)

Red - Data does not support enforcement of prerequisite.

Note: ID refers to "Insufficient Data"

Appropriateness of Prerequisites:

RELIG-100

- *READ-925, 956, and 078*
 - Insufficient data existed to determine the appropriateness of READ-925, 956, or 078 as prerequisites for RELIG-100.

- *READ-925 and Placement into ENGL-914 Prerequisite:*
 - Students who successfully completed READ-925 or placed into ENGL-914 had a statistically significantly ($p = .025$) higher success rate (70%) in RELIG-100 than students who did not successfully complete READ-925 or place into ENGL-914 (57%).
 - The effect size was .28, indicating a sufficient relationship to success if students successfully completed READ-925 or placed into ENGL-914 prior to enrolling in RELIG-100.
 - The lower limit 95% effect size CI was .04 indicating a 95% probability that the success rate in RELIG-100 of students who successfully completed READ-925 or placed into ENGL-914 will increase.

- *ENGL-914 Prerequisite:*
 - Students who met the ENGL-914 prerequisite had a statistically significantly ($p = .016$) higher success rate (71%) in RELIG-100 than students who did not meet the ENGL-914 prerequisite (57%).
 - The effect size was .30, indicating a sufficient relationship to success if students met the ENGL-914 prerequisite prior to enrolling in RELIG-100.
 - The lower limit 95% effect size CI was .06 indicating a 95% probability that the success rate in RELIG-100 of students who met the ENGL-914 prerequisite will increase.

RELIG-100 (Continued)

- *ENGL-015 Prerequisite:*
 - Students who met the ENGL-015 prerequisite had a statistically significantly ($p = .012$) higher success rate (72%) in RELIG-100 than students who did not meet the ENGL-015 prerequisite (57%).
 - The effect size was .31, indicating a sufficient relationship to success if students met the ENGL-015 prerequisite prior to enrolling in RELIG-100.
 - The lower limit 95% effect size CI was .07 indicating a 95% probability that the success rate in RELIG-100 of students who met the ENGL-015 prerequisite will increase.

- *ENGL-101 Prerequisite:*
 - Students who met the ENGL-101 prerequisite had a statistically significantly ($p < .001$) higher success rate (80%) in RELIG-100 than students who did not meet the ENGL-101 prerequisite (54%).
 - The effect size was .56, indicating a substantial relationship to success if students met the ENGL-101 prerequisite prior to enrolling in RELIG-100.
 - The lower limit 95% effect size CI was .30 strongly indicating a 95% probability that the success rate in RELIG-100 of students who met the ENGL-101 prerequisite will increase substantially.

RELIG-101

- *READ-925 and Placement into READ-956 Prerequisite:*
 - Students who successfully completed READ-925 or placed into READ-956 had a substantially ($ES = .22$) higher success rate (77%) in RELIG-101 than students who did not successfully complete READ-925 or place into READ-956 (66%).

RELIG-100 (Continued)

- *READ-956:*
 - Students who successfully completed READ-956 had a substantially (ES = .28) higher success rate (80%) in RELIG-101 than students who did not successfully complete READ-956 (66%).

- *READ-078:*
 - Students who successfully completed READ-078 had a substantially (ES = .29) higher success rate (80%) in RELIG-101 than students who did not successfully complete READ-078 (66%).

- *READ-925 and Placement into ENGL-914 Prerequisite:*
 - Students who successfully completed READ-925 or placed into ENGL-914 had a statistically significantly ($p = .012$) higher success rate (73%) in RELIG-101 than students who did not successfully complete READ-925 or place into ENGL-914 (61%).
 - The effect size was .24, indicating a sufficient relationship to success if students successfully completed READ-925 or placed into ENGL-914 prior to enrolling in RELIG-101.
 - The lower limit 95% effect size CI was .05 indicating a 95% probability that the success rate in RELIG-101 of students who successfully completed READ-925 or placed into ENGL-914 will increase.

RELIG-100 (Continued)

- *ENGL-914 Prerequisite:*
 - Students who met the ENGL-914 prerequisite had a statistically significantly ($p = .009$) higher success rate (73%) in RELIG-101 than students who did not meet the ENGL-914 prerequisite (61%).
 - The effect size was .25, indicating a sufficient relationship to success if students met the ENGL-914 prerequisite prior to enrolling in RELIG-101.
 - The lower limit 95% effect size CI was .06 indicating a 95% probability that the success rate in RELIG-101 of students who met the ENGL-914 prerequisite will increase.

