Efficacy of Using a Single, Non-Technical Variable to Predict the Academic Success of Freshmen Engineering Students

LAURA W. LACKEY
Department of Biomedical and Environmental Engineering
Mercer University School of Engineering

W. JACK LACKEY
George W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology

HELEN M. GRADY
Technical Communication
Mercer University School of Engineering

MARJORIE T. DAVIS
Technical Communication
Mercer University School of Engineering

ABSTRACT

This paper evaluates the efficacy of using freshman student scores from one non-technical assignment to predict academic success as measured by cumulative grade point average after completion of the first two semesters enrolled at the Mercer University School of Engineering. The predictor assignment is keeping a dialectic course notebook and corresponds to the student's attitude, persistence, and organizational skills rather than math and science preparedness. Statistical analysis, at the 99 percent confidence level, indicated that there was a strong relationship between the student notebook scores and grade point average. Although there was scatter in the data, this one variable does provide insight into student success in the Mercer University Engineering program.

I. INTRODUCTION

Numerous papers have been written on the topic of student retention in higher education and a variety of multi-variable models have been developed to predict student success. To gain admittance into an engineering school, students must meet or exceed a model or criteria established by their prospective college or university. The admittance criteria attempt to establish the baseline skill level necessary for success in the engineering curriculum. Admittance guidelines are based on accepted academic success predictors such as standardized tests scores, high school grade point average, and participation in extracurricular activities. But regardless of this selective admission criterion, all students are not successful in engineering programs.

Predicting the success of students engaged in higher education is important. Many models have been developed to predict student success and retention in chosen fields of study as well as at the chosen college or university. Frequently, retention models incorporate scores from standard achievement tests and the high school grade point average (GPA) with additional predictive variables. In this study, professors had noted a correlation between performance on a dialectic notebook assignment and the student's performance in the Professional Practices class where the assignment was a requirement. Closer examination revealed a relationship between success in the dialectic notebook assignment and success during the freshman year.

The dialectic notebook (also sometimes called a critical thinking notebook) employs a technique of having students reflect upon their learning throughout the semester's course. Dividing notebook pages with a vertical line, students take notes on one side and write questions, comments, or speculations about what they are reading or learning on the other side. Students in the Professional Practices course are required to complete the readings and to complete notebook entries about them—thus assuring a level of engagement beyond casual skimming of the texts. Additionally, students are encouraged to interact with the ideas they are reading—questioning, relating, noticing applications, and so forth. The notebooks thus become a strong indicator of the student's degree of engagement in the readings and activities.

Notebooks are not "graded" in terms of extensive comments; rather, the teacher simply skims the entries and makes a global qualitative assessment of how well the student completed the assignment. The following variables were used to quantify the notebook grade: completeness (student has read and responds to the meaning of the material), presentation (including neatness, readability, organization), quality of reflection (student does more than repeat the content of readings), and application (student makes an effort to link ideas or concepts, or to apply something they have read to something in their own experience). Faculty noticed that those students who created good notebooks seemed to be performing better and sought to challenge this hypothesis.

II. LITERATURE REVIEW AND BACKGROUND INFORMATION

Success in engineering programs has been linked to a variety of intellectual and non-cognitive skills. Researchers have historically used scores from the mathematics portion of the SAT to distinguish persisters from those who either drop out of the engineering curriculum and enter into an alternate field of study and those who no longer pursue any type of secondary education [7, 9, 17]. Additional intellectual success factors include the high school

GPA and university math and chemistry placement scores [8, 16, 17]. Levin and Wycokoff [16, 17] also incorporated a variety of non-intellective factors such as attitude toward high school mathematics and physics into a model used to predict success. Additional non-academic factors such as personality, motivation, student background and their attitude towards themselves, level of parental education, attitudes toward studying, and prior knowledge of the engineering major have all been shown to be useful as predictive retention and success variables [6, 9, 10, 17].

The retention of students based on gender and minority differences has also been evaluated. Felder et al. [10] reported that although women begin their pursuit of an undergraduate engineering degree with equal or better credentials than their male peers, by the end of their sophomore year they were twice as likely to drop out as compared to male students.

For admittance to Mercer University School of Engineering (MUSE), potential freshman are required to meet the following three minimum criteria:

1. SAT score $\geq$ 1000;
2. SAT score on math portion (SAT-M) of the exam ($\geq$550; and
3. High School Academic GPA $\geq$ 3.0 (continuous scale from 0 to 4).

