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ABSTRACT

The Longitudinal Student Success Study was a six-year study to identify factors associated with to student success at a large Eastern community college. The study focused on American Black students as one group of students likely to have different background characteristics and preparedness levels than what generally facilitates success at a postsecondary educational institution. Information was collected on 522 American Black students and 893 American White students who were first-time students in Fall, 1990. Student success levels were constructed from information on students' graduating, transcript information, and/or earning 12, 24, or 36 credit hours while maintaining a passing grade point average. An iterative chi-square segmental modeling technique was used to identify factors most likely to predict student success and non-success. Application of logistic regression allowed a prediction of non-success for a statistically significant portion of students within that category. Identified predictor variables included race, sex, age, full-time/part-time status, financial aid information, student work data, math assessment, and English assessment information. (Contains 32 references.) (JLS)

MODELING STUDENT OUTCOMES: A LONGITUDINAL STUDY

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Jean Endo
Editor
AIR Forum Publications

Modeling Student Outcomes: A Longitudinal Study

ABSTRACT

Today, facilitating student success at community colleges is an integral part of the President's ten-point plan for the American educational system. The Longitudinal Student Success Study (LSSS) is a six-year study designed to gather information on first-time students enrolled at a large Eastern community college for the purpose of improving student success at a community college. It is the objective of the LSSS to identify factors associated with student success so that this information may be utilized on behalf of students who are believed to be "at-risk", that is, are least likely to be successful. Student success levels were constructed from information on students' graduating, transcript information and/or earning 12, 24, or 36 credit hours while maintaining a passing grade point average. An iterative chi-squared segmental modeling technique was utilized to identify factors most likely to predict student success and non-success. Only information available at the time of first entry was used in this effort. Application of logistic regression allowed the researcher to predict non-success for a statistically significant portion of students within that category. This application is transportable and may be utilized by researchers and decision-makers at other educational institutions.

Modeling Student Outcomes: A Longitudinal Study

INTRODUCTION

Minority group members, particularly Black students, frequently depend on community colleges to provide an entry point into postsecondary education. Although Black students attend community colleges in disproportionate numbers, their relative success at community college often pales compared to other ethnic/racial groups. The current study will utilize data that originated from an on-going longitudinal project on student success at a large Eastern community college. This information will be used to assess the relative success rates of Black students and White students at that college and will provide the basis for modeling student success. The student success model will facilitate the early identification of students that are most likely to be at-risk, that is, are least likely to be successful. Early identification of these students will improve the effectiveness of intervention strategies that are designed to promote student success. The role of community colleges has become increasingly an important one in the American Education system, as noted by President Clinton in the most recent State of the Union Address, in which he indicated that it is necessary to raise the educational floor to a minimum of 14 years if Americans are to remain competitive in the future (Clinton; January, 1997). Recently, President Clinton reiterated and expanded on this subject during his keynote speech at the annual conference of the American Council on Education, again emphasizing the increasing importance of community colleges in the United States (Clinton; March, 1997).

BACKGROUND

In the United States, there currently exists a growing number of minority group members both in total number and in their enrollment at community colleges. Day (1996) projected that in the year 2010 the minority population of the United States will comprise 32% of the total population. This estimate remains close to that of the ACE (1988) which reported that approximately one-third of the population will be members of minority groups by the year 2010. Considering the invariable ties between education and the economy and their collective effect on minority groups and the larger society Green (1989) wrote:

> "The future of out nation is inextricably tied to an educated population that can contribute the labor force and the economy, as well to our national well-being. If one-third of the nation will be composed of minority persons by the year 2010..., minority citizens must be included in the economic, political, social and education mainstream."

The importance of including minority group members in the mainstream of society would appear to be self-evident. However, inclusion is an economic matter as well as social and therefore is heavily influenced by educational attainment. Speaking to this point in his 1995 address to community colleges President Clinton discussed the importance of education in economic recovery and of community colleges in providing educational opportunities to non-traditional students (Boutque and Clinton, 1995).

