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ABSTRACT

A study of a continuous quality improvement effort at Auburn University (Alabama) is reported. The study investigated variables predicting which students are at risk of failure. Data were drawn from the records of pre-engineering students enrolling at the university in fall terms of 1991 and 1993-95 (n=2,505). Data sources included achievement tests, high school transcripts, several standardized psychometric tests, freshman survey results, college grades, and exit questionnaire responses. Results are presented concerning the proportion of white and black pre-engineering students making a successful transition to the engineering program, correlation between college entrance examination scores and college grades/program completion, the predicted impact of raising entry standards, racial differences in achievement in pre-engineering, sex differences in achievement, correlation of personality factors and achievement, relationship of persistence to student use of time, program elements that students liked or disliked, and reasons offered for leaving engineering. Results of a survey of students (undergraduate and graduate) and faculty in the college of engineering, designed to identify factors important in improving the program (curriculum, accreditation, financial support, post-graduation employment, group working experiences, course attributes, cooperative experience, instruction) are then summarized. (MSE)

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**ASSESSMENT AND QUALITY IN HIGHER EDUCATION:**

**A MODEL WITH BEST PRACTICE**

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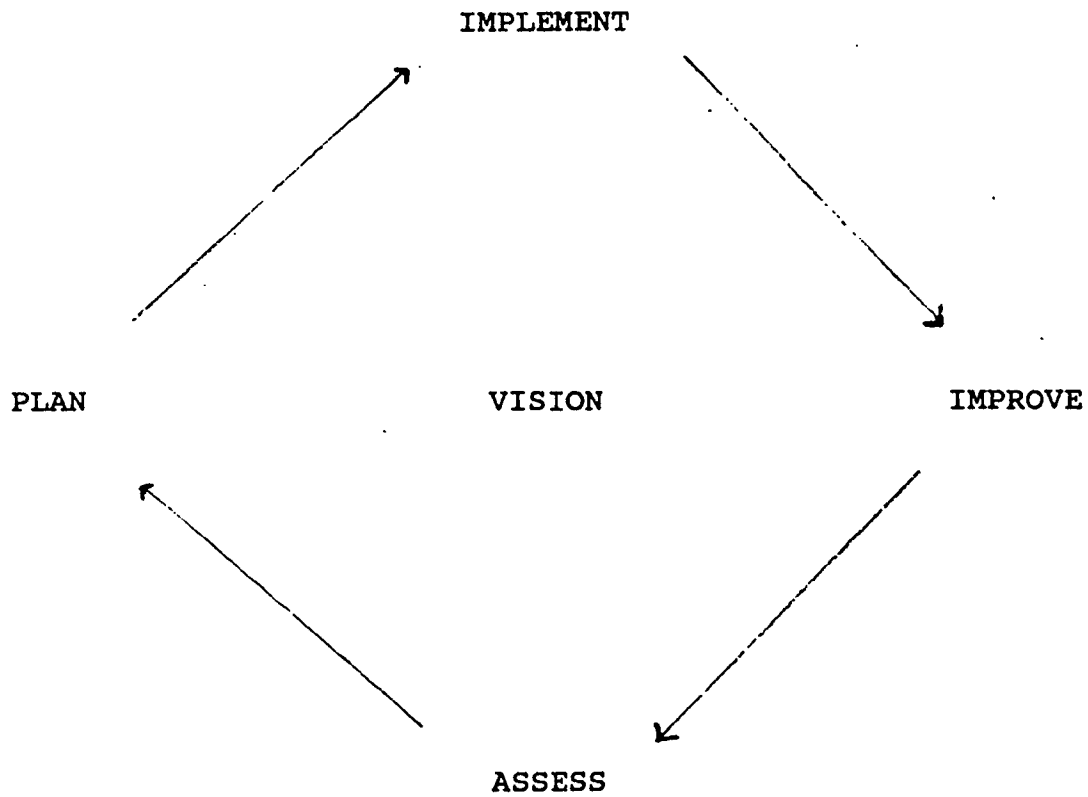
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MEC 29 371



AUBURN UNIVERSITY COLLEGE OF ENGINEERING

CONTINUOUS IMPROVEMENT MODEL

The focus of this research is on assessment aimed at student retention as well as on quality improvement throughout the higher educational experience.

## ASSESSMENT AIMED AT STUDENT RETENTION

### Objectives

Specific program objectives are to predict which students are at risk of failure and to develop intervention strategies that will reduce failure of at-risk students.

