Engineering Students’ Perceptions of their Educational Experiences: the Effects of Gender within Minority Membership

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ABSTRACT

In Fall 1998 and 1999, pre and post student perception surveys, as well as student interviews were employed, at TX A&M University, as part of a multi-threaded plan to evaluate the impact of pedagogical and curricular course revisions upon the educational experiences of freshman and sophomore Engineering students. With the intention of informing faculty and administrators who design, modify and implement curriculum, and instructional delivery, students surveyed were those enrolled in the freshman engineering program in Fall of 1998, and those enrolled in three of the first sophomore engineering course in the Fall of 1999. These data were supplemented by collation of all results with longitudinal student data, in order to provide us with information about students’ demographics and past academic experience helpful for interpreting student perceptions. This paper will present the results of perception surveys, and individual interviews in relation to differential perceptions of the educational experiences reported by women and minority students.

INTRODUCTION

The Dwight Look College of Engineering, at Texas A&M University, strives to provide a learning environment conducive to the success of ALL engineering students. Some of the means by which the College attempts to achieve inclusiveness, along with excellence, is through the implementation of numerous innovative, student centered educational strategies, consciously designed to consider the diversity of orientations and conditionings which its large and diverse student body brings to the challenges of learning in the university environment. These educational strategies include pedagogical methods and curricular structures to facilitate active and collaborative learning, through both individual and team assignments; integrated, multi-disciplinary curricula integrally employing technology; and clustering of most freshmen and some sophomore students in learning communities in which students take two more of their required engineering program courses together.

Many of these innovative educational strategies were developed and tested, at the freshman and sophomore level in the College of Engineering (COE) at TAMU, between the 1994 and 1997 academic years, through the Foundation Coalition (FC) pilot program, which involved 100 - 200 students each year. In Fall of 1998, the COE officially institutionalized most of the FC pilot program features throughout the freshman year (directly impacting almost 2000 or the 2400 freshmen), and actively encouraged the adoption of many FC features in the core of sophomore courses common to most engineering major programs. In the 1999 academic year, these innovations have persisted, improved, and deepened in the freshman and sophomore programs, and have spread further into sophomore and upper division.

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courses, providing much greater opportunity for impact upon the educational experiences of an ever growing number of students.

The sampling of student perceptions assists educators in viewing the educational experience from the perspective of the consumer. It assists in assessing the degree to which that which was intended was perceived as intended, and why it may or may not have had the effect, which was intended. Students' perceptions and attitudes may also provide insight into fundamental individual, and group differences which are not captured in institutional information databases, or in course grades. These were some of the reasons why we wished to sample student perceptions of their experiences in the freshman year and in the first sophomore courses of the engineering program.

In any study of student perceptions, many factors should be considered, and two of these that are often associated with extreme differences in perceptions are gender and ethnicity. Female and male students have been noted to have different classroom experiences. So it is logical to believe that their perceptions of the classroom, including level of expectation, and active learning and teaming, would be different based on their experiences. It is clear that groups of students enter college with variations of (1) social relational skills, values, and characteristics, (2) information-processing orientations and skills, (3) communication patterns, (4) learning styles and strategies, (5) motivational styles, and (6) psychological characteristics. (Anderson and Adams, 1992) What is not known clearly is if the stylistic differences in learning between groups are so pronounced to make clear distinctions among groups, and moreover what type of effect they have on student’s perceptions in the classroom.

**METHODOLOGY**

The information discussed in this study came from the following sources: (1) pre- and post-perception survey of 1998 freshman in their first engineering course -- ENGR 111; (2) pre- and post-student perception surveys for Fall 1999 students in their first two sophomore level engineering courses -- ENGR 211/212. The first perception survey was created, in Fall 1998, for freshmen entering their first institutionalized FC-like program of courses, by a program administrator (J. Rinehart) attempting to establish a baseline on perceptions related to freshman student retention. The instrument contained items “borrowed” from a freshman instrument employed at another university, as well as questions of specific concern to the Engineering Academic Program Office, including self perception and valuation in relation to peers; perception of the quality of relevant preparation received in high school; perceptions of learning and study styles and skills; and orientation toward individual and group work.

