J. COLLEGE STUDENT RETENTION, Vol. 3(4) 351-364, 2001-2002

RETAINING BLACK STUDENTS IN ENGINEERING: DO MINORITY PROGRAMS HAVE A LONGITUDINAL IMPACT?

JENNIFER GOOD

GLENNELLE HALPIN

GERALD HALPIN

Auburn University

ABSTRACT

In an effort to assist minority populations who are at risk of attrition in science, mathematics, and engineering programs, university administrators have launched and evaluated minority support programs. One such program implementation and evaluation was completed and reported, which noted trends in academic outcomes of program participants, such as grade point averages and standardized mathematics and science reasoning test scores, with participants' outcomes observably exceeding those of a similar sample of nonprogram participants (Good, Halpin, & Halpin, 1999). As is true with many program evaluations, however, this data only revealed information concerning achievement of the students in the freshman year and did not follow the students' success into subsequent years after program completion. Therefore, the purpose of this study was to examine if an effect on academic achievement occurred throughout the participants' sophomore years of study and if participants in the program were more likely to remain within the College of Engineering as a result of program involvement. The data source for this study was 58 African-American students enrolled in a pre-engineering program at a large land-grant university (34 volunteer program participants and a comparison group of 24). Quarter grade point averages and retention status were collected for both groups throughout their sophomore years. In addition, 12 of these students (six per group) were interviewed concerning

their freshman year pre-engineering experiences. Results of this study indicate that, although benefits to academic achievement due to academic support encountered during the freshman year may possibly diminish over time, the effects of engaging in such programs on actual retention remain of significant interest to program administrators and researchers.

The problem of attrition exists in quantitatively-oriented fields and continues to develop as the diversity of the student population of universities increases. Gainen (1995) reported that the greatest attrition among collegiate students occurred between the freshman and sophomore years of study with students who chose to major in science, mathematics, or engineering (S. M. E.). In addition, "among students of color, attrition is much higher" (p. 5) than among White students. In their landmark study, Seymour and Hewitt (1997) explained that "65 percent of students of color entering science or mathematics left their major, compared to 37 percent of white students" (p. 319), and according to their extensive review of the literature, "the question of why students from particular racial or ethnic groups have higher S. M. E. attrition rates than white students has not been satisfactorily answered" (p. 320). What causes this attrition, and how can it be addressed at the university level?

Researchers (MacGuire & Halpin, 1995; McNairy, 1996; Seymour & Hewitt, 1997; White & Shelley, 1996) suggest that some commonalities in experiences exist among African-American students, causing detrimental rates of attrition for this particular population. For instance, McNairy (1996) and Seymour and Hewitt (1997) cite a lack of adequate high school preparation as a deterrent in university science and math programs. White and Shelley (1996) noted that Black students craved a sense of belonging on predominantly White university campuses and stated that often "the ability to identify, create, and maintain supportive learning communities" (p. 32) presented difficulty. Tang (2000) stated that "Blacks are less inclined to enter engineering because of inadequate encouragement and institutional support" (p. 35). Thus, it appears that a combination of cognitive factors, such as inadequate high school preparation and lack of study skills, and noncognitive factors, such as lack of community and identity on college campuses, exacerbate the attrition problem for African-American students.

In order to retain African-American students, administrators in higher education should first consider the academic needs and expectations of these students and then make adjustments at the institutional level in order to meet those needs (Landis, 1995; Wharton, 1992). Administrators in higher education have initiated numerous support programs to foster academic success and encourage a sense of community among African-American students in hopes of retaining them in quantitative majors. Although minority retention programs varied, peer interaction seemed to be a key component in assisting students both cognitively and noncognitively. Three successful minority retention programs described by Carreathers et al. (1996) used peer facilitators in some aspect of the program because "students of

color lack peers, faculty role models and mentors" (Seymour & Hewitt, 1997, p. 320). Although many minority engineering programs share common features, "they do not always share common successes" (Torres, 2000, p. 219).