### Data Base

The data base is from an ongoing longitudinal study of student retention in engineering beginning with data from 1991. Included to date are students entering Auburn University as pre-engineers fall, 1991 ( $N = 837$ ); fall, 1993 ( $N = 547$ ); fall, 1994 ( $N = 531$ ); and fall, 1995 ( $N = 590$ ).

### Sources of Data

Sources of data were achievement tests, high school transcripts, the Myers-Briggs Personality Type Indicator, the College Student Inventory, Group Embedded Figures Test, College Freshman Survey, college grade reports, and an exit questionnaire.

### Preliminary Results of Assessment Aimed at Student Retention

1. Of the 837 students who began as freshmen in the pre-engineering program in 1991, only 53.6% successfully made the transition to engineering. Furthermore, there were 91 black students in the pre-engineering group, and only 33% (30) students made the transition to engineering. Hence, one must conclude that the attrition of students in engineering is quite high, but the attrition of black students is much higher than that of their white counterparts.
2. In general, there is a direct correlation between ACT scores and grades students received in a particular course. For example, the mean ACT composite score for the 29 students from the 1991 freshman class who received an F in Computer Science was 21.8, while the mean score for the 84 students who received an A was 27.6. A similar relationship holds for the mean ACT math score.

3. There appears to be a strong correlation between ACT scores and successful completion of the pre-engineering program. The correlation coefficient for the ACT composite score was .34. For the ACT math score, it was .38. The mean ACT composite score for students who successfully completed the pre-engineering program was 26.27, and the mean ACT math score was 26.45.
4. Comparing the total number of 1991 freshman students with an ACT composite score greater than or equal to a particular value with the number of students who successfully completed the pre-engineering program shows that almost 71% of the students who entered with a score of 27 successfully completed the pre-engineering program, while only 60% of the students who entered with a score of 24 were successful.
5. The impact of raising the minimum ACT composite score for admission to pre-engineering would have a devastating effect on minority students. Data for the 1991 pre-engineering students indicate that the mean for white students was 25.6 and the mean for black students was 21.8. The score distribution was such that 86% of the white students had ACT composite scores higher than the 21.8 mean value for black students while only 14% of the white students had scores lower than the 21.8 mean. These data suggest that academic potential may be one factor which must be considered when seeking solutions to the problem of high attrition for black students in engineering.
6. To determine if factors other than academic potential contribute to the retention problem of black students in pre-engineering, black students and white students were matched on the basis of ACT composite scores using a random number generator to select the white students. Eighty-one students in each respective group were compared. Almost 46% of the white students successfully completed pre-engineering while only 33% of the black students successfully completed pre-engineering. Hence, it must be concluded that factors other than academic potential, as measured by the students' performance on the ACT, play a role in determining if black students will be able to complete pre-engineering successfully.

7. A very strong relationship (correlation coefficient of .55) existed between first quarter GPA and successful completion of the pre-engineering program. For the 1991 pre-engineering students, the mean GPA for those admitted to engineering was 3.0, while that for students not admitted because of grades was 1.89. The mean first quarter GPA for those students not admitted to engineering but with overall GPAs equal to/greater than 2.2 was 2.0. Hence, it appears that there is little difference in the overall grades of students not admitted to engineering with grades less than 2.2 and those not admitted with grades equal to/greater than 2.2.
8. The eight pre-engineering courses with the lowest mean grade which had enrollments of 100 students or more were Chemistry 102, Chemistry 101, Physics 220, History 101, Chemistry 104, History 102, Chemistry 103, and Math 160. The mean grade for these courses ranged from a low of 1.5 for Chemistry 102 to a high of 2.2 for Math 160. In all of these courses, white students performed better than black students. Because of the diverse nature of these courses, these findings suggest that bridge or academic assistance programs limited to math and science courses might be too narrow an approach for effective intervention.
9. For the 1993 pre-engineering student group as a whole, strong correlations were found between ACT composite scores and first and second quarter GPAs and also between ACT math scores and first and second quarter GPAs. The correlations were also quite strong when the students were classified on the basis of sex. When the 1993 students were classified on the basis of race, very strong correlations were observed for white students, but the correlations did not hold for the black students. For example, the correlation coefficient for the relationship between first quarter GPAs for white students and their ACT math scores was .53. However, for black students the coefficient value dropped to .06.