The academic GPA includes only grades from core academic classes such as mathematics, science, and English. Grades from courses such as physical education and band are not included. If students fail to meet one of the above criteria, students may still be admitted if their MUSE defined academic preparedness index (API) score is $\geq$ 85, where the API is defined as follows:

$$API = 10 \times Academic\ GPA + \frac{SAT\text{–}M}{10}$$

Engineering education pedagogy began to reform in the mid 1980's as the importance of writing across the curriculum (WAC) was recognized for technical (non-English) courses [15]. The importance of writing in science, engineering, and technology coursework was benchmarked by the work of J.A. McLellan and John Dewey [21] and has been successfully applied by a variety of researchers [6, 25, 26] and integrated into numerous colleges and universities [22]. In brief, the WAC system encourages instructors to minimize traditional classroom lecture activities and permit students to learn by writing [20, 22]. The purpose of this type of active learning (journals, in-class writing, etc.) is to engage students in critical thinking and problem solving within their specific discipline. WAC has been shown to improve student learning by embracing all four learning styles as described by Kolb [14] and by enabling students to achieve higher levels of comprehension as described by Bloom's taxonomy [4].

III. The Professional Practices Course Design

MUSE faculty has adopted the WAC concept and it is initially introduced to the students during their freshman year in a Professional Practices course (EGR 108). Student-based outcomes for EGR 108 are listed below:

(1) to demonstrate the ability to read critically for content, implications, and communication strategies by keeping a critical notebook and writing short essays;
(2) to develop an understanding of the history of engineering and its impact upon society by writing several short essays and a comprehensive research paper;
(3) to develop and apply methods for solving moral and ethical engineering problems by analyzing and presenting several case studies; and
(4) to communicate successfully by delivering formal and informal presentations, either individually or in a group.

The EGR 108 course content is divided into two distinct modules. Module 1 introduces students to the engineering innovations that have caused paradigm shifts in society. Three books are read: *Five Equations that Changed the World* [13], *Beyond Engineering* [19], and *Science and Technology Today* [18], which document the social, political, and global forces that shape engineering and scientific developments. Students also select a specific engineering innovation, research its development, assess its impact on society, and present their findings in writing and orally. This module is designed to foster critical reading, thinking, writing, and speaking skills. Students are introduced to a variety of active reading strategies and to a variety of rhetorical devices for both written and oral communication. Module 2 introduces the student to personal and professional ethics that govern the actions of engineers. Using a multimedia case study of the Challenger disaster [24], as well as case studies from the book *Engineering Ethics* [11], students identify ethical problems/issues and develop a means for solving them. Engineering codes of ethics serve as a framework for discussing issues of professional conduct. Students focus on what it means to be a responsible engineer and how the actions of engineers can affect the well being of others. Working in small groups, students develop and resolve an ethical case study to present to the class.

Throughout EGR 108, students are required to take critical notes on all reading assignments. Furthermore, class time is often devoted to thoughtful free write activities associated with assigned readings (free writes are in-class, unstructured, timed responses, sometimes on an assigned topic and sometimes student selected). These and all other assignments are kept by the student and organized in a three-ring binder (notebook) as instructed by the professor. The student grade from this three-ring binder is the non-intellective, independent variable used in this study to predict success and persistence of MUSE freshmen engineering students.

This research relied on the premise that all students meeting the MUSE admittance criteria were academically prepared and capable of succeeding in the engineering curriculum. Unfortunately, on a national scale, a large percentage (attrition of 55-60%) of entering engineering students do not complete the degree requirements [2, 3, 23]. This paper details the effectiveness of using one non-technical assignment given during the freshman year to predict success, as measured by GPA, of freshmen engineering students. Furthermore, by combining this non-intellective variable with more traditional intellectual preparedness indicators such as the SAT score, a model was developed to predict the engineering student GPA after completion of the first two semesters of study.

IV. Methods

A. Participants

All Mercer engineering students are required to take the engineering professional practices course that is focused on technical writing, history, and ethics. Students enrolled in the course were primarily freshman and were unaware of the study. The participants, a total of 109 students of which 21 percent were female, were from 6 different EGR 108 sections over a three-year period. All study participants met previously defined admittance requirements and were MUSE students. It was therefore assumed that all students participating in the study were well prepared academically and were properly equipped from their K-12 experience to succeed in the engineering curriculum.