The relatively low success rates for Black students at community colleges is particularly trouble-some not only because Black students are disproportionately enrolled at community colleges, but also because community colleges historically have provided an opportunity for social mobility for those otherwise not having educational opportunities (Brint and Karabel, 1989). However, rather than the "ladders on which the aspiring can rise" of which Carnegie (1889) spoke. writers such as Brint and Karabel sometimes find that the relatively low

success rates experienced by disadvantaged students at community colleges may serve to further limit any real prospect for social mobility for these individuals. Similarly, Roueche and Roueche (1993), in Between a Rock and a Hard Place , contend that community colleges typically enroll a relatively high percentage of students who are disadvantaged and for whom success in college is less likely compared to other college students.

DATA SOURCES and DEFINITIONS

It is the intention of this study to use information that is commonly available at colleges and universities so that the methodology used herein may be adapted by other institutions. This study uses information on graduation and transfer, along with transcript, grade point average, and credit hour information to define its dependent measures (Table 1). Identified predictor variables include: race, sex, age, full-time/part-time status, financial aid information, student work data, math assessment and English assessment information.

Table 1. Definitions of Success and Levels of Success

Below, are three definitions of student success. Level I success requires students to: 1) complete 12 credit hours and have a minimum of a 2.0 grade point average (GPA) or, 2) to transfer to a four-year institution or, 3) to list 'to transfer' as their reason for attendance while earning less than 12 hours and maintaining at least a 2.0 GPA and completing a transcript application. Level II success is defined as: 1) earning at least 24 credit hours and having a GPA of at least 2.0 or, 2) to transfer or graduate or 3) intending to transfer and earning more than 12 but less than 24 hours and completing an application for a transcript. Level III success requires: 1) earning 36 or more credit hours while maintaining a 2.0 GPA or, or, 2) to transfer or graduate or, 3) intending to transfer and earning 24-35 credit hours and applying for a transcript.

Level	(Credits Earned	and	GPA)	OR	Other
I	12+		2.0		Reason=Transfer Credits < 12 & Transcript
II	24+		2.0		Reason=Transfer Credits => 12 & Credits =< 23 & GPA =2.0+ & Transcript or Graduated
III	36+		2.0		Reason=Transfer Credits => 24 & Credits =< 35 & GPA =2.0+ & Transcript or Graduated

METHODOLOGY

Student Population

Information has been collected on 522 American Black students and 893 American White students that were first-time students in fall 1990. The first-time students that were full-time students or who wished to register for a college-level English or math course were required to take assessment tests in English, reading and math (about one-half of the students took the assessment tests at some point in time).

Descriptive Data Analysis

Crosstabulations have been constructed showing student success rates for Black students and white students and each of the seven independent variables by race. All tables use a chi-square approach to determine statistical significance.

Overall, Black students were less often successful than White students (Table 2). Twenty-five percent of the Black students and 43% of the White students were successful at Level I. At Level II, 19% of the Black students and 36% of the White students were successful. The success rate for Black students at Level III was 13%; for White students it was 29%. (In subsequent analyses success rates are utilized only from Level I as Level I represents the most basic level of success defined herein and will be used to demonstrate the utility of the statistical methodology presented in this study.)

Table 2. Level I, II, and III Success Rates By Race

	Black		White	
	N	%	N	%
Level I	493	25%	840	43%
Level II	474	19%	804	36%
Level II	459	13%	765	29%

Table 3 presents information on sex by race. Both Black students (56.3%) and White students (56.4%) enrolled more female students than male students, with the same proportion of female and male students for each group.

Table 3. Sex by Race

	Black		White	
	N	%	N	%
Female	294	56.3	504	56.4
Male	228	43.7	389	43.6
Total	522	100.0	893	100.0

Table 4 shows information by age and race ($p<.01$). Collectively, White students were younger than Black students when they first enrolled in college. At the time of first enrollment, more than one-half of White students were less than 20 years old compared to 40% for Black students. The average age of Black students was 25.7 years with a median age of 21 years. The average age of White students was 22.9 years with a median age of 19 years.

Table 4. Age by Race

	Black		White	
	N	%	N	%
Less than 20	209	40.0	460	51.6
Twenty or older	313	60.0	432	48.4
Mean Age	**25.7 years**		**22.9 years**	
Median Age	**21 years**		**19 years**	
Total	522	100.0	893	100.0

Black students (70.7%) were more frequently enrolled on a part-time basis than were White students (64.5%) ($p<.05$). In the aggregate, Black students earned fewer credit hours than did White students. Black students earned an average of 20.5 hours and a median of 13 credit hours compared to 27.7 hours and 16 hours, respectively for White students (Table 5).