As much as the programs varied, so too did the methods of program evaluation. Giordano (1996) emphasized the importance of varied methods of data collection and formative, ongoing methods of evaluation when completing program evaluations regarding minority retention. Unfortunately, few programs follow the progress of participants' longitudinally to assess if newly acquired skills continue to transfer into future academic careers and coursework. Numerous researchers (Popham, 1993; Posavac & Carey, 1992; Worthen, Sanders, & Fitzpatrick, 1997) stressed the importance of finding appropriate criteria and objectives as an essential aspect of effective evaluation. Thus, when evaluating retention programs, actual retention outcomes should be a central concern of the program evaluation.

In the fall of 1997, a minority engineering program (MEP) was created which considered both the cognitive and noncognitive needs of African-American students. This particular program was comprised of three components designed to help the freshman pre-engineering students meet the demands of science, mathematics, and engineering courses of study: 2-hour tutorial sessions held on Sunday evenings with a weekly dinner, a weekly critical thinking workshop series, and an interactive learning laboratory which students visited for three 1-hour sessions per week. Each student was assigned a mentor, an upperclass division African-American student majoring in engineering, and members of the mentoring staff were available at all program activities. Participants remained in the program throughout their entire freshman years.

An initial evaluation of the program, completed after the first year of program administration, suggested that student achievement was affected by program involvement. Because of the small sample size, the program evaluators analyzed trends in the data, realizing that tests of statistical significance would be inappropriate. Thus, although not significantly different, participants in the program earned observably higher first quarter grade point averages than nonparticipants ($M = 2.53$ as opposed to 2.26). In addition, program participants significantly increased standardized tests in mathematics ($M = 57.41$ to 59.71) and scientific reasoning ($M =$ 57.73 to 59.36) from pre- to postintervention. Also, the first quarter grade point averages of students involved in the program exceeded those of their peers in earlier years of study prior to the program's existence (Good, Halpin, & Halpin, 1999). The data regarding various outcomes appeared to be casting in the same positive direction. Although these findings were promising, they were too preliminary to be conclusive. They did not track actual retention status throughout the students' pre-engineering years until they matriculated into the College of Engineering as upperclassmen.

Because a program evaluation yielded positive results on its first implementation, can it be assumed that similar achievement trends will continue for program

participants after completing the program? In other words, will the benefits of the program transfer to future years of study and continue to impact grade point averages even after program involvement has ceased? According to Fletcher (1998), first quarter grade point averages are powerful predictors of student success and retention. Therefore, can educators infer that the initial benefit to grade point averages experienced by participants involved in an academic support program will carry over into future quarters and, more important, will this initial bolstering of academic achievement truly have an impact on program retention? Few program evaluations continue to track student achievement after the participants have left a program.

Thus, the purpose of this study was to complete a longitudinal evaluation of this minority engineering program, tracking the retention status of these African-American students as they progressed through their pre-engineering courses of study. Specifically, this report examined if the effect on academic achievement experienced by these students in their first quarters of study continued throughout the participants' sophomore years of study, and if participants in the program were more likely to remain within the College of Engineering than nonparticipants as a result of program involvement. In addition, follow-up interviews of a sample of these students were conducted, which explored potential issues to help understand better why some African-American students continue to pursue an education in engineering and why some do not do so.

PROCEDURES AND ANALYSIS DESIGN

The institutional setting for this study is a large land-grant university in the Southeast. The university enrolls over 20,000 students and houses 12 different colleges, including colleges such as engineering, pharmacy, sciences, and mathematics. Because of an interest in the success of African-American students in quantitative majors, the College of Engineering supported and housed this particular academic support program, which included voluntary involvement in critical thinking workshops, use of mathematic and scientific interactive software, and tutoring sessions.

Participants in this study were 58 African-American students. While 24 of these students opted not to participate in the minority engineering program, the remaining 34 volunteered to take part in the program, making a comparison of similar groups possible. As mentioned earlier, these 34 students were involved in various aspects of the program (critical-thinking workshops, an interactive learning laboratory, or Sunday-evening tutorials) throughout their freshman year of study. With the exception of a few students who returned to the program as upperclass mentors, program involvement ceased for all students in their sophomore years of study.