B. Procedure

As an EGR 108 requirement, students keep all course work organized in a three-ring binder that is graded at the end of the semester. Both in writing and through oral instruction, students were advised to organize their notebooks in three separate sections that included class notes and quizzes, both in and out of class writing assignments, and critical notes associated with reading assignments. As previously described, notebook grades were dependent on four non-technical issues including notebook completeness, presentation, quality of reflection and application. A complete notebook contained all writing assignments, quizzes, exams, critical notes associated with reading assignments and class notes. All tests, quizzes, and writing assignments had been previously graded, and therefore minimal effort was required by the instructor to review the quality of class notes and critical notes taken during the semester. The total grading time per notebook was less than five minutes. Possible scores were integers within the range from zero to four with four being the highest possible grade. The same individual graded all notebooks. For a notebook to receive a grade of four, all assignments must have been thoughtfully completed and placed logically in the notebook. A notebook assigned a score of three might be missing relatively few assignments or lack some depth of reasoning in critical notes, yet still be organized as instructed. A notebook would also receive a grade of three if all required elements were present but they were not organized in the manner instructed. A grade of two was assigned if more than half of the assignments were missing or poorly completed and the material was not organized as instructed. A notebook received a score of one if the student turned in a notebook containing minimal course content. A zero was only assigned when no notebook was submitted for a grade. A description of all model variables is included in Table 1.

C. Analysis

A primary interest of this study was to determine if there was a correlation between individual student notebook scores and the cumulative grade point average (GPA; 0 − 4) calculated after completing the first two semesters at MUSE. To this end, least squares linear regression was performed and the confidence intervals for the fitted line as well as the predicted intervals were obtained with the statistical package Statistix7. Furthermore, stepwise regression was utilized to develop a model to predict student grade point average as a function of both intellective and non-intellective variables.

V. Results and Discussion

A strict admittance criterion is used to select students that have an aptitude toward mathematics and science such that they will succeed in the rigorous engineering curriculum. As a result of this criterion, it is assumed that each student admitted has the ability to succeed. But, attrition rates in engineering schools approximate 50 percent.

The SAT score is reported to be a good predictor of academic success [12]. A relationship between the SAT score and the MUSE GPA (cumulative GPA earned after two semesters, i.e., completion of the freshmen year, at MUSE) was identified. As expected, a trend was noticed showing that as the SAT score increased, the MUSE GPA increased. The R^2 adjusted value equaled only 0.006 indicating a very weak relationship between the variables. With appreciable scatter in the data the p-value was equal to 0.22 indicating only 78 percent confidence that a real relationship exits. Similar results were observed when the SAT-M scores were analyzed with respect to the MUSE GPA. A weak relationship was noted between the variables having an R^2 value equal to 0.07. Table 2 summarizes results from single-variable linear regression models where the MUSE GPA was the dependent variable. A much better correlation was obtained when the notebook score was used as the predictor. The relationship between MUSE GPA and the notebook score is graphically shown in Figure 1. The adjusted R^2 value equaled 0.33, indicating a moderately strong relationship between the variables. Although there was scatter in the data, the p-value was less than 0.01 indicating a statistically significant relationship between notebook score and GPA at the 99 percent confidence level. Of the students that scored a zero or one on their notebook,

Variable Name	Description (possible score)
Dependent Variable – **MUSE GPA**	Student grade point average after first two semesters attending Mercer University School of Engineering (continuous from 0 to 4)
Predictor Variables	
SAT	Scholastic Aptitude Test (continuous from 400 to 1600)
SAT-M	Scholastic Aptitude Test – Mathematics (continuous from 200 to 800)
SAT-V	Scholastic Aptitude Test - Verbal (continuous from 200 – 800)
HS GPA	High school academic grade point average (continuous from 0 to 4)
Notebook	EGR 108 Notebook grade (integers within the range from 0 to 4)

Table 1. Description of variables affecting engineering student grade point averages.

67 percent were either placed on academic warning, suspension, or were placed on academic probation at the end of their freshmen year. However, of the students that scored two or better, only seven percent were struggling academically after two terms at MUSE.