- *ENGL-015 Prerequisite:*
 - Students who met the ENGL-015 prerequisite had a statistically significantly ($p = .026$) higher success rate (62%) in RELIG-101 than students who did not meet the ENGL-015 prerequisite (52%).
 - The effect size was .21, indicating a sufficient relationship to success if students met the ENGL-015 prerequisite prior to enrolling in RELIG-101.
 - The lower limit 95% effect size CI was .03 indicating a 95% probability that the success rate in RELIG-101 of students who met the ENGL-015 prerequisite will increase.
 - The corrected for restricted range bivariate correlation coefficient (.372) exceeded the .35 threshold

- *ENGL-101 Prerequisite:*
 - Students who met the ENGL-101 prerequisite had a higher ($p = .056$, $ES = .18$) success rate (72%) in RELIG-101 than students who did not meet the ENGL-101 prerequisite (64%).
 - The corrected for restricted range bivariate correlation coefficient (.474) exceeded the .35 threshold

Disproportionate Impact and Differential Prediction

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 55000(h)), 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 55003(g) (2)). 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.” Phillips, Spurling, and Armstrong go on to state, “while the issue of access is important, the real question is access for what purpose. Access needs to lead to goal attainment. Without goal attainment, access becomes a meaningless exercise.”

A useful statistical model in analyzing disproportionate impact is classification and regression tree (CART) modeling, a statistical application that is useful in situations in which the overall goal is to divide a population into segments that differ with respect to a designated criterion. In short, CART modeling affords researchers the opportunity to examine the interaction and impact of a number of distinct categorical predictor variables (e.g., gender, ethnicity, age, and disability status) on a categorical dependent variable (e.g., met prerequisite/did not meet prerequisite). CART modeling initially identifies the best predictor variable, conducting a splitting algorithm that further

identifies additional statistically significant predictor variables and splits these variables into smaller subgroups. CART modeling merges categories of a predictor variable that are not significantly different. This merging, combined with the splitting algorithm, ensures that cases in the same segment are homogeneous with respect to the segmentation criterion, while cases in different segments tend to be heterogeneous with respect to the segmentation criterion. As it applies to disproportionate impact, CART modeling has a number of distinct advantages over traditional statistical applications used to examine categorical data (e.g., chi-square, cluster analysis, etc.). Utilizing CART modeling, researchers can easily determine whether specific aspects of numerous categorical predictor variables merge to provide a more accurate identification of populations experiencing disproportionate impact (e.g., male Latino students under twenty-one years of age, female Asian students 30 to 34 years of age, etc.).

As it pertains to this study, CART modeling was conducted to determine whether specific student populations disproportionately meet/do not meet the proposed prerequisites. The following predictor variables were entered into each CART model:

Gender:

- Group 1) Male
- Group 2) Female
- Group 3) Unknown/No Response

Ethnicity:

- Group 1) African American
- Group 2) Asian
- Group 3) Caucasian
- Group 4) Hispanic
- Group 5) Native American
- Group 6) Pacific Islander
- Group 7) Other
- Group 8) Unknown/No Response

Age:

- Group 1) 19 or Younger
- Group 2) 20 to 24 Years of Age
- Group 3) 25 to 29 Years of Age
- Group 4) 30 to 34 Years of Age

- Group 5) 35 to 39 Years of Age
- Group 6) 40 to 49 Years of Age
- Group 7) 50 Years of Age or Older
- Group 8) Unknown/No Response

Disability:

- Group 1) Students with Disabilities
- Group 2) Students Who Do Not Have Disabilities

To examine whether disproportionate impact existed, CART models were generated for each possible prerequisite course/target course combination. The last column in the tables on page 13 (“Disproportionate Impact”) identify whether disproportionate impact was observed (“Yes” if disproportionate impact was observed; “No” if disproportionate impact was not observed).

When findings indicate that prerequisites may result in possible disproportionate impact, it is useful to conduct additional research concerning the issues of differential prediction. Differential prediction identifies the best prediction equations that are significantly different for different groups of students (Young & Kobrin, 2001). Differential prediction addresses two questions:

1. Is the predictive power of the test markedly stronger or weaker for particular student groups?
2. Does the test systematically tend to overpredict or underpredict the performance of particular groups?

