article:1424

An Examination of Indicators of Engineering Students' Success and Persistence

This study examined the influence of a set of cognitive, noncognitive, and environmental factors on engineering students' academic achievement and persistence. The ability to predict specific academic outcomes within engineering programs are of particular concern with the declining interest in engineering among graduating high school students, coupled with the fact that only 50% of the students who enter college as an engineering major complete degree requirements. There is a lack of research that has examined such factors with engineering students. Empirical evidence identifying the extent to which cognitive and noncognitive factors can predict student outcomes can assist with effectively shaping curricular reform and in developing successful student programs designed to meet the needs of matriculating engineering students.

Participants

Data included two cohorts of first year engineering undergraduate students from a large Midwestern university. Cohort 1 (*N* = 1000, 19.3% females) and Cohort 2 (*N* = 756, 18.25% females) were representative of incoming engineering students at the university. Almost half of the students in Cohorts 1 (47.3%) and 2 (48.68%) were enrolled in an engineering orientation seminar during their first semester. Participants agreed to complete two surveys at the end of the orientation seminar and allow tracking of their academic progress until graduation. Whereas gender differences in academic achievement and persistence were examined, sufficient numbers of underrepresented minority students were not available for comparative analyses.

Variables

Variables included gender, participation in a first-year seminar, SAT Math and Verbal, academic motivation, institutional integration, high school rank, cumulative grade point average (GPA), enrollment status, and declared academic major. With the exception of the self-report measures, data were obtained through university records after seven and five semesters for Cohorts 1 and 2, respectively.

Analysis

The use of two cohorts was beneficial for the identification of significant variables (Cohort 1) and cross-validation of results (Cohort 2). Three separate analyses were conducted. A standard hierarchical multiple linear regression was conducted to examine the influence of the independent variables on cumulative grade point average. Hierarchical logistic regressions were conducted to examine the influence of the independent variables (including GPA) on the dichotomous outcome variables of continued enrollment within the university and major. Within the hierarchical regression analysis the significance of the addition of the variables was

evaluated by a statistically significant change in R^2 or $?^2$ for linear and logistic regression, respectively. Significant parameter estimates from Cohort 1 analysis were used for cross-validation with Cohort 2.

Results

Predicting GPA

Three achievement variables (i.e., $SAT_{Verbal,}$ $SAT_{Math,}$ HS rank) and gender were significant predictors of GPA, accounting for 18% of the variance. The average parameter estimates of these variables were used to predict GPA for Cohort 2 for cross-validation purposes. These predicted values were correlated with the observed GPA values (r^2=.26) providing generalizability evidence of the regression equation.

Enrollment at the University

A hierarchical logistic regression was conducted to evaluate the prediction of continued enrollment at the university using the independent variables in the first analysis and the addition of GPA. There was no reliable improvement with the addition of the motivation and integration variables or enrollment in a seminar beyond the achievement variables. GPA was the only significant variable resulting in a correct classification rate of 89%. Cross-validation with Cohort 2 resulted in a correct classification rate of 90.5%.

Enrollment in Engineering Major

A hierarchical logistic regression was conducted to evaluate the prediction of continuing as an engineering major at the university. There was a reliable improvement with the addition of the motivation and integration variables. Significant variables included GPA, high school rank, SAT Math, and motivation, with a correct classification rate of 65%. Cross-validation with Cohort 2 resulted in a correct classification rate of 64%.

Concluding Remarks

Prediction of GPA was consistent with previous research [1,2,3] with prior achievement variables being significant and participation in the first-year seminar and the noncognitive variables not substantially contributing additional information. The prediction of persistence at the university revealed that GPA could result in a high correct classification rate of approximately 90%. Consistent with national trends, the percentage of students persisting toward an engineering degree was slightly better than 50% (i.e., Cohort 1, 56.5%; Cohort 2, 59.4 %). Examination of persistence within an engineering major revealed that prior academic attainments, college GPA, and motivation were key predictors.

Results suggest that starting one’s engineering academic career with a strong academic background, achieving good grades at the university, and having the motivation for academic work should assist with persistence at the university and specifically as an engineering major.

These results should be considered in conjunction with findings obtained through the use of other research methods. As evident in these results, much variance remains to be explained. Research is encouraged to continue to examine how other variables contribute to engineering students' academic success and persistence.

References

[1] Bordonaro, M., A. Borg, G. Campbell, B. Clewell, M. Duncan, J. Johnson, K. Johnson, R. Matthews, G. May, E. Mendoza, J. Dineman, S. Winters, & C. Vela, *Land of plenty: Diversity as America's competitive edge in science, engineering and technology*, Report of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, Opportunities in Science and Engineering, 2000.

[2] Astin, A. W., "Engineering outcomes," *ASEE Prism*, September 1993, pp. 27-30.

[3] Noble, J., M. Davenport, J. Schiel, and M. Pommerich, Relationships between the noncognitive characteristics, high school course work and grades, and test scores for the CAT-tested students. Iowa City, IA: ACT, Inc, 1999.

Author 1: Brian French frenchb@purdue.edu

Author 2: Jason Immekus jimmeku1@purdue.edu

Author 3: William Oakes oakes@purdue.edu

Article Link: www.asee.org

: Back to 2006 Winter Issue Vol. 2, No. 1

: Back to List of Issues

: Back to Table of Contents