

Analysis of the GE Faculty for the Future Program at Bucknell University: Learning from the Past and Improving for the Future

Margot A.S. Vigeant, Karen T. Marosi, and Candice R. Stefanou

Department of Chemical Engineering, Bucknell University/College of Engineering, Bucknell University/ Department of Education, Bucknell University

Abstract

Despite years of encouragement from the GE Faculty for the Future (GE-FFF) program, there has been no increase in the number of female students from our university going on to graduate school and academic careers. GE-FFF was a summer research program designed to pair students with professor-mentors with whom they would conduct research and learn about academic careers. While there was success in filling the program with interested students, it did not appear successful at encouraging women and minority students to go on to academic professions. In this work, we present the results of two surveys on why people do (or do not) go on to academic careers and the work currently ongoing at Bucknell to address the findings.

The first survey queried graduates who may or may not have participated in GE-FFF, to discover if the training they had received was important to their decision about which career to pursue. The conclusion of this survey was that there seemed to be positive impressions of the GE-FFF program, but that direct conclusions about students' failure to pursue academic careers were not possible due to the limited size of the data set. Also, given the large number of choices available to someone starting their career, it seems somewhat unreasonable to ask graduates to state why, exactly, they decided against one career in particular. Therefore a second survey was conducted, and given to people currently employed as professors. In this survey, respondents were asked about life events and preferences which had lead them to their current work. Based on the conclusions of this survey, programming was started or improved at Bucknell to give students access to mentors, information on graduate school, and access to female faculty in an informal setting, all of which were flagged as important factors by respondents from academia.

Introduction

Bucknell University is a small Liberal Arts University, consisting of a College of Arts and Sciences as well as a College of Engineering. The university has an excellent gender balance (average of 50% for the past 10 years), which is not uncommon in Liberal Arts Universities.

Slightly more uncommon is the fact that this gender balance extends to a large extent to the Engineering college, where 24% of the students are female (average over 1992-2002). This number has been approximately constant with slight increase for 17 years, and compares favorably to the national average of 18% for the same period (Engineering Workforce Commission).

Bucknell's College of Engineering takes pride in the fact that a relatively large fraction of students which proceed on to graduate school after attending Bucknell. One might therefore guess that female Bucknell Engineering graduates would likewise be well represented in graduate school, and subsequently also in academia, but this appears not to be the case. Data collected from alumni suggest that the pool of students from Bucknell that goes on to graduate studies in engineering is, in general, relatively depleted of women, and very few have gone on to careers in academia (see Table 1).

Table 1: Percentage of graduating class pursuing advanced degrees*

Group	Year of Graduation						
	1995	1996	1997	1998	1999	2000	2001
All graduates	18	19	25	18	14	18	18
Female graduates	6	7	4	5	2	3	32

*All graduates hold a B.S. in Engineering from Bucknell University. GE-FFF ran from the summer of 1995-2002; graduates of the class of 1995 were the last class not to have access to this program.

For a number of years, Bucknell Engineering participated in the General Electric Faculty for the Future (GE-FFF) program in which female students along with other under-represented groups in engineering were encouraged to pursue graduate studies and academia via a summer-long research and mentoring partnership with an engineering faculty member. In this paper, we examine the success of the GE-FFF program at Bucknell. We also analyze the results of a survey designed to reveal what programs might be needed in addition to summer research in order to encourage more female students to careers in academia, and finally we discuss the programs Bucknell is developing based on these findings.

Data collection and analysis

Data for this study was obtained by “mining” the alumni records maintained by the Engineering college, and by conducting two surveys. Results from the alumni records were used to confirm our initial impressions of the success of the GE-FFF program; that is, it did not appear that the GE-FFF program significantly encouraged students to go on to graduate study and academe. As is seen in Table 1, although a number of students pursued graduate degrees during the GE-FFF years, the existence of the program does not seem to have created an increase in the number of women attending graduate school. The spike in women attending graduate school for 2001 cannot, unfortunately, be attributed to GE-FFF, as none of the women who participated in the program were among those who went on to advanced study. As was mentioned above, with the exception of 2001, the fraction of female students going on to graduate study was low relative to their proportion in the college population, regardless of participation status.

The available data for Bucknell Engineering graduates in academic careers does not show any great increase as a result of GE-FFF activity. Based on self-reports of graduates, from the years 1996-1998 (the latest year from which a graduate could reasonably be expected to have obtained a faculty job) there are only two professors, one male and one female (neither of which were GE-FFF participants).

This curious lack of women from pursuing advanced degrees was troubling, particularly in view of Bucknell's reputation for sending students on to graduate study. There was no obvious reason to account for this observation. Therefore, further study was conducted so that GE-FFF-like programs could be improved to better meet the objectives.

Two surveys were conducted for this research. In the first survey, Bucknell Engineering women and minority graduates, regardless of whether they participated in the GE-FFF program were asked about their career choices, and the extent to which exposure to different topics from the GE-FFF program were important in their choices. A copy of the survey may be found at <http://www.facstaff.bucknell.edu/mvigeant/asee03>.

This survey was administered, by mail and world-wide web to all graduates who were eligible to participate in the GE-FFF program at Bucknell (all women and minorities) as well as all those who actually participated. The survey was administered during the summer of 2001. Out of approximately 200 surveys sent, 78 responses were received. The results are summarized in Table 2.

Table 2: Results of the GE-FFF program, as reported in survey data*.

Status within GE-FFF program	Gender	Responses	Number pursuing advanced degrees	Number of graduates from these years in academic careers *
Participants	Female	8	1	0
	Male	0	0	0
Non-participants	Females	69	26	1
	male	1	0	1

*Data reported by Bucknell students who either participated or were eligible to participate in GE-FFF during the summers of 1995-2001. *The final column is based on University data.

In the survey, participants in the GE-FFF program were asked how various aspects of the program impacted their graduate school and career choices. The feedback on topics covered in the GE-FFF summer, such as teaching a lesson and working with a faculty member, was overall more positive than negative. However, even though it was viewed as encouraging, the desired effect was not achieved, as can be seen in Table 2, where a smaller percentage of *participants* went on to graduate school than did *non-participants*. A variety of reasons were given for this, primarily the desire to gain work experience (75%) and financial reasons (63%).

While there was a reasonable response rate for the survey, the sample size of actual participants in the GE-FFF program was very small. Because of this, no clear conclusion could be drawn about the reasons behind the apparent lack of success of the GE-FFF program. Upon reflection, this seems reasonable, given the nature of the first survey, which asked a relatively small number of people about the reasons they did not follow a particular life path. Given the almost limitless career possibilities for recent graduates, asking a small number why they did not choose a specific career (academia) on a multiple choice survey seems destined to fail.

Due to the inconclusive nature of the first survey, a second was conducted from a different perspective, namely that of the professor. The focus of this survey was to try to determine the key influences (at the undergraduate and graduate level) that inspired current professors to follow their chosen career paths. A copy of this survey is available at <http://www.facstaff.bucknell.edu/mvigeant/asee03>. It was hoped that by using this approach, the factors which influenced people who *are* professors to become such would be more clearly defined. This information could be more useful in producing programming designed to aid others in choosing to pursue academic careers themselves.

The survey was administered during July and August 2002 to approximately 100 engineering faculty, and 