Table 5. Full-time/Part-time Status by Race

	Black		White	
	N	%	N	%
Full-time	153	29.3	317	35.5
Part-time	369	70.7	576	64.5
Mean Hours	20.5 Hours		27.7 Hours	
Median Hours	13 Hours		16 hours	
Total	522	100.0	893	100.0

Approximately 12% of the Black students and 16% of the White students received financial aid in their first semester at the College ($p<.05$) (Table 6). Blaylock (1993) noted that on the average, Black students received more aid support per recipient than did White students.

Table 6. Financial Aid Status by Race

	Black		White	
	N	%	N	%
Did Not Receive Aid	459	87.9	747	83.7
Received Aid	63	12.1	146	16.3
Total	522	100.0	893	100.0

There is a statistically significant difference ($p<.01$) in the employment categories of Black students and White students (Table 7). A similar proportion of Black students (52.0%) and White students (49.4%) reported that they were employed full-time. White students (28.7%) more frequently were employed on a part-time basis than were Black students (21.4%). Black students (19.8%) were more frequently not employed, but seeking employment compared to White students (12.9%). Relatively few Black students (6.7%) or White students (9.0%) were unemployed, yet not seeking employment.

Table 7. Work by Race

	Black		White	
	N	%	N	%
Employed Full-time	262	52.0	436	49.4
Employed Part-time	108	21.4	253	28.7
Not Employed, Seeking	100	19.8	114	12.9
Not Employed, Not Seeking	34	6.7	79	9.0
Total	522	100.0	893	100.0

Among students that took the college English assessment test, a significantly higher percentage of Black students (64.1%) scored as having less than college-level capability than did White students (46.5%) (Table 8) ($p<.01$). Only slightly more than one-third of American Black students and slightly more than one-half of American White students were assessed as having college-level skills in English.

Table 8. English Assessment by Race

	Black		White	
	N	%	N	%
Below College Level	157	64.1	197	46.5
College Level	88	35.9	227	53.5
Total	522	100.0	893	100.0

Table 9 presents information on math assessment by race. Black students (85.8%) less frequently had college-level math skills than did White students (71.8%) ($p<.01$).

Table 9. Math Assessment by Race

	Black		White	
	N	%	N	%
Below College Level	212	85.8	293	71.8
College Level	35	14.2	115	28.2
Total	522	100.0	893	100.0

CHAID analysis is performed and presented with tree diagrams to delineate the relationship between the independent variables and the dependent measure (See Figure 1, Table 2 for an example). CHAID analysis (Chi-Squared Interaction Detection) is a relatively new statistical technique developed for the Statistical Package for the Social Sciences by Magidson (1993). CHAID is a segmental modeling technique that is used in this study as an intermediary step to aid in the development of a predictive model for student success. CHAID uses an iterative chi-squared approach to perform segmentation modeling wherein potential independent variables are assessed with regard to their relationship to a dependent variable (student success) (Magidson, 1993). Tree diagrams are utilized to show the set of "best" predictors at success Level I for Black students and for White students.

Figure 1 presents information on Level I success for Black students. One-quarter of all Black students were successful at Level I (Figure 1). Among full-time students, 36% were successful compared to 21% of the part-time Black students. Full-time students that worked (45%) were more successful than full-time students that did not work (24%). Among part-time students, that tested as having college-level math skills, 47% were more frequently successful compared to students that scored below college-level math or did not take the math assessment test (19%).

Forty-three percent of the White students were successful at Level I (Figure 2). Among White students, 64% of the full-time students and 31% of the part-time students were successful at Level I. Among full-time students, students with college-level math skills (78%) were more likely to be successful than those without college-level math skills (59%). Part-time White students were more likely to be successful if they had college-level English skills (59%) than if they did not have college-level English skills (40%).