Differential prediction could not be examined because there were not enough students who had taken the religion courses and who had also completed the reading or English course prerequisite. Since we weren’t able to look at differential prediction, an alternate method to address the two questions above was used. In evaluating whether a prerequisite would have a disparate impact, a mathematical comparison must be made of the disproportionately impacted group's predicted success rate versus the success rate of the other group. Accordingly, the predicted outcome of the disproportionately impacted group was examined to determine if there was an increase in the success rates and a decrease in the gap between the expected outcomes for both groups. Consequently, if the success rate gap between the two groups is reduced and the

prerequisite increases the likelihood of success for the disproportionately impacted group then it is acceptable to proceed with the prerequisite (Meehl, & Rosen, 1955; Phillips, Spurling, & Armstrong, 2002). Conversely, it is important to remember that there are other considerations besides the success of students. Access to programs and the right to fail are also areas that need to be addressed when considering selection models for highly impacted programs. Access to programs for all groups is an important consideration when trying to promote diversity. If high standards on a prediction instrument deny access disproportionately to minority groups, then such a selection method might be considered unfair. According to Meehl and Rosen's argument, given that not all applicants can be served, it makes sense to serve those most likely to succeed. In addition, if a new higher standard were imposed, it is hard to know how many students in each age group in the applicant population would meet that higher standard. As a result, if the differential prediction analysis indicates that the gap between groups is reduced and the likelihood of success increases for the disproportionately impacted group then it is acceptable to institute the prerequisite and monitor the progress of students.

The graphs and tables on the following pages identify:

- Student populations by gender, age, ethnicity, and/or disability that experienced disproportionate impact (NOTE: only outcomes that resulted in observed disproportionate impact are included. If a CART model did not identify the occurrence of disproportionate impact ("No" in the Disproportionate Impact columns on pages 13), no further analyses were conducted
- the success rates of segmented groups with and without prerequisite enforcement
- whether the enforced prerequisite results in similar or greater predictive power (i.e., course outcome) for the disproportionately impacted group(s)
- whether enforcement of the proposed prerequisite overpredicts or underpredicts performance of the disproportionately impacted group relative to: 1) all students; and b) students groups that are not disproportionately impacted

Graphs and tables are not shown for the following prerequisites and target courses because disproportionate impact was not found:

Target Course: RELIG-100

- READ-925 or Placement into ENGL-914
- ENGL-914
- ENGL-015

Target Course: RELIG-101

- READ-925 or Placement into READ-956
- READ-956
- READ-078

In addition, disproportionate impact was not examined for READ-925, 956, and 078 as the prerequisites for RELIG-100 because there was insufficient data.