After students completed their sophomore years of study, quarter and cumulative grade point averages were collected. Program status at the end of the sophomore

year was also monitored and recorded into one of three categories: students remaining in the College of Engineering; students leaving the engineering program or the university in poor academic standing (grade point averages < 2.2); and students leaving the engineering program or university in good academic standing (grade point averages > 2.20). To determine if academic achievement and retention differed in the two groups, mean grade point averages throughout the sophomore year of study were compared using *t*-tests. Cross tabulations to determine the effect of participation in the minority engineering program on status and retention in the College of Engineering were also completed, yielding contingency coefficients as indicators of significance.

In addition, in order to add a qualitative depth to the study, 12 students were selected to complete interviews regarding the students' pre-engineering experiences and choices of major. Using a semi-structured interview protocol, an interviewer solicited responses from one male and one female representative for each of the three categories of program status described earlier (see Appendix). Thus, six program participants and six nonparticipants from each of the three program status categories were interviewed. When all twelve interviews were completed, the interviewees' responses were transcribed, and a content analysis of the responses was completed for each question. The thematic responses were placed in a large grid per individual and question, and the themes were analyzed by gender, participation in the program, and retention status in order to determine if particular patterns occurred for these various groupings.

RESULTS

Grade Outcomes

One of the objectives of the minority engineering program (MEP) is for the participants to have a stronger comprehension of mathematics, science reasoning, and critical thinking skills which will help them to succeed in their programs of study. Inasmuch as the program is designed for mutual reinforcement of the concepts being taught in these different domains, the goal was to increase student understanding within the various domains which might be reflected in grades. Even though the students were no longer involved in the minority engineering program, it was the hope of the program administrators that the skills taught and acquired by participants in their freshman years would help to bolster grades throughout participants' future academic careers. Table 1 indicates the mean quarter and cumulative grade point averages for participants and nonparticipants throughout their sophomore year of study.

As apparent from Table 1, no pattern of mean grade point averages emerged for participants as opposed to nonparticipants. Whereas the mean grade point averages for the participants exceeded those of the nonparticipants during the spring quarter, the mean grade point average for the nonparticipants was higher

Table 1. Means of Quarter and Cumulative Grade Point Averages for African-American Pre-Engineering Students during the Sophomore Year of Study

Group	Fall quarter	Winter quarter	Spring quarter	Cumulative
Participants	2.31	2.43	2.44	2.45
Nonparticipants	2.31	2.59	2.35	2.23

during the winter quarter, and even though the mean cumulative grade point average appears to be higher for the participants, a series of *t* tests revealed that no significant differences existed on any of these variables. Thus, these data suggested that no clear impact of the minority engineering program on academic outcomes, such as quarter grades, occurred after program completion. In other words, the effect of the academic support program on grades could possibly be dependent upon current and constant program involvement. Possibly, the constant probing, questioning, and interacting in the tutoring sessions, workshops, and interactive learning laboratory more readily transferred into current courses, but once the interaction ceased, the effect and transfer to coursework ceased as well.

Retention Outcomes

The practical intent of the minority engineering program is to retain students within the College of Engineering by providing them with essential skills which will help them to succeed in their chosen major. If this important objective is achieved, then differences in retention patterns should be apparent for the participants as opposed to the nonparticipants. The students were placed into one of three groups: those who remained within the College of Engineering, those who left engineering (or the university) due to poor academic records, and those who left engineering (or the university) in spite of strong academic standings. Because a grade point average of 2.20 is required for admission into the College of Engineering, this cut-off was used to determine academic standing. Table 2 provides the retention rates at the end of the students' sophomore years of studies by program participants and nonparticipants.

The retention patterns for the two groups were obviously different. Whereas over three-quarters of the program participants remained within the College of Engineering, less than half of the nonparticipants remained. Twenty-four percent more of the nonparticipants left for academic reasons, with grade point averages less than 2.2, with 14 percent more of the nonparticipants also opting to leave in spite of their strong academic standing. A contingency coefficient of .374 indicated that this significance was different at the .01 level. Thus, participation in the minority engineering program appears to have a significant impact on decisions

Table 2. Program Status and Retention Rates for Black Students within the College of Engineering

	Status		
	Engineering	Left (GPA < 2.2)	Left (GPA > 2.2)
Participants	26 (76%)	3 (9%)	5 (15%)
Nonparticipants	9 (38%)	8 (33%)	7 (29%)

concerning retention within the College of Engineering, the primary thrust of the program and an essential outcome for consideration when evaluating the program.