Predictive, multi-variable models were developed using stepwise regression. The dependent variable for the regression models was MUSE GPA and included the following independent variables: SAT-M, SAT-V, HS GPA, and notebook score. Variables listed in the summary tables are listed in the order of their contribution to the model. An analysis of variance for a model predicting the MUSE GPA for all study participants, incorporating three significant independent variables is shown in Table 3. Table 4 shows that the notebook score is the most important variable ($R^2 = 0.33$) in that it accounts for 33 percent of the variation in the MUSE GPA. When the next most significant term is added to the model, HS GPA, the adjusted R^2 value increased by 0.166 yielding a total adjusted R^2 of 0.501. The table shows that adding the SAT-M variable had a smaller yet statistically significant effect. The analysis showed that the addition of the SAT-V variable was not statistically significant at the 90 percent confidence level. This observation is consistent with other researchers [9, 16] that have shown that the SAT verbal score has no predictive value for academic success in science and engineering programs. Figure 2 compares the MUSE GPAs predicted by the three-variable model with the observed values.

Predictor Variable	p-value	R^2 Adjusted
SAT	0.2185	0.0058
SAT-M	0.0058	0.0710
SAT-V	0.1591	0.0110
HS GPA	2.99×10^{-8}	0.3205
Index	0.0001	0.1584
Notebook	9.15×10^{-10}	0.3343

Table 2. Single variable model using linear regression analysis for dependent variable.

Similarly, a separate stepwise regression was conducted for both male and female students to observe the effects of the independent variables on the MUSE GPA of both student populations. Table 5 summarizes the results for the male engineering students. Notice that the notebook score was again observed to be most strongly correlated with the MUSE GPA. Table 5 shows that the model with just the notebook variable has an adjusted R^2 value of 0.360. With the addition of the next most significant term, HS GPA, the R^2 adjusted value increased by 0.168 to 0.528. The SAT-M score also had a statistically significant effect on model predictions with a p-value of 8.944×10^{-5}.

Table 6 summarizes the result from stepwise regression considering only the female students. For the female students, the HS GPA made the most significant contribution to the predictive model. Table 6 shows that the model with just the HS GPA variable has an R^2 adjusted value of 0.573. With the addition of the only additional significant variable, notebook score, the R^2 adjusted value increased by 0.059 to 0.632. Obviously, the notebook score, or student attitude, was not as significant for predicting the success of female students as measured by GPA when compared to their male peers. These results indicate that academic preparedness for female students is more critical to their academic success than to their male counterparts. Furthermore, these results correlate well with the finding of Felder et al., 1995 that suggest that women, compared to their male peers, have a better attitude toward learning and are more highly motivated to study (staying up-to-date with assignments). If it is concluded that women across the board are more responsible academically than their male peers, it would reasonably