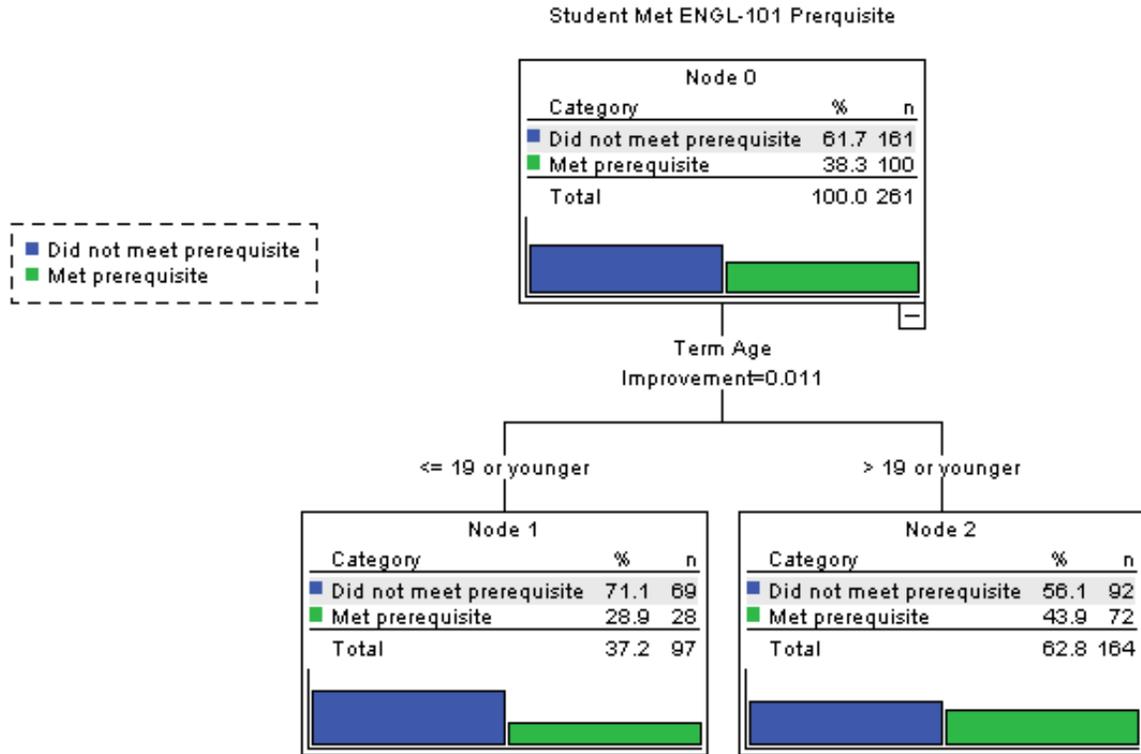
ENGL-101 as a Prerequisite to RELIG-100

Disproportionate Impact

The figure on the following page uses segmentation modeling to identify disproportionate impact when ENGL-101 is the prerequisite for RELIG-100. Overall, 38% of students who enter RELIG-100 successfully complete the ENGL-101 prerequisite. However, 44% of student's age 20 years old or older who entered RELIG-100 had successfully completed the ENGL-101 prerequisite. Conversely, only 29% of students age 19 years or younger who entered RELIG-100 successfully completed the ENGL-101 prerequisite. ***This finding, a 15% difference between segments, represents an observed disproportionate impact by age.***

Equally important is how the ENGL-101 prerequisite is related to the RELIG-100 success rates of students in each segment. As the table on the following page indicates, the current success rate of students 19 years of age or younger is 59% while the success rate of students 20 years of age or older is 67%, an 8% differential. When the ENGL-101 prerequisite is applied; 89% of students age 19 or younger are successful and 76% of students 20 years of age or older are successful. ***The success rate for both groups increased substantially. For the students 19 years old or younger the success rate increased from 59% to 89%, a 30% increase, and for the students 20 years old or older the success rate increased from 67% to 76%, a 9% increase. Accordingly, the success rates of students in the disproportionately impacted segment (i.e., students 19 years of age or younger) increased 30%.***

CART Segmentation Model Showing Disproportionate Impact When Prerequisite for RELIG-100 is ENGL-101 (Age, Gender, Ethnicity, and Disability examined)



*Risk Estimate = .383, SE of Risk Estimate = .030, Improvement set to .01, Child Node set to 5% of Total N, Parent Node is twice the Child Node.

The Impact of ENGL-101 as a Prerequisite for RELIG-100 on the Two Age Categories Identified in the Disproportionate Impact Study

Node	Age	All Students	Students that Meet PreReq	Percent of All Students	Current Success Rate	New Success Rate
1	19 years old or younger	97	28	28.9	58.8	89.3
2	20 years old or older	164	72	43.9	67.1	76.4
	Total	261	100	38.3	64.0	80.0

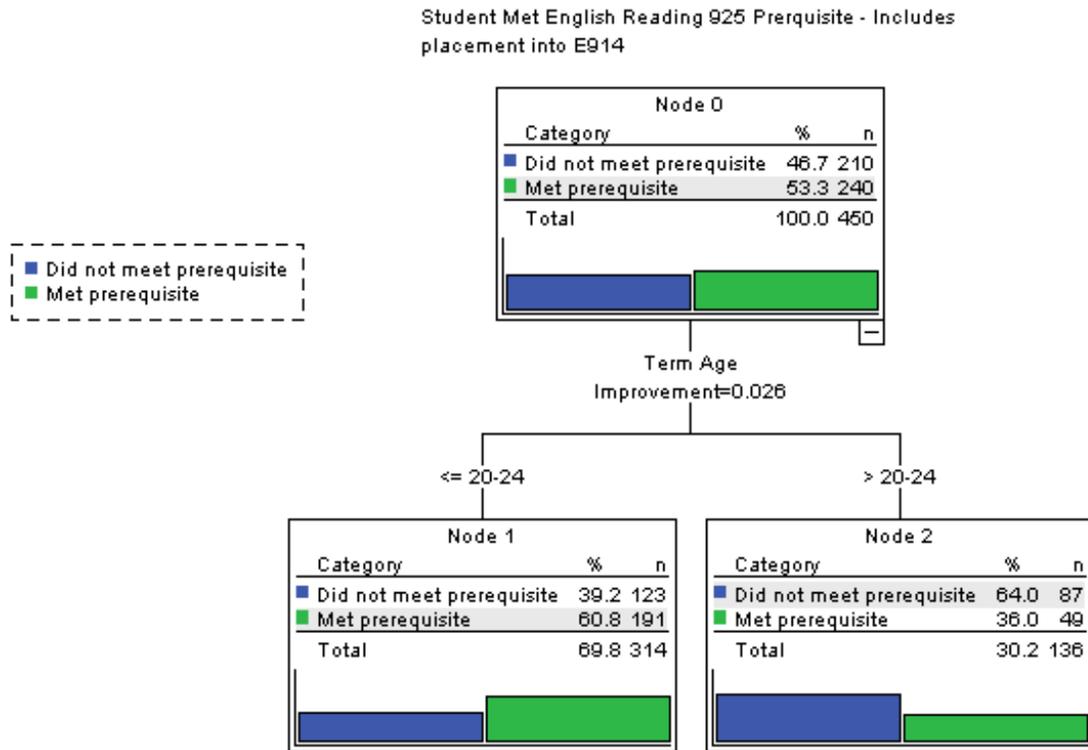
READ-925 or Placement into ENGL-914 as a Prerequisite to RELIG-101