Interview Responses

Because the retention status of the students participating in the Minority Engineering Program fared notably better than the non-participating comparison group, logical conjectures regarding reasons for this difference needed to be pursued. Possibly, participation in the Minority Engineering Program alone could have accounted for this difference; however, it seemed more reasonable to consider and explore some of the varied factors that students, both MEP participants and nonparticipants, experienced during their pre-engineering years that could have affected their decision to remain in or switch out of their selected courses of study. In order to determine what factors may have impacted Black students regarding their choices of major as engineers, a sampling of twelve students, representing equal numbers of males and females, as well as MEP participants and nonparticipants, were interviewed.

Regarding commitment to engineering and reasons for pursuing engineering, all but one of the interviewees indicated that they were highly or extremely committed to becoming engineers. Their reasons for pursuing engineering varied across the twelve students; however, a clear pattern emerged differentiating the stayers from the switchers. The participants who opted to remain in engineering were familiar with the profession, due to actual exposure to the engineering profession through parents or family friends. In contrast, the switching students admitted to having little knowledge of the engineering profession prior to pursuing the major. Over half of the switchers pursued engineering simply because they were good in mathematics and science. For instance, one individual stated the following: "You know when you are in high school and you don't really know what you want to do? Well, I did engineering because I knew I liked math and science, and I knew it was a good career." Similarly, another student stated that he "really didn't know that much about what actual engineers did." Instead, he "liked the idea of being an engineer." Prior knowledge of the profession and opportunities to

talk with engineers appeared to be a factor that differentiated between stayers and switchers, regardless of MEP involvement.

All 12 interviewees experienced some form of academic difficulty during their pre-engineering course of studies, and all 12 interviewees contemplated leaving the pre-engineering major during their freshman years. However, the way the students approached the difficulty at that particular juncture in the program varied, again, by stayers and switchers. Whereas the stayers were determined to get through the program in spite of the academic challenge, the switchers simply tended to leave the program rather than face academic failure. For instance, one of the stayers explained that she decided to remain in engineering for the following reason:

> Because I have a lot of classes already under my belt. I don't want to lose all my credits and start over again. The hardest part I think is like some of the core classes, the physics, and the math, and like the early engineering classes, but after that, I think it gets easier.

Another participant stated that he decided to remain in engineering, in spite of some poor grades early in his academic career, because he had "put so much time working to it." In general, the students who opted to remain in engineering all described an investment to the program once they had survived the initial academic adjustment. In contrast, the switching student cited specific courses and course grades as the primary reason for leaving the pre-engineering program. For instance, one of the switching students stated the following: "After my first quarter, my grades fell substantially, so I went to an easier major." Simply stated, the switching students had not accepted the possibility that the adjustment to the engineering major may coincide with an acceptance of lower grades than they had maintained in high school. As a result, the switchers simply changed majors while the stayers persevered. Again, participation in the Minority Engineering Program did not appear to be a factor when considering the thematic patterns that emerged for these responses.

When asked about involvement in academic support programs, an interesting pattern emerged, this time surrounding the MEP participants versus the nonparticipants. The students who volunteered to participate in the MEP also pursued an average of three additional academic support programs during their pre-engineering courses of study. In contrast, the non-MEP participants did not seek as much outside help through university support programs. Half of the non-MEP students sought help from only one support program, while the other half of the non-MEP students did not pursue any form of academic assistance at all. Although all six of the participants described the MEP as more helpful than the other programs around the campus, this finding still suggested that students who are willing to volunteer to participate in the MEP share a willingness to seek other forms of help as well. Similarly, when asked about support systems, the MEP participants cited a number and variety of systems on which they relied regularly, including parents, mentors, roommates, friends, and classmates; in contrast, the non-MEP participants

were more solitary, stating that they relied on either no one or one hometown friend. Essentially, the MEP students appear to reach out to others for assistance more readily. Thus, possibly the findings regarding retention could be clouded by the impact of other academic support programs and systems in addition to the MEP.