Figure 1. Tree Diagram of Level I Success (Black Students)

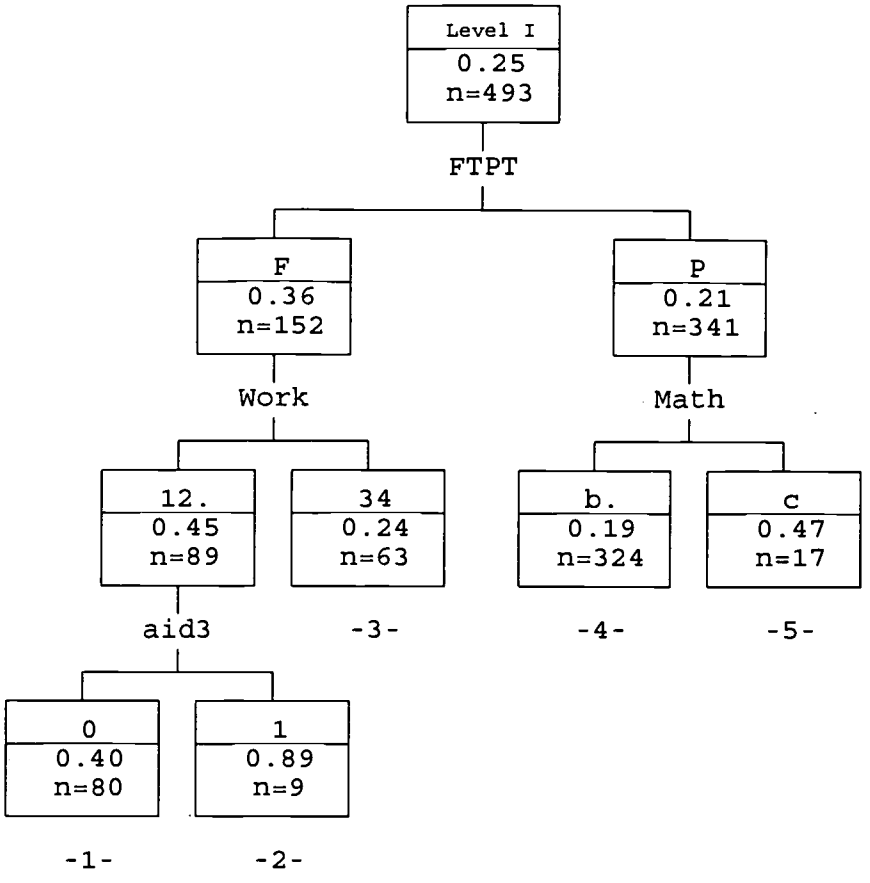


Table 10. Predictor Variables and P-Values	
Predictor	P-value
Math Level	0.00016
FT/PT	0.00029
Work hours	0.0031
English Level	0.0040
Sex	0.036

Note: Each figure in this section is accompanied by a table that presents information on the following: the "predictor" variable which is the independent variable, the p-value of the predictor variable, the "levels" or number of values the predictor variable begins with and ends with as a result of merging or collapsing values and "groups", indicating the grouping of those values.

Figure 2. Tree Diagram of Level I Success (White Students)