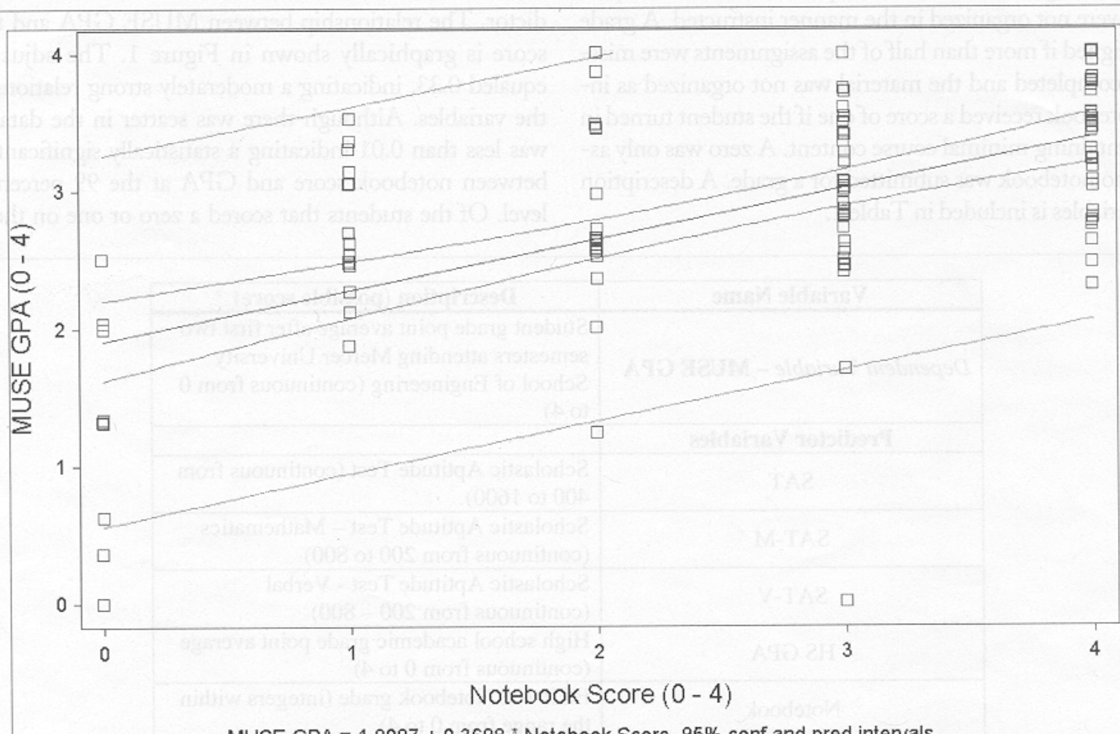

Figure 1. Linear regression plot showing MUSE GPA correlation with the notebook score.

Source	SS	SS %	MS	F	F Signif	df
Regression	31.00	61	10.33	44.58	2.46×10^{-17}	3
Residual	19.47	39	0.232			84
Total	50.47	100				87

Table 3. Analysis of variance for the model incorporates the three significant terms.

Effect	Coefficient	p-Value	R^2 Adjusted Improvement	R^2 Adjusted Total
Intercept	-3.258	1.151×10^{-5}		
Notebook	0.326	1.958×10^{-11}	0.3343	0.3343
HS GPA	0.832	1.463×10^{-6}	0.1662	0.5005
SAT-M	0.00271	9.540×10^{-4}	0.1000	0.6005
SAT-V	0.00108	0.219	0.0025	0.6030

Table 4. Stepwise regression for dependent variable MUSE GPA.

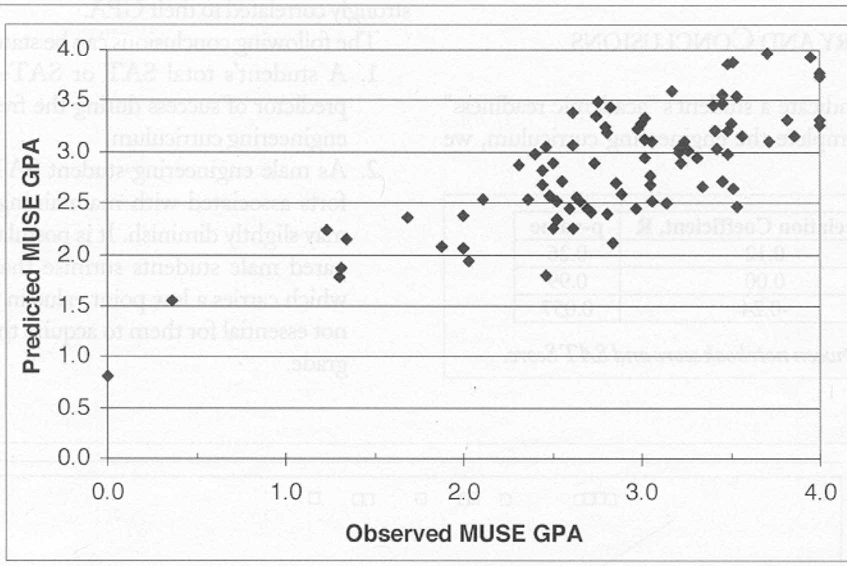

Figure 2. The results (Predicted GPA) from the multivariable stepwise regression model correlate well with study participants actual GPA.

Effect	Coefficient	p-Value	R^2 Adjusted Improvement	R^2 Adjusted Total
Intercept	-3.542	5.051×10^{-5}		
Notebook	0.371	9.956×10^{-11}	0.360	0.360
HS GPA	0.841	1.121×10^{-5}	0.168	0.528
SAT-M	0.00405	8.944×10^{-5}	0.100	0.628

Table 5. Stepwise regression for dependent variable MUSE GPA for male students.

Effect	Coefficient	p-Value	R^2 Adjusted Improvement	R^2 Adjusted Total
Intercept	-2.454	0.0328		
HS GPA	1.271	0.0009	0.573	0.573
Notebook	0.214	0.0498	0.059	0.632

Table 6. Stepwise regression for dependent variable MUSE GPA for female students.

follow that the HS GPA variable would more strongly correlate to academic success as compared to the notebook score.