One of the most illuminating findings regarding the potential impact of the MEP on students revolves around the students' sense of connectedness to the engineering community during their pre-engineering programs. Whereas four of the six (66 percent) MEP participants stated that they felt as though they belonged to the engineering community, all six of the non-MEP participants stated that they felt disconnected to the engineering community. For instance, when asked if they felt they were part of the engineering community during their freshman year, one student stated the following: "Yeah, well, sort of because I was in the Minority Engineering Program, and I was surrounded by engineers." Another student responded similarly: "In the MEP I did, because there are people like me, pursuing the same goals." And another student stated the following:

> Yeah, I did, I did, I did because, I really did, mainly because I was in MEP, and the majority of the minority students who come here are in engineering, so, you know, I felt like I was part of engineering. I felt like I fit in, just because I was around all the other students like me, you know?

Whereas all of the MEP nonparticipants felt disconnected, the MEP participants actually felt as though they were part of the engineering community as early as their freshman year, and interestingly, they all volunteered the MEP program as the single factor that made them feel as though they belonged.

Regarding work and study habits, a primary emphasis of the Minority Engineering Program, all 12 of the interviewees felt as though they were not academically prepared when they first entered the university, and 11 of the twelve students (92 percent) indicated that they improved their study habits during their freshman and sophomore year out of necessity to survive academically. No single program or method was cited above others by the students as helping them to improve their study skills at the university.

When asked to compare the pre-engineering courses with other core courses outside of the engineering field, the responses varied per stayers and switchers. All but one of the interviewees stated that the engineering courses were more difficult than non-engineering courses. Specifically, students described the courses as more time-consuming, more demanding, and more open-ended without clear resolutions on problems. In spite of this, the stayers described the engineering courses as more meaningful and practical to them than other core courses, particularly the upper level courses within their majors. In contrast, the switchers described the courses outside of engineering as more meaningful. Again, no differentiation between MEP and non-MEP participants occurred regarding this question.

When asked about ethnicity, all but one of the twelve interviewees stated that ethnicity was not an issue within the engineering program. The only student who expressed any concern stated the following:

> It's hard. It's very difficult, but, like, the Minority Engineering Program, that helped a whole lot. I just don't know if I would still be in engineering without it. You know, just seeing other people like you in engineering. It's very encouraging.

Her statement was the exception. Otherwise, the other interviewees consistently stated that ethnicity was not a distinguishing factor within the pre-engineering program. For instance, one student stated the following: "I really don't think about it as being a minority. I just think about it as trying to be an engineer." Another student noted the following: "I was intimidated because this campus was so huge, not necessarily because I was a minority." When asked if students felt they were treated differently in the pre-engineering program because of their ethnicity, all 12 stated that they were not. For instance one student stated the following: "I don't think I was, especially academically. I don't think it mattered." Other students simply stated that there was "no difference" in their treatment compared to majority students.

In direct contrast to the question regarding ethnicity, every female felt that they had experienced some form of gender discrimination. When asked about being a female in the pre-engineering program, one student stated the following: "Oh man. I felt stupid in physics because all these guys were in there, and they would crack jokes and stuff like that. I felt pretty awkward in that situation." Similarly, when asked how it feels to be a female engineering major, another student replied:

> It's just like, in class you're picked on more, you're called on more, you're looked to more to try and answer questions than maybe the guy next to you, who they think knows it already or something like that, or they automatically think you're not going to do too well in this math course because, you know, you are a female.

And, one student noted that instructors "assumed she wouldn't succeed" because she was a female. Whereas five of the six females interviewed indicated that this was a discouraging issue to face within the pre-engineering program, the other interviewee stated that she accepted the gender difference as a direct challenge:

> I like being in a big society where there's a lot of males and very little females. I think it is so much fun. I mean it makes me reach higher. I guess it's expected for females to be a little lower than men, but when it comes to me, I want to be as high as they are.

Her attitude was unique; the other females experienced frustration due to the stereotypes placed upon them.

Finally, regarding pre-engineering experiences, the 12 students had varying suggestions for how to improve the program. Four of the MEP participants had no suggestions at all, while one of the MEP participants suggested expanding the mentoring program and one suggested a supplemental class that would introduce students to various disciplines in engineering. Three (50 percent) of the non-MEP students suggested that advisors needed to make more of an active effort to engage the students in the program in addition to offering both academic support and counseling. Other suggestions from the non-MEP students included setting math and science instructors up in teams that work with the same group of students, slowing the pace of instruction or offering more entry level courses, and offering an introductory course which exposes students to various adjustment issues within the engineering program.