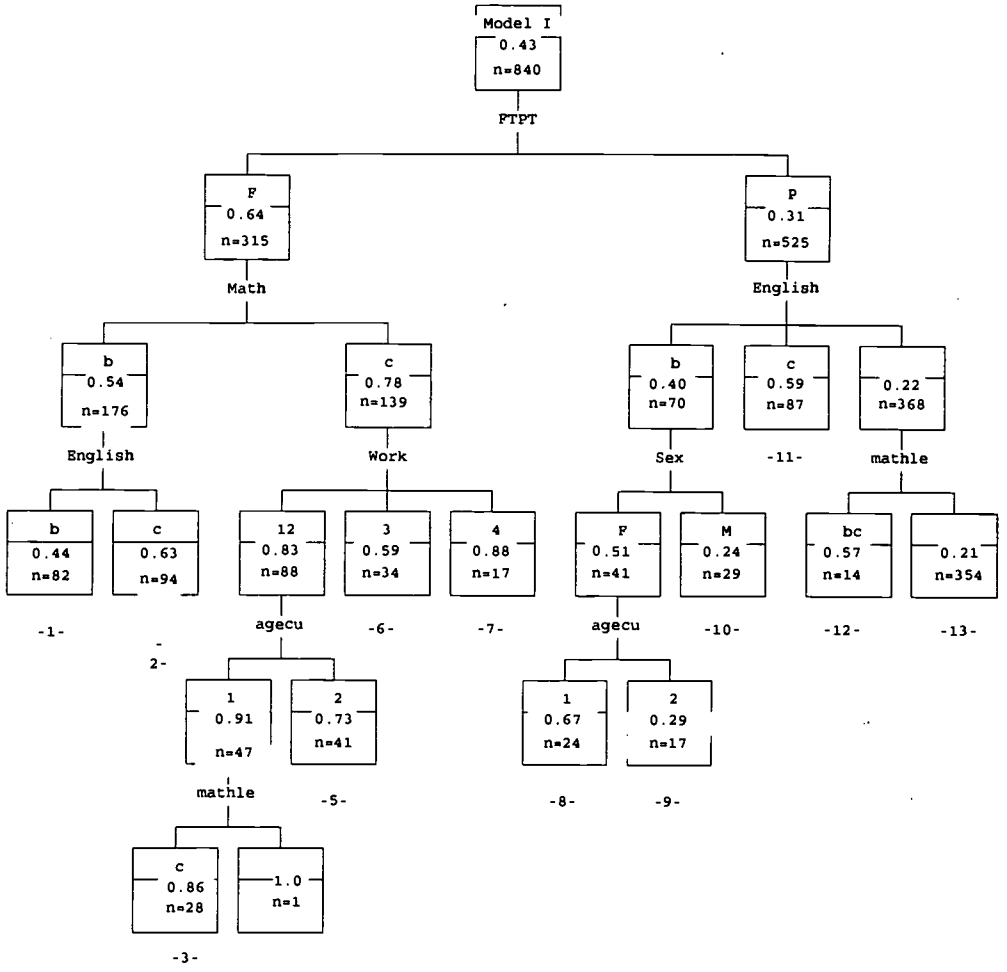


Table 11. Predictors and P-Values for Level I Success (White Students)			
Predictor	P-Value	Levels	Groups
FT/PT Status	7.6e-22	2	F P
English	1.9e-17	3	b c .
Math	3.2e-17	3	b c .
Work	1.6e-10	5->3	1 2 3-.

Note: Refer to the note at the end of Figure 1.

Inferential Data Analysis

Menard (1995) suggested that collinearity among independent variables be tested using the *Tolerance* statistic. This test utilizes each independent variable, in turn, used as the dependent variable, regressing the remaining independent variables against the dependent measure, using the ordinary least-squares method (OLS). The R^2 should not exceed .80, so that 1- R^2 represents the variance in each independent variable, X, is explained by all of the other independent variables. Corresponding to these guidelines a tolerance of less than .20 is cause for concern; a tolerance of less than .10 is nearly certain to be indicative of a serious collinearity problem. Table 51 presents the collinearity test for the independent variables that will be considered for use in the logistic regression model. There does not appear to be a concern with regard to collinearity for any of these variables.

Table 12. Testing for Collinearity

Independent Variable	R^2
English Assessment	.02
Math Assessment	.04
Full-time/Part-time	.19
Financial Aid	.02
Sex[1]	.01
Hours Worked	.19
Age Category	.18

1 - Estimated using logistic regression rather than OLS

Figure 3 presents logistic regression output for American Black students. The initial load variables included information on age, financial aid, English assessment, full-time/part-time status, math assessment, sex and work hours. The model correctly predict 95% of the non-successful students at Level I success for American Black students and 23% of the successful students. Overall, successful prediction was made for three-quarters of all cases.

The following figures have only been edited for the purposes of readability. All Figures, statistics, etc. remain unchanged.