Table 7 summarizes the relationship between SAT and notebook scores. Notice that when all students study participants were included in the analysis, there was no correlation noted between SAT and notebook score as indicated by the very weak correlation coefficient, $R = 0.12$ and the p-value of 0.26. Similar results were observed with an analysis of the female participants. Again, no relationship was observed as the correlation coefficient was essentially zero and the p-value was 0.99. But, for the male students, there appears to be a relationship between SAT score and notebook score as shown in Table 7. Figure 3 highlights the relationship between the SAT and notebook score for the male students. Note that although statistically a slope of zero could be possible, there is a trend that indicates that as SAT scores increase the predicted notebook score decreases. The correlation coefficient is relatively weak, $|R| = 0.24$ and the p-value is equal to 0.057. It is anticipated that male students with superior academic preparedness recognize they can skimp on the notebook activity (i.e., everyday readiness) and still obtain the grade desired.

VI. Summary and Conclusions

Although SAT scores indicate a student's "academic readiness" or ability to successfully complete the engineering curriculum, we suggest the notebook grade measures student engagement, attitude, initiative, time management skills, study habits, and willingness to persevere. Furthermore, we believe the notebook score represents the willingness of the student to invest time in learning. And as the notebooks cannot be recreated at the last minute, a good grade represents persistence and planning skills. These attributes associated with obtaining a good notebook grade do not focus on mathematic or scientific principles (i.e., intellectual attributes), but rather on a student's consistent attention to course material. Data indicate that once admitted to MUSE (i.e., admittance criteria are met, GPA and SAT scores), the score obtained on the notebook kept during the EGR 108 course is a good predictor of academic success, as measured by GPA, for freshmen engineering students.

Stepwise regression was effectively used to predict engineering student GPAs at the conclusion of the freshmen year. By combining intellective variables such as the HS GPA and the SAT-M score with the non-intellective, or effort based variable notebook score, a model to predict academic success was developed. For male students, the notebook score was the variable that contributed most to the adjusted R^2 value. But, for female students, the HS GPA was most strongly correlated to their GPA.

The following conclusions can be stated.

1. A student's total SAT or SAT-M score is not a reliable predictor of success during the freshmen year in the MUSE engineering curriculum.
2. As male engineering student SAT scores increase, their efforts associated with maintaining the EGR 108 notebook may slightly diminish. It is postulated that exceptionally prepared male students surmise that a high notebook grade, which carries a low point value in the overall course grade, is not essential for them to acquire the desired EGR 108 course grade.

Participants	Correlation Coefficient, R	p-value
All	0.12	0.26
Female only	0.00	0.99
Male only	-0.24	0.057

Table 7. Correlation between notebook score and SAT Score.