Thus, when considering the various responses solicited through the interviews, it appeared as though the MEP has little impact on certain factors which tend to inhibit success during the freshman year. Instead, a clearer distinction arose between the stayers' and switchers' responses, rather than MEP participants' and nonparticipants' responses. However, some compelling evidence existed regarding the MEP participants' comfort with reaching out for additional assistance and the sense of belonging within the engineering community afforded though the MEP.

DISCUSSION

When considered holistically, some interesting findings can be addressed regarding the longitudinal data on this particular class of freshman pre-engineering students. Although the data regarding mean grade point averages appeared initially discouraging and disconcerting because of its observable decrease after program completion, the data regarding retention patterns was promising. Fletcher (1998) hypothesized that the first quarter of the freshman year is crucial to future success in academic careers, and specifically that first quarter grade point averages act as one of the best predictors of retention. If that is true, then the program participants had an academic advantage over the nonparticipants during the pivotal first quarter of instruction. In addition, Seymour and Hewitt (1997) asserted that Black students experience a sense of ethnic isolation when enrolling in science, mathematics, and engineering programs. Possibly, as suggested by the interview responses, involvement in the minority engineering program negates this sense of isolation. Seymour and Hewitt also stated that many students of color internalize stereotypes and in turn experience self-doubts and a lack of confidence (p. 361). As a result, these students are less likely to seek help. When the academic support program, however, is provided as a constant and natural part of their programs of study, then help is always available without fear or shame of asking questions or being labeled as remedial.

Important future research should attempt to create an evaluation method which quantitatively as well as qualitatively teases out the factors affecting longitudinal

retention patterns of Black students, and the relationship of these factors to academic support programs. As evident through this study, retention appears to be affected by program involvement; however, the importance of grades on retention appears to have diminished. What, then, is the cause of the improved retention rates for program participants and how does program involvement achieve this end? This study initially maintained the assumption that academic achievement was directly related to retention issues. Although this hypothesis could have merit, the results of this research seem to suggest that other factors have a greater impact on retention issues than merely academic achievement for Black students. Continued research into minority engineering programs and their effect on minority issues remains imperative:

> Although a significant body of descriptive work offers insight into field switching and stopping out versus dropping out–leaving higher education altogether–the institutional research has largely been short-term and problem-specific and has not addressed the broad spectrum of issues unique to minority students in rigorous science-based majors. (Denes, 2000, p. 317)

White and Shelley (1996) asserted that an "ability to identify, create, and maintain supportive learning communities" (p. 32) most encouraged retention among minorities. Hence, the noncognitive factors provided through involvement in a minority engineering program appear to be as essential to understanding retention as are the cognitive factors of student achievement. Although the longitudinal impact of this minority engineering program on student achievement is questionable, the impact of the program on retention patterns is notable. Future evaluations should continue to discern those other important factors in the noncognitive domain which help to retain Black students in science, mathematics, and engineering disciplines.

APPENDIX

Semi-Structured Interview Protocol

The following questions are based on the landmark study by Seymour and Hewitt (1997) entitled *Talking about Leaving*.

1. Describe how committed you were to the engineering program. What factors affected your level of commitment?
2. Stayers: Why have you chosen to remain within engineering?
   Switchers: Why did you leave engineering?
3. Stayers: Have you ever considered leaving engineering? Why?
   Switchers: When did you first decide to leave engineering? Why?
4. Did you pursue any academic support programs at the university? How helpful were they to your goals as an engineering student?
5. Do/Did you feel like you were a part of the engineering community at the university? Explain.

6. How would you describe your own work and study habits?
7. What strategies for survival did you employ while you were in the College of Engineering?
8. How would you rate the university support for assisting you in academic success during your freshman year? Explain.
9. Describe your support systems (formal systems involving faculty and staff and informal peers) that you rely on regularly. How did you establish these support systems?
10. How would you compare your courses within the pre-engineering and engineering curriculum to those you have taken outside of the engineering curriculum?
11. What advice would you give to a high school student who tells you that they are considering engineering as a college major?
12. How does it feel being a minority at a predominantly White institution? How does it feel being a female? Do you feel you have been treated any differently because of your ethnicity or gender?
13. What changes could the College of Engineering make to better assist the incoming freshman pre-engineering majors in order to encourage them to pursue engineering?