Disproportionate Impact

The figure on the following page uses segmentation modeling to identify disproportionate impact when READ-925 or placement into ENGL-914 is the prerequisite for RELIG-101. Overall, 53% of students who enter RELIG-101 successfully complete the READ-925 or placement into ENGL-914 prerequisite. However, 61% of student's age 24 years old or younger who entered RELIG-101 had successfully completed the READ-925 prerequisite or placed into ENGL-914 or higher. Conversely, only 36% of student's age 25 years old or older who entered RELIG-101 successfully completed the READ-925 prerequisite or placed into ENGL-914. ***This finding, a 25% difference between segments, represents an observed disproportionate impact by age.***

Equally important is how the READ-925 or ENGL-914 placement prerequisite is related to the RELIG-101 success rates of students in each segment. As the table on the following page indicates, the current success rate of students 24 years of age or younger is 65% while the success rate of students 25 years of age or older is 74%, a 9% differential. When the READ-925 or ENGL-914 placement prerequisite is applied; 71% of students 24 years of age or younger are successful and 78% of students 25 years of age or older are successful. ***The success rate for both groups increased. For the students 24 years old or younger the success rate increased from 65% to 71%, a 6% increase, and for the students 25 years old or older the success rate increased from 74% to 78%, a 4% increase. Accordingly, the success rates of students in the disproportionately impacted segment (i.e., students 25 years of age or older) increased 4%, and is higher than the students 24 years old or younger.***

CART Segmentation Model Showing Disproportionate Impact When Prerequisite for RELIG-101 is READ-925 or Placement into ENGL-914 (Age, Gender, Ethnicity, and Disability examined)



*Risk Estimate = .382, SE of Risk Estimate = .023, Improvement set to .01, Child Node set to 5% of Total N, Parent Node is twice the Child Node.

The Impact of READ-925 or Placement into ENGL-914 as a Prerequisite for RELIG-101 on the Two Age Categories Identified in the Disproportionate Impact Study

Node	Age	All Students	Students that Meet PreReq	Percent of All Students	Current Success Rate	New Success Rate
1	24 years old or younger	314	191	60.8	64.6	71.2
2	25 years old or older	136	49	36.0	73.5	77.6
	Total	450	240	53.3	67.3	72.5