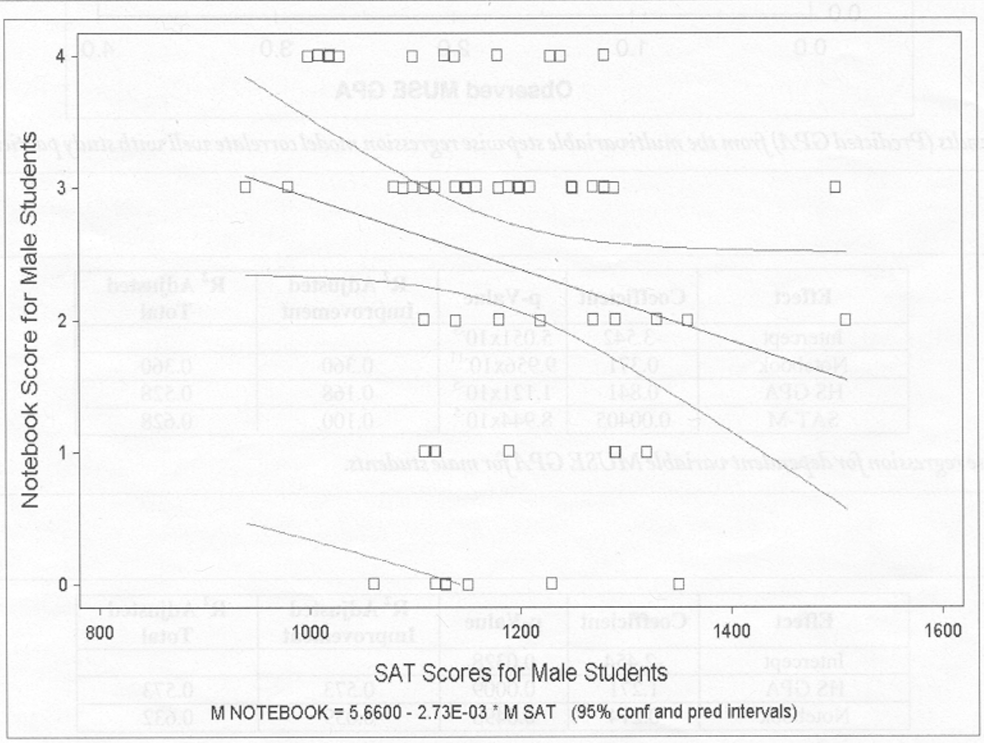

Figure 3. Linear regression plot showing the notebook score correlation with SAT scores for male students.

3. The EGR 108 notebook score is a reasonably reliable predictor of freshmen student success in the MUSE engineering curriculum.
4. The EGR 108 notebook score represents student attitude and willingness to learn.
5. Multivariable models containing variables representing both ability and interest best predict student success with respect to GPA in agreement with Levin and Wycokeff, 1991.

References

[1] Agrawal, P.K. 1997. Integration of critical thinking and technical communication into undergraduate laboratory courses. *Proceedings, American Society for Engineering Education.* Session 1213.

[2] Astin, A.W. 1993a. *What Matters in College: Four Critical Years Revisited.* San Francisco, Jossey-Bass.

[3] Astin, A.W. 1993b. Engineering outcomes. *ASEE Prism.* September: 27–30.

[4] Bloom, B.S., and D.R. Krathwohl. 1956. Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. Handbook 1: Cognitive Domain. New York: Longmans, Green.

[5] Boyd, G., and M.F. Hassett. 2000. Developing critical writing skills in engineering and technology students. *Journal of Engineering Education.* 89(4): 409–412.

[6] Brown, N.W., and E.J. Cross, Jr. 1993. Retention in engineering and personality. *Education and Psychological Measurement.* 53: 661–671.

[7] Dickenson, D.C. 1969. Prediction and success of freshmen engineers. *Personnel and Guidance Journal.* June: 1008–1014.

[8] Dorio, H.F., C.A. Kildow, and J.A.T. Clover. 1980. Mathematics achievement level testing as a predictor of academic performance and retention in engineering students, paper presented at the Third Annual Meeting of the Southwest Educational Research Association, San Antonio, TX; February.

[9] Elkins, R.L., and J.F. Leutkemeyer. 1974. Characteristics of successful freshmen engineering students. *Journal of Engineering Education.* November: 189–191.

[10] Felder, R.M., et al. 1995. A longitudinal study of engineering student performance and retention. III. Gender differences in student performance and attitudes. *Journal of Engineering Education.* 84(2): 151–163.

[11] Fledderman, C. 1999. *Engineering Ethics.* New York: Prentice Hall.

[12] Gehring, J. 2001. SAT Said to be reliable predictor of college success. *Education Week.* 20(34): 3.

[13] Guillen, M. 1995. *Five Equations that Changed the World.* New York: Hyperion.

[14] Kolb, D.A., and R. Fry. 1975. Toward an applied theory of experiential learning. In: C. Cooper, editors. Theories of group process. New York: Wiley; 33–58.

[15] Kurfiss, J. 1985. Do students really learn from writing? *Journal of Writing Across the Curriculum.* 3(1): 3–5.

[16] Levin, J., and J. Wycokoff. 1988. Findings-effective advising: Identifying students most likely to persist and succeed in engineering. *Engineering Education.* 78(11): 178–182.

[17] Levin, J., and J. Wycokoff. 1991. Predicting persistence and success in baccalaureate engineering. *Engineering Education.* 111: 461–468.

[18] MacKenzie, N.R. 1995. *Science and Technology Today.* New York: St. Martin's Press.

[19] Pool, R. 1997. *Beyond Engineering.* New York: St. Martin's Press.

[20] Maimon, E., B.F. Nodine, and F.W. O'Connor. 1989. *Thinking, Reasoning, and Writing.* White Plains, NY: Longman.