REFERENCES

Carreathers, K. R., Beekmann, L., Coatie, R. M., & Nelson, W. L. (1996). Three exemplary retention programs. In M. J. Barr & M. L. Upcraft (Series Eds.) & I. H. Johnson & A. J. Ottens (Vol. Eds.), *Leveling the playing field: Promoting academic success for students of color: Vol 74. New directions for student services* (pp. 35–52). San Francisco: Jossey-Bass.

Denes, R. (2000). Gaining access: A research and policy agenda. In G. Campbell, Jr, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 314–323). New York: Oxford University Press.

Fletcher, J. (1998). *A study of the factors affecting advancement and graduation for engineering students.* Unpublished doctoral dissertation, Auburn University, Auburn, Alabama.

Gainen, J. (1995). Barriers to success in quantitative gatekeeper courses. In R. J. Menges & M. D. Svinicki (Series Eds.) & J. Gainen & E. W. Willemsen (Vol. Eds.), *Fostering student success in quantitative gateway courses: Vol. 61. New directions for teaching and learning* (pp. 5–14). San Francisco: Jossey-Bass.

Giordano, F. G. (1996). Evaluation as empowerment: Using evaluation strategies to improve retention of regularly admitted students of color. In M. J. Barr & M. L. Upcraft (Series Eds.) & I. H. Johnson & A. J. Ottens (Vol. Eds.), *Leveling the playing field: Promoting academic success for students of color: Vol 74. New directions for student services* (pp. 69–78). San Francisco: Jossey-Bass.

Good, J. M., Halpin, G., & Halpin, G. (1999, April). *Retaining minorities in engineering: Assessment of a program prototype.* Paper presented at the Annual Meeting of the American Educational Research Association, Montreal.

Landis, R. B. (1995). *Studying engineering: A road map to a rewarding career.* Los Angeles, CA: Discovery Press.

MacGuire, S., & Halpin, G. (1995, November). *Factors related to persistence in engineering: Results of a qualitative study.* Paper presented at the Annual Meeting of the Mid-South Education Research Association, Biloxi, MS. (ERIC Document Reproduction Service No. ED398052).

McNairy, F. G. (1996). The challenge for higher education: Retaining students of color. In M. J. Barr & M. L. Upcraft (Series Eds.) & I. H. Johnson & A. J. Ottens (Vol. Eds.), *Leveling the playing field: Promoting academic success for students of color: Vol 74. New directions for students services* (pp. 3–14). San Francisco: Jossey-Bass.

Popham, W. J. (1993). *Educational evaluation.* Boston, MA: Allyn and Bacon.

Posavac, E. J., & Carey, R. G. (1992). *Program Evaluation: Methods and case studies.* Englewood Cliffs, NJ: Prentice Hall.

Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview Press.

Tang, J. (2000). *Doing engineering.* New York, NY: Rowman and Littlefield.

Torres, A. (2000). Rethinking the model. In G. Campbell, Jr, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 219–221). New York, NY: Oxford University Press.

Wharton, D. E. (1992). *A struggle worthy of note: The engineering and technological education of Black Americans.* Westport, CT: Greenwood Press.

White, C. J., & Shelley, C. (1996). Telling stories: Students and administrators talk about retention. In M. J. Barr & M. L. Upcraft (Series Eds.) & I. H. Johnson & A. J. Ottens (Vol. Eds.), *Leveling the playing field: Promoting academic success for students of color: Vol 74. New directions for students services* (pp. 15–34). San Francisco: Jossey-Bass.

Worthen, B. R., Sanders, J. R., & Fitzpatrick, J. L. (1997). *Program evaluation: Alternative approaches and alternative guidelines*. New York: Longman.

Direct reprint requests to:

Jennifer Good
5026 Haley Center
Ed. Foundations, Leadership & Tech. Dept.
Auburn University
Auburn, AL 36849
e-mail: goodjen@auburn.edu