Figure 3. Logistic Regression Output: Black Students

RACE: AMERICAN BLACK

Total number of cases: 493 (Unweighted)
Number of selected cases: 493
Number of unselected cases: 0
Number of selected cases: 493
Number rejected because of missing data: 297
Number of cases included in the analysis: 196

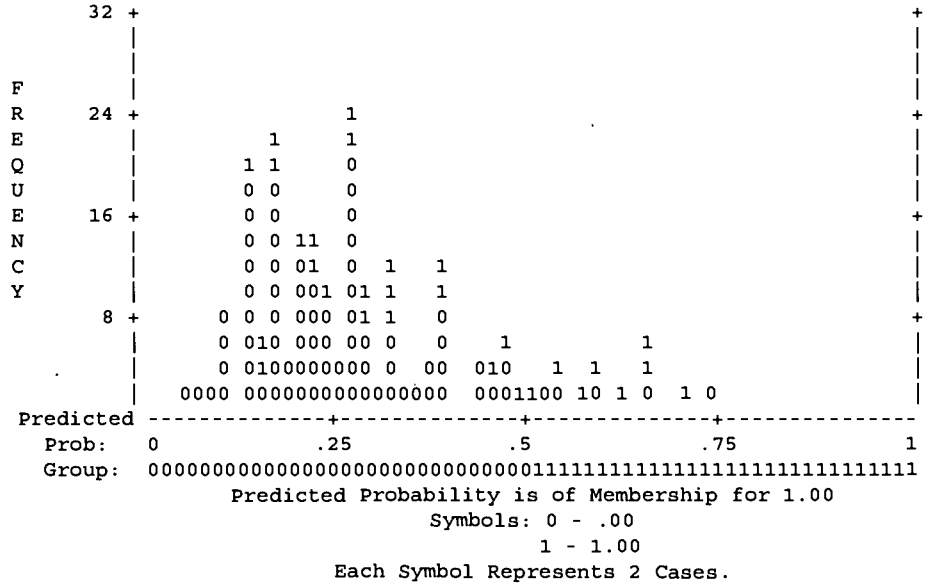
Classification Table for MODEL1

Observed	0	1	Percent Correct
0	133	7	95.00%
1	43	13	23.21%
		Overall	74.49%

---------- Variables in the Equation ----------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
AGECUT	.2823	.3934	.5148	1	.4731	.0000	1.3262
AID2	-.1210	.4243	.0813	1	.7756	.0000	.8861
ENGLEVEL	.5536	.3581	2.3897	1	.1221	.0408	1.7396
FTPT	-.7761	.3861	4.0399	1	.0444	-.0933	.4602
MATHLEVL	1.1180	.4661	5.7529	1	.0165	.1265	3.0588
SEX(1)	.2668	.1777	2.2539	1	.1333	.0329	1.3057
WORKHRS	-.2556	.1893	1.8243	1	.1768	.0000	.7744
Constant	-.0173	.8898	.0004	1	.9845		

Observed Groups and Predicted Probabilities



Predicted Probability is of Membership for 1.00
Symbols: 0 - .00
1 - 1.00
Each Symbol Represents 2 Cases.

In the section labeled "variables in the equation" are listed logistic regression coefficients, standard errors, Wald statistics, the degrees of freedom associated with each variable and the Statistical significance of the Wald statistic. The full-time/part-time status and the math assessment variable both appear to be statistically significant ($p<.05$) with the English assessment variable, sex and work hours being moderately significant ($p<.2$).

In the section labeled "observed groups and predicted probabilities" a histogram of the estimated probabilities of student non-success (o) and student success (1) is presented with the symbol that is used for each case (actually representing 2 cases) designating the group to which the cases belong. The more the two groups cluster at their respective ends of the plot the more accurate is the predictive model. This histogram indicates a high degree of accuracy in predicting non-success for Black students, given the fairly uniform clustering of zeroes to the left of the predicted probability of .5, on the X axis.

Figure 2 presents logistic regression output for American White students. The initial load variables included information on age, financial aid, English assessment, full-time/part-time status, math assessment, sex and work hours. The model correctly predict 45% of the non-successful students at Level I success for American White students and 75% of the successful students. Overall, successful prediction was made for 62% of all cases. Again, the following figures have only been edited for the purposes of readability. All Figures, statistics, etc. remain unchanged.