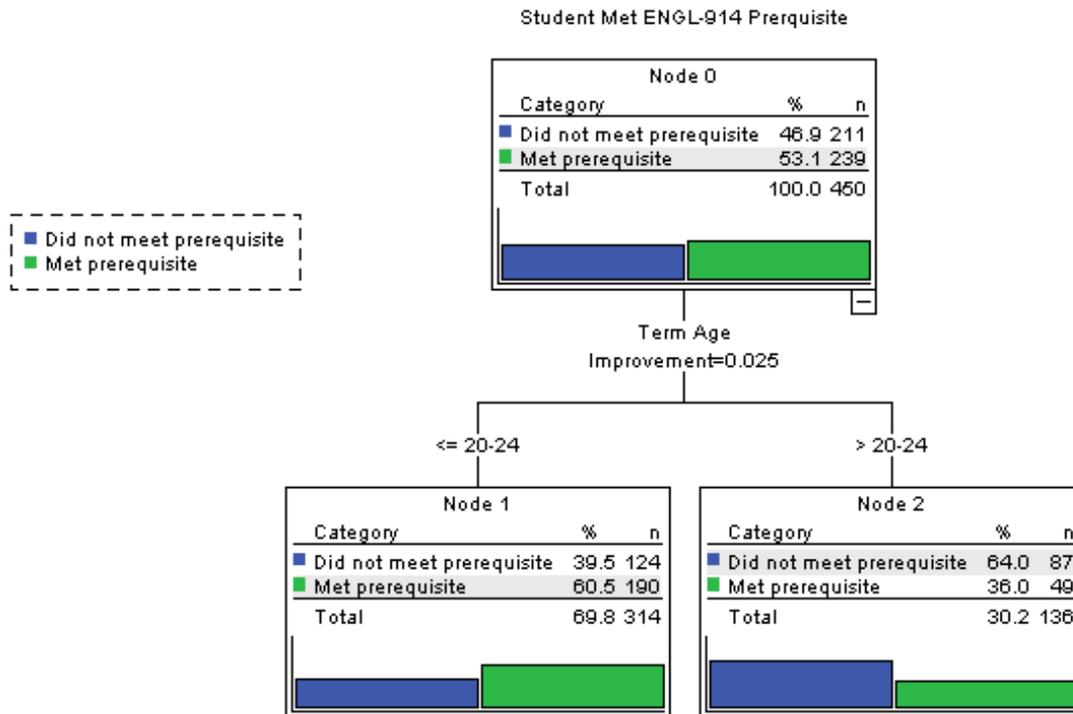
ENGL-914 as a Prerequisite to RELIG-101

Disproportionate Impact

The figure on the following page uses segmentation modeling to identify disproportionate impact when ENGL-914 is the prerequisite for RELIG-101. Overall, 53% of students who enter RELIG-101 successfully complete the ENGL-914 prerequisite. However, 61% of students age 24 years old or younger entered RELIG-101 successfully completed ENGL-914 or placed into ENGL-015 or higher. Conversely, only 36% of student's age 25 years old or older who entered RELIG-101 successfully completed ENGL-914 or placed into ENGL-015 or higher. ***This finding, a 25% difference between segments, represents an observed disproportionate impact by age.***

Equally important is how the ENGL-914 prerequisite is related to the RELIG-101 success rates of students in each segment. As the table on the following page indicates, the current success rate of students 24 years of age or younger is 65% while the success rate of students 25 years of age or older is 74%, a 9% differential. When the ENGL-914 placement prerequisite is applied; 72% of students 24 years of age or younger are successful and 78% of students 25 years of age or older are successful. ***The success rate for both groups increased. For the students 24 years old or younger the success rate increased from 65% to 72%, a 7% increase, and for the students 25 years old or older the success rate increased from 74% to 78%, a 4% increase. Accordingly, the success rates of students in the disproportionately impacted segment (i.e., student's 25 years of age or older) increased 4%, and is higher than the students 24 years old or younger.***

CART Segmentation Model Showing Disproportionate Impact When Prerequisite for RELIG-101 is ENGL-914 (Age, Gender, Ethnicity, and Disability examined)



*Risk Estimate = .384, SE of Risk Estimate = .023, Improvement set to .01, Child Node set to 5% of Total N, Parent Node is twice the Child Node.

The Impact of ENGL-914 as a Prerequisite for RELIG-101 on the Two Age Categories Identified in the Disproportionate Impact Study

Node	Age	All Students	Students that Meet PreReq	Percent of All Students	Current Success Rate	New Success Rate
1	24 years old or younger	314	190	60.5	64.6	71.6
2	25 years old or older	136	49	36.0	73.5	77.6
	Total	450	239	53.1	67.3	72.8