[21] McLellan, J.A., and J. Dewey. 1889. *Applied Psychology, An Introduction to the Principles and Practice of Education.* New York: Educational Publishing Company.

[22] McLeod, S. and E. Maimon. Clearing the air: WAC myths and realities. *College English,* 62(5): 573–583.

[23] Moller-Wong, C., and A. Eide. 1997. An engineering student retention study, *Journal of Engineering Education,* 86(1): 7–15.

[24] Raju, P.K., and C.S. Sankar. 2000. Design of Field Joint for STS 51-L: Launch or Do not Launch Decision. Anderson, SC: Taveneer Publishing Company,

[25] Randolph, G.B. 2000. Collaborative learning in the classroom: A writing across the curriculum approach. *Journal of Engineering Education.* 89(2): 119–122.

[26] Sharp, J.E. 1997.Upgrading: Adding learning intensive writing assignments without increasing grading load. *Proceedings, American Society for Engineering Education.* Session 2647.

Author Biographies

Laura W. Lackey is an Associate Professor in the Department of Biomedical and Environmental Engineering at the Mercer University School of Engineering. She earned B.S., M.S., and Ph.D. degrees in Chemical Engineering from the University of Tennessee. The terminal degree was awarded in 1992. She has six years of industrial experience at the Tennessee Valley Authority as an Environmental/Chemical Engineer where she conducted both basic and applied research with emphasis on the mitigation of organic wastes through bioremediation. In the four years since Dr. Lackey began her career at Mercer, she has taught 14 different courses, ranging from a freshman-level Introduction to Problem Solving course to a senior-level Process Chemistry course, which she developed.

Address: Mercer University School of Engineering, 1400 Coleman Ave, Macon, GA, 31207; telephone: 478-301-4106; fax: 478-301-2166; e-mail: lackey_l@mercer.edu.

Jack Lackey received B.S. degrees in Ceramic Engineering and Metallurgical Engineering from North Carolina State University in 1961. He received a Master of Science degree and Ph.D. in Ceramic Engineering from North Carolina State University in 1963 and 1970, respectively. He conducted basic and applied research on nuclear fuel fabrication, nuclear waste disposal, and processing of ceramic coatings and composites at Battelle Northwest Laboratory and the Oak Ridge National Laboratory. From 1986–1997 while employed at the Georgia Tech Research Institute, he performed research on ceramic coatings and composites, advised graduate students, and taught undergraduate and graduate courses. In 1997 he joined the faculty of the George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, as a Professor. He has published 98 refereed papers and has 16 patents. He is the proud father of co-author Laura W. Lackey.

Address: Georgia Institute of Technology, George W. Woodruff School of Mechanical Engineering, 813 Ferst Drive, NW, Atlanta, Georgia 30332-0405; telephone: 404-894-0573; fax: 404-894-9342; e-mail: jack.lackey@me.gatech.edu.

Helen M. Grady is an associate professor in the Department of Technical Communication in the School of Engineering at Mercer University. She is also the founder and current director of Mercer's Center for Excellence in Engineering Education, which provides training and support to faculty in teaching and technology related issues. She has taught technical communication and engineering core courses at Mercer since 1991. Prior to joining Mercer, she managed an information systems division for a major corporation in Research Triangle Park, NC. She is a member of ASEE, IEEE, AAUW, and a senior member of STC.

Address: 1400 Coleman Avenue, School of Engineering, Mercer University, Macon, GA, 31207; telephone: 478-301-2211; fax: 478-301-2241; e-mail: grady_h@mercer.edu.

Marjorie T. Davis, Ph.D., is a professor and founding chair of the Department of Technical Communication in the School of Engineering at Mercer University, Macon and Atlanta, Georgia. The Technical Communication Department pioneered distance learning at Mercer in the MS degree program in technical communication management. Dr. Davis regularly teaches distance learning courses and also uses Web-based supplemental resources for on-campus undergraduate courses. In addition to being an ASEE member, Dr. Davis is a Senior Member of IEEE and serves on the IEEE Professional Communication Society AdCom and is active in the Society for Technical Communication.

Address: 1400 Coleman Avenue, School of Engineering, Mercer University, Macon, GA, 31207; telephone: 478-301-2356; fax: 478-301-2241; e-mail: davis_mt@mercer.edu.