Care should be taken in comparing the correlations for the different racial groups because only 33 black students were included in the 1993 data base. When data from the 1991 freshman class which contained 91 black students were analyzed, the correlation coefficient for the relationship between first quarter GPA and ACT math score was .42.

10. Except for the Thinking/Feeling preference scale on the Myers-Briggs Type Indicator, the 1993 pre-engineering students were fairly equally divided relative to their preference on each MBTI preference scale. For the Thinking/Feeling preference scale, approximately 64% of the students were classified as thinking while 36% were classified as feeling.
11. Attempts to correlate the first and second quarter GPAs for the 1993 pre-engineering students as a group with the MBTI preference scales were, in general, unsuccessful. The strongest correlation observed was  $-.14$  between the second quarter GPA and the Perceiving/Judging scale. However, when the correlations were computed for males and females and for different racial groups, a number of fairly strong relationships were seen.

For female students the correlation was  $-.21$  between second quarter GPA and the Extraversion/Introversion scale and  $-.24$  between second quarter GPA and the Perceiving/Judging scale. No correlation this strong was found for male students. The strongest relationship noted for this group was  $-.11$  between second quarter GPA and the Thinking/Feeling scale.

For black students the strongest relationships were noted between first quarter GPA and the Extraversion/Introversion scale ( $r = -.20$ ) and between first quarter GPA and the Thinking/Feeling scale ( $r = .23$ ). The strongest relationship noted for white students was between second quarter GPA and the Perceiving/Judging scale ( $r = -.12$ ).

12. Correlations for the Group Embedded Figures Test administered to the 1993 pre-engineering students and first and second quarter GPAs were  $.11$  and  $.10$  respectively.
13. A number of strong correlations were observed between responses to questions on the College Student Inventory and first and second quarter GPAs. The strongest relationships were observed for the predicted academic difficulty scale ( $r = -.34$  and  $-.31$  respectively), the student's assessment of his/her high school performance ( $r = -.44$  and  $-.48$  respectively), and the student's assessment of his/her composite score on the ACT ( $r = .41$  and  $.34$  respectively).

14. Multiple regression analysis showed a strong relationship (regression coefficient of .61) between first quarter GPA and ACT math scores, self-reported high school grades, the study habits scale of the CSI, scores on the Group Embedded Figures Test, the highest educational level of the student's father, and the student's self-rating of his/her academic preparation.

A similar analysis for the second quarter GPA (regression coefficient of .57) showed the important independent variables to be ACT math scores, self-reported high school grades, scores on the study habits scale of the CSI, and the highest educational level of the student's mother.

15. Black/white comparisons on the overall grade index from the high school transcripts of 1991 freshmen pre-engineering students revealed no significant differences. According to these high school transcript data for the freshmen pre-engineering students in the fall of 1991, the blacks made grades as good as those of the whites in high school.
16. There were no significant differences in the amount of time persisters and dropouts from engineering spent in class, studying, watching television, or working at a place of employment. Persisters did tend to spend more time in nonacademic university activities (e.g., fraternity/sorority, intramural sports, clubs, band, etc.).
17. Regarding ratings of instruction in mathematics, science, and other courses, students tended to see their professors as being organized, genuinely interested in teaching, and willing to help students individually. Mean composite ratings across nine items by persisters and dropouts were not significantly different for mathematics and science courses, but the composite mean rating by dropouts of other courses was significantly higher than that by persisters.
18. When dropouts were asked what they had liked while in engineering, 16.13% of the blacks as compared to 4.48% of the whites indicated that they liked the help or tutoring available. A higher percentage of whites (17.24%) indicated that they liked math than was true for the blacks (12.90%). Also worthy of attention is the discrepancy in the percentages of whites (15.52%) and blacks (9.68%) who cited concern and attention demonstrated by faculty and counselors as something they liked.



19. When dropouts were asked what they had not liked while in engineering, the percentage of blacks (25.81%) who indicated that they did not like mathematics was substantially higher than the percentage of whites (14.48%). Also a much higher percentage of blacks (22.58%) than of whites (13.79%) indicated that they disliked physics.
20. Poor grades were given as the reason for leaving engineering by an overwhelming percentage of the black students (41.94% as compared to 23.79% of the white students). Other reasons for leaving engineering cited by a number of the black students were that they preferred another major (25.81%), did not like engineering or lost interest (16.13%), or had problems with specific courses (12.90%).