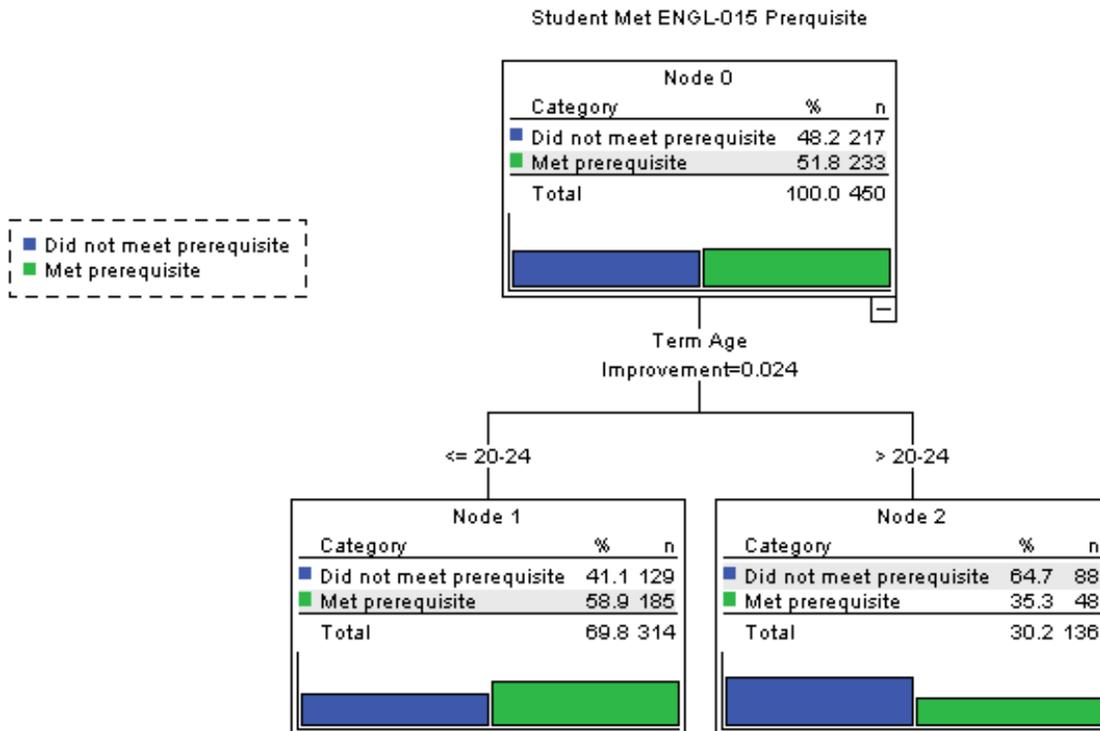
ENGL-015 as a Prerequisite to RELIG-101

Disproportionate Impact

The figure on the following page uses segmentation modeling to identify disproportionate impact when ENGL-015 is the prerequisite for RELIG-101. Overall, 52% of students who enter RELIG-101 successfully complete the ENGL-015 prerequisite. However, 59% of the student's age 24 years old or younger who entered RELIG-101 successfully completed the ENGL-015 prerequisite. Conversely, only 35% of student's age 25 years old or older who entered RELIG-101 successfully completed the ENGL-015 prerequisite. ***This finding, a 24% difference between segments, represents an observed disproportionate impact by age.***

Equally important is how the ENGL-015 prerequisite is related to the RELIG-101 success rates of students in each segment. As the table on the following page indicates, the current success rate of students 24 years of age or younger is 65% while the success rate of students 25 years of age or older is 74%, a 9% differential. When the ENGL-015 placement prerequisite is applied; 71% of students 24 years of age or younger are successful and 77% of students 25 years of age or older are successful. ***The success rate for both groups increased. For the students 24 years old or younger the success rate increased from 65% to 71%, a 6% increase, and for the students 25 years old or older the success rate increased from 74% to 77%, a 3% increase. Accordingly, the success rates of students in the disproportionately impacted segment (i.e., student's 25 years of age or older) increased 3% and is higher than the students 24 years old or younger.***

CART Segmentation Model Showing Disproportionate Impact When Prerequisite for RELIG-101 is ENGL-015 (Age, Gender, Ethnicity, and Disability examined)



*Risk Estimate = .393, SE of Risk Estimate = .023, Improvement set to .01, Child Node set to 5% of Total N, Parent Node is twice the Child Node.

The Impact of ENGL-015 as a Prerequisite for RELIG-101 on the Two Age Categories Identified in the Disproportionate Impact Study

Node	Age	All Students	Students that Meet PreReq	Percent of All Students	Current Success Rate	New Success Rate
1	24 years old or younger	314	185	58.9	64.6	70.8
2	25 years old or older	136	48	35.3	73.5	77.1
	Total	450	233	51.8	67.3	72.1