All other perception surveys, including those specifically designed for sophomores, were all modeled on that first freshman perception instrument in order to maintain some consistency in tracking the evolution of certain student perceptions over time. Nevertheless, sophomore perception surveys were significantly modified to accommodate inquiries relevant to the particular experiences which those students were expected to have had, and also to capture information of specific interest of instructors. Pre-surveys were administered in the first
weeks of the Fall semester, while post-surveys were administered in the final weeks of the Fall semester, with one exception: the sophomore, ENGR 211/212 pre-survey was used as a post-survey for comparison with the previous year's ENGR 111 survey responses. This was done because it was felt that the full impact of the freshman experience would have been felt and evaluated by students returning the following year to begin their sophomore Engineering program. We acknowledge the bias that this element of "selection" may introduce.

We characterize our inquiry and examination as a "qualitative" study because we have focused on gathering largely subjective information about the characteristics and qualities of students' educational experiences. In the process we have also gathered information with perception and attitude surveys which employ ordinal scales of agreement or endorsement. Although such scales have often been subjected to quantitative analysis, simply because, at face value, the numerical scales resemble interval metrics, they are, at best, very individually subjective and relative measurement devices, whose data, in the opinion of some experts, should only be treated as categorical (nominal) data.

In our attempts to uncover patterns of perceptions, we have organized and compared data primarily around gender and minority membership. We have also noted the relative intensity of assertion or degree of agreement whether expressed in open responses to interview questions or expressed by means of ordinal agreement scales. The anecdotal data recorded in interviews was categorized and sorted, assessed for level of intensity. Data sets were examined for response patterns in intensity and in percentages of students responding similarly to common dimensions across instruments within sample universes, then by gender, by ethnicity, and by subsets representing intersections between these grouping variables. These subsets and intersecting subsets were then subjected to same analysis applied to the aggregated universes. Acknowledging the underlying qualitative nature of our data, we have NOT resorted to statistical data reduction techniques, to statistical tests of association, or to the exclusion of differences noted through tests of statistical difference.

RESULTS

The results of all instruments combined reveal sufficient consistencies in overall student responses to yield interpretable and helpful information to program administrators and course instructors. However, below the surface of the aggregated results for sample universes, we begin to find some complexity in the patterns of responses by gender, and ethnicity. Student Perceptions differentiated by gender and by minority vs. non-minority membership in these data are interesting; nevertheless, if we "zoom in" closer and deeper, focusing upon interactions between gender and ethnicity, we discover the most complex and interesting results in our data set. We note that the perceptions of minority men and minority women compare with each other in as interesting a manner as they do with the perceptions of non minorities or with all other members of the same or opposite gender. We also note that the perceptions of minority men and women change between the freshman and the sophomore year. In the interest of brevity, for this paper, we will forgo

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any discussion of the universe results, or of perceptions and trends differentiated by only
gender or ethnicity. We will limit ourselves to data from the intersection of gender and
ethnicity. Fortunately, the student samples for the Fall 1998 ENGR111 perception pre-
survey (universe =1386; minority women =33; minority men=101) and the Fall 1999
ENGR211-212 perception pre & post surveys (universe=779; minority women=24;
minority men=61) had sufficient male and female minority representation to allow for the
detection of response patterns among the members of those groups.

Student gender within minority membership were observed to interact and to relate
to student perceptions in ways over time:

- At the beginning of the freshman year, more minority women were positive on
  questions relating to self esteem than any other group in the survey sample (Engr111)
- At the same time, fewer minority men were positive on questions relating to self
  esteem than any other group in the sample (Engr111)
- A year later, however, fewer minority women than non-minority women rated
  themselves positively on self esteem (Engr211-212)

- As new freshmen, minority women rated themselves positively on social self
  confidence more than any other group (Engr111)
- Whereas a year later, minority men rated themselves very positively on social self
  confidence far more than any other group (Engr211-212)
- And far fewer minority women rated themselves positively on social self confidence
  than any other group (Engr211-212)
- Somewhat consistently, fewer sophomore minority women than non-minority women
  rated themselves very positively on interpersonal skills (Engr211-212)