## QUALITY IMPROVEMENT

### College Goal

The initial goal was to develop a means for defining and assessing quality as it relates to instructional, research, and outreach programs. A subsequent goal is to employ results to guide continuous quality improvement in the College of Engineering.

### General Process

In October of 1993, the College of Engineering began to investigate how to integrate the philosophy of continuous quality improvement into its instructional program. A Quality Standards Committee was formed. One of their early undertakings was to determine how well those constituents who derive a benefit or advantage from an activity or process carried out under the auspices of the College of Engineering feel that their needs are being met.

### Constituents

Constituent groups were students (both undergraduate and graduate), faculty, industry, and alumni. Initial data collections were limited to these groups.

### Sources of Data

Each constituent group provided data via questionnaires or telephone interviews. Students and faculty were asked to judge which attributes were important to the quality of engineering programs and at what level their expectations were being met relative to implementing each attribute. Alumni were asked to provide information on the importance of instructional program attributes and how well their expectations were met for those attributes. Business and industry representatives were asked to be sources of information on important attributes for program graduates as well as for information on employment. Results from the survey of undergraduate students, graduate students, and faculty in the College of Engineering are being reported here.

### Student/Faculty Results Related to Quality Improvement

1. The most important attribute identified by each group was different. The undergraduate students consider "a curriculum that prepares one to pass professional licensure examinations" to be the most important attribute of the instructional program. Graduate students consider "support for graduate teaching and research assistantships" to be the most important attribute, while the faculty consider "engineering accreditation" to be the most important attribute.

2. A significant difference of opinion exists between the undergraduate students and the faculty relative to the importance of a curriculum that prepares one to pass professional licensure examinations. The undergraduate students consider this attribute to be the most important of the instructional program while the faculty place it in the bottom third of their attribute list relative to importance.
3. All groups consider engineering accreditation to be a very important attribute. The faculty rate this attribute as the most important. The undergraduate students rate it as the second most important, while the graduate students rate it as the fifth most important. All three ratings are in the top third of each respective attribute list relative to importance.
4. Financial support is, in general, an important issue for all groups of respondents. Every attribute listed in the Financial Support category for undergraduate students and graduate students is rated in the top one third of all attributes for importance. Four of the six attributes in the Financial Support category of the faculty survey are also rated in the top one third of all attributes for importance.
5. Employment after graduation is an important concern for all groups of respondents. "Graduates who are sought by potential employers" is rated the third most important attribute by the faculty and graduate students and the eleventh most important attribute by undergraduate students.
6. Group working experiences do not appear to be highly valued by any of the respondent groups. The undergraduate students place only two of the five attributes listed in this category within the top one third of all attributes for importance. Graduate students place only one of the four attributes listed in the Group Working Experience category in the top one third of their attributes list, while the faculty place none of the three attributes in this category in the top one third of their attributes list.

7. The two attribute categories which are valued the least by the respondent groups are Flexible/Relevant Curriculum, and Satisfying Campus Experience. The undergraduate students and the graduate students rate no attribute in either category at an importance level that would place it in the top one third of the attribute list for importance. The faculty rate one attribute in each category high enough to be in the top one third of the attribute list for importance. These attributes are "courses which are designed to develop students' oral and written communication skills" (rated number 10) for the Flexible/Relevant Curriculum category and "safe campus environment" (rated number 2) for the Satisfying Campus Experience category.
8. Undergraduate students rate the attribute, "courses which are designed to develop students' oral and written communication skills," next to last in their attribute list for importance.
9. Neither the faculty nor the undergraduate students seem to consider that a co-op experience is of high value. Undergraduate students rate the attribute, "opportunity for co-op experience," 28th in their attribute list for importance, while the faculty rate it 23rd.
10. The graduate students do not seem to be particularly motivated to pursue a career in academia. They rate the attribute, "a curriculum that prepares one for a position in academia," 41st in their attribute list for importance.
11. Faculty do not appear to feel that it is important to place additional emphasis on the instructional program. The following attributes were rated so they fell in either the middle or lower one third of the attribute list relative to importance:
  - "Outstanding teaching given the same weight as outstanding research in tenure, promotion, and salary adjustment deliberations."
  - "Faculty teaching awards available to reward outstanding instruction."
  - "Research and publishing in the teaching area given the same consideration as similar activities in other areas."
  - "Internationally recognized teaching faculty."