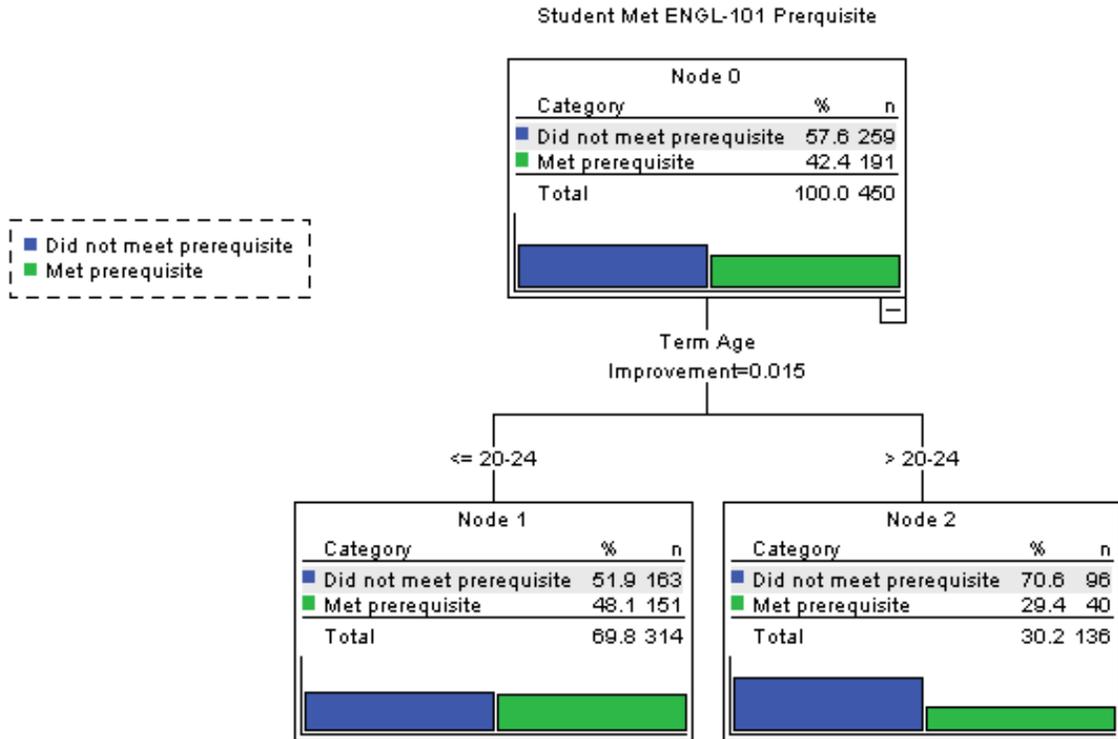
ENGL-101 as a Prerequisite to RELIG-101

Disproportionate Impact

The figure on the following page uses segmentation modeling to identify disproportionate impact when ENGL-101 is the prerequisite for RELIG-101. Overall, 42% of students who enter RELIG-101 successfully complete the ENGL-101 prerequisite. However, 48% of the student's age 24 years old or younger who entered RELIG-101 successfully completed the ENGL-101 prerequisite. Conversely, only 29% of student's age 25 years old or older who entered RELIG-101 successfully completed the ENGL-101 prerequisite. ***This finding, a 19% difference between segments, represents an observed disproportionate impact by age.***

Equally important is how the ENGL-101 prerequisite is related to the RELIG-101 success rates of students in each segment. As the table on the following page indicates, the current success rate of students 24 years of age or younger is 65% while the success rate of students 25 years of age or older is 74%, a 9% differential. When the ENGL-101 placement prerequisite is applied; 72% of students 24 years of age or younger are successful and 73% of students 25 years of age or older are successful. ***For the students 24 years old or younger the success rate increased from 65% to 72%, a 7% increase, and for the students 25 years old or older the success rate slightly decreased from 74% to 73%, a 1% decrease. Accordingly, the success rates of students in the disproportionately impacted segment (i.e., student's 25 years of age or older) are approximately the same as the 24 year old or younger students.***

CART Segmentation Model Showing Disproportionate Impact When Prerequisite for RELIG-101 is ENGL-101 (Age, Gender, Ethnicity, and Disability examined)



*Risk Estimate = .424, SE of Risk Estimate = .023, Improvement set to .01, Child Node set to 5% of Total N, Parent Node is twice the Child Node.

The Impact of ENGL-101 as a Prerequisite for RELIG-101 on the Two Age Categories Identified in the Disproportionate Impact Study

Node	Age	All Students	Students that Meet PreReq	Percent of All Students	Current Success Rate	New Success Rate
1	24 years old or younger	314	151	48.1	64.6	72.2
2	25 years old or older	136	40	29.4	73.5	72.5
	Total	450	191	42.4	67.3	72.3

References

- Meehl, P., Rosen, A. (1955). Antecedent probability and psychometric signs. *Psychological Bulletin*, 52(3), 194-216.
- Phillips, B., Spurling, S., & Armstrong, W. (2002). Associate degree nursing: Model prerequisites validation study. *California Community College Associate Degree Nursing Programs by the Center for Student Success and Health care Initiative Sponsored Project*.
- Russell, B. A. (January, 2011). *Title 5 Section 55003: Policies for Prerequisites, Corerequisites and Advisories on Recommended Preparation: First Reading (Public Hearing)*. Retrieved January 26, 2010 from http://www.cccco.edu/Portals/4/Executive/Board/2011_agendas/jan_2011/7_1_title_5_prerequisites.pdf
- Research and Planning Group for the California Community Colleges (RP Group). (July 2010). *A Comprehensive Approach to Prerequisites*. Retrieved January 26, 2012 from <http://www.rpgroup.org/sites/default/files/RP%20Group%20Response%20to%20Prerequisite%20Changes.pdf>
- Research and Planning Group for the California Community Colleges (RP Group). (January 2011). *RP Group Statement on the Title 5 Prerequisite Proposal Revision*. Retrieved January 26, 2012 from <http://www.rpgroup.org/sites/default/files/Statement%20on%20Prerequisite%20Proposal%20Revision.pdf>
- Young, J., & Kobrin, J. (2001). *Differential validity, differential prediction, and college admission testing: A comprehensive review and analysis*. College Entrance Examination Board, New York, http://www.collegeboard.com/research/pdf/differential_validity_10539.pdf.