- As freshmen, more minority men rated themselves very positively on intellectual self
  confidence than any other groups (Engr111)
- And, encouragingly, more freshman minority women than non minority women rated
  themselves very positively on intellectual self confidence (Engr111)
- Yet, surprisingly, far fewer freshman minority women rated themselves positively on
  their ability to think critically than any other groups (Engr111)
- A year later sophomore minority men continued to rate themselves very positively on
  intellectual self confidence far more than any other group (Engr211-212)
- However, unfortunately, far fewer minority women rated themselves positively on
  intellectual self confidence than any other group (Engr211-212)

- As new freshmen, more minority men and women than non-minority women, and
  fewer minority men and women than non-minority men were positive about the
  contributions of their HS Science courses to their preparation for engineering (Engr111)
- As freshmen, fewer minority men were positive about the contributions of their HS
  math courses to their preparation for engineering than any other group (Engr111)
• Despite that fact, more freshman minority men rated themselves very positively on
math ability than any other group (Engr111)
• By the sophomore year, it was minority women who rated themselves positively on
math ability in greater percentage, than any other groups (Engr211-212)

• In early Fall of 1998, freshmen minority women rated themselves positively on their
ability to work cooperatively more than any other groups (Engr111)
• At the same time, minority women also rated themselves very positively on their
ability to work independently more than any other groups (Engr111)
• While fewer freshmen minority men rated themselves very positively on their ability to
work independently than any other group (Engr111)
• By their sophomore year more minority women still rated themselves positively on
their ability to work independently than any other group (Engr211-212)

• Many more new freshman minority men rated themselves very positively on their drive
to achieve than any other group in the sample universe (Engr111)
• While fewer new freshman minority women rated themselves positively on their drive
to achieve than any other groups (Engr111)

• More freshman minority women than non-minority women rated themselves somewhat
positive on competitiveness (Engr111)
• Yet fewer freshman minority men than non-minority men rated themselves as being
somewhat positive on competitiveness (Engr111)
• A year later, more sophomore minority women than non-minority women again rated
themselves slightly positive on competitiveness (Engr211-212)

• As new freshmen, fewer minority men were positive about their leadership abilities
than any other groups (Engr111)
• But, as new sophomores, more minority men rated themselves positively on leadership
than any other group (Engr211-212)
• In contrast, minority women rated themselves positively on leadership far less than any
other groups (Engr211-212)

CONCLUSIONS

The significance of the interrelated patterns of perceptions and development of those
perceptions over time and in relation to each other is not clear from the data. However the
existence of hidden, driving factors is suggested by the combinations of polar
relationships, position reversals, and logically inconsistent perceptions of seemingly
related concepts.

We have to wonder at the fact that minority males in our samples appear to exhibit notable
levels of intellectual self-confidence, when they retain at a much lower rate than other
groups. According to Seymour and Hewitt (1997)², many students of color were
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“shocked” when they realized that there capabilities were overestimated. They enter higher education under-prepared and over-confident in their abilities.

We are equally puzzled by the fact that minority women, who start out with self-confidence, but expressing reservations, appear to drop in their self-assessment of confidence and abilities by the sophomore year. This is in despite of the fact that, as a group they are both retained relatively well and perform well academically (particularly African American women). This loss of self-confidence may be a result of the abrupt withdrawal of familiar sources of praise, encouragement, and reassurance by teachers. (Seymour and Hewitt)²

We also wonder why minority men and women seem positioned at opposite extremes in relation to the sample universes, with regard to a number of educationally related self-perceptions. Again, we ask what causes men and women to exchange positions on some perceptions between the freshman and sophomore years.

Educated speculation about the interplay of underlying factors would require the very persistent and internally consistent collection of a wider scope of information over time. One suggestion is to launch a follow-along-study of a sample of minority men and women engineering students throughout the course of their college careers, in which students would be interviewed, and surveyed at least twice a semester every year using open ended instruments and protocols. Case-note documentation of contacts and methods, in conjunction with collateral data tracking should complete the set of rich data from which more answers could be mined.

REFERENCES