Figure 4. Logistic Regression Output: White Students

Race: American White

```
Total number of cases:      840 (Unweighted)
      Number of selected cases:   840
       Number of unselected cases: 0
Number of selected cases:                 840
Number rejected because of missing data:  467
Number of cases included in the analysis: 373
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Classification Table for MODEL1

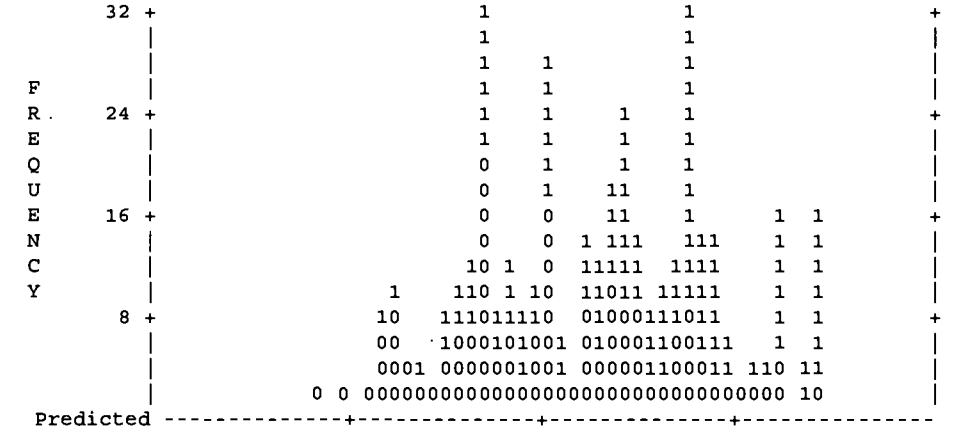
Observed	0	1	Percent Correct
0	71	88	44.65%
1	54	160	74.77%

Overall 61.93%

Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
AGECUT	-.0712	.3048	.0546	1	.8153	.0000	.9313
AID2	-.3998	.3889	1.0571	1	.3039	.0000	.6704
ENGLEVEL	.7442	.2254	10.9025	1	.0010	.1323	2.1048
FTPT	-.4831	.2606	3.4382	1	.0637	-.0532	.6168
MATHLEVL	.9429	.2762	11.6551	1	.0006	.1377	2.5674
SEX(1)	-.1736	.1123	2.3866	1	.1224	-.0276	.8407
WORKHRS	.0438	.1300	.1132	1	.7365	.0000	1.0447
Constant	.3530	.5463	.4176	1	.5181		

Observed Groups and Predicted Probabilities



Predicted Probability is of Membership for 1.00
Symbols: 0 - .00
1 - 1.00
Each Symbol Represents 2 Cases.

The English assessment variable and the math assessment variable both appear to be statistically significant ($p<.05$). Full-time/part-time status is significant at ($p<.1$) and sex is moderately significant ($p<.2$)

Summary

In the future, more and more students will begin their postsecondary education at a community college (Special Report, 1996). Community colleges have historically provided educational opportunities for students that otherwise would not have attended college (Roueche, 1993). Today, and in the near future, community colleges will serve an increasingly diverse student population that often is under-prepared for college. The next century will witness an increase in minority students, both American and International, who represent different cultures, have a first language other than English and may not have strong support from their families.

This study has focused on American Black students as one group of students likely to have different background characteristics and preparedness levels than what generally facilitates success at a postsecondary educational institution. The current generation of American Black students have been the subject of much concern among American educators, with other groups of students now also garnering greater concern as they increase in visibility. It is the intention of this study, to provide educators with information intended to heighten their awareness of the need to continually review academic policies and procedures; and, to provide educators with an analytical approach whereby at-risk students may be identified early in their college careers, followed by the use of intervention strategies designed to promote student success

The purpose of this study was to examine factors that appear to be related to the relative success of Black students and White students and to use this information to benefit at-risk

students. This study presents background information, college administrative data and information on student success for American Black students and White students. This study was relegated to American students to equivocate potential cultural and language differences that would otherwise be present. In the future, similar methodology may be used for other student groups.

This study is limited in scope with data collection relegated to one community college. Additionally, the dependent measures used to assess student success are only the writer's attempt to reconcile perspectives in the current body of literature; undoubtedly, the outcome measures can be defined in many different ways and should be redefined as our understanding of the underlying structure of student success improves. The methodological approaches utilized by this study are intended to be easily transportable to other educational institutions and can be revised to fit the profile of other student groups.

Conclusions

The pre-college experience of Black students may often limit their chances for success as college students. For example, Black students more frequently: come from one-parent households, have relatively low incomes, have children at an early age and less frequently attend college directly following high school than do White students. In high school, Black students are less frequently enrolled in college preparatory programs than are White students and more frequently arrive at college without the preparation necessary to be successful, compared to White students. Information collected in this study indicated that Black students frequently were from families with less education, that were likely to be employed in more labor/worker intensive occupations and made considerably less income as compared to White students.

Subsequently, Black student success rates were much lower than the success rates of White students, as would seem logical given the barriers faced by Black students.

Survey information from this study suggested that Black students sometimes had higher success rates when employed, compared to Black students that were not employed. Among all Black students that were successful at Level I, more than three-quarters were employed either full-time or part-time, with 44% being employed full-time and 33% being employed part-time. Among full-time Black students, those students that were employed (full-time or part-time) were nearly twice as likely (45%) be successful than were students that were not employed (24%).

Utilizing both survey information and administrative information, it seems to be suggested that student perceptions and attitudes regarding the relative importance of succeeding do not appear to be associated with success, in direct contradiction to commonly held contentions regarding student attitude and student success (Jalomo, 1995; Rendon, 1993).

Examination of financial aid information suggested that although there exists a statistically significant between the percentage of Black students (12%) and the percentage of White students (16%) that receive financial aid this difference is of secondary importance. Of greater importance, Black students (22%) more frequently received financial aid than did White students (6%), when both groups of students were successful, possibly suggesting that financial aid may have a greater positive impact on Black students as compared to White students.

Sociologists and many educators have long insisted that socio-economic status accounts for most of the differences in educational outcomes for Black students and White students. In this study, information on education, occupation and income was gathered via a student survey. This information was analyzed revealing that the most salient factor in determining student

success was the educational level of the parents; and, that when the parents of Black students and White students were held constant, the success rate for Black students and White students were not significantly different from one another.

The statistical methodology utilized in this study included both descriptive and inferential techniques. The use of CHAID analysis and the subsequent use of logistic regression were paired as complimentary statistical procedures, with the iterative chi-square approach used to explore the ability of the selected independent variables to predict student success. Logistic regression procedures used the best predictors, as determined in the CHAID analysis, to construct a logistic regression model. A high percentage of non-successful Black students (95%) was identified using the statistical approach taken in this study.

The "best" predictor variables may vary by student group and over time, as educational requirements and group composition will also vary. However, a similar approach will provide administrators and educators with an analytical tool to be used for early identification of at-risk students.

Recommendations

The following recommendations are intended to be utilized by institutional researchers to identify at-risk students.

- Math and English assessment information is extremely useful when identifying at-risk students. It should be collected for as many students as is practicable and used to identify potentially at-risk students.
- It is recommended that identification of at-risk students take place early in the students' college careers, with intervention strategies, employed in a systematic manner within the

students' first semester. Intervention strategies should include: 1) A community based effort, to enhance college preparedness, that is a joint effort between area high schools and the community college; 2) Developmental course-work at the college; 3) Financial aid counseling at the college, with students being advised with regard to the availability of funds that may be packaged together to facilitate full-time attendance; and, 4) Students being encouraged to work as part of a work-study or work-related cooperative program.

- Indicators for success should be reviewed and modified as needed. The success of these recommendations should also be reviewed on a regular basis with predictive techniques and intervention strategies to be modified as is necessary, as part of an on-going evaluative process.

Future Research

Further institutional research is needed at the College to determine better understand the relationship between student employment, motivation, financial aid and students success. The findings from this study may serve as the basis for this future research with the relationships between these independent variables described above and student success measures being more fully developed.

The successful use of sophisticated methodology does not in itself ensure that the predictive capability of such techniques will endure. To accomplish this, a monitoring system is required to collect and analyze information that will serve as a feed-back loop in order to make adjustments to the predictive model .

Other research in this area may include examining national databases in an effort to extract information that may be analyzed using an approach similar to that employed in this

thesis. One such opportunity, that is part of a training program for institutional researchers, is designed to train researchers to utilize national databases for institutional research purposes (AIR, 1996). The use of national databases, in this manner, would contribute to the refinement of the measures of success and the research methodology established within this study. The availability and use of national data resources will also allow the techniques from this study to be established as generalizeable, and with these results further contributing to the dissemination of information and the use of techniques that culminated from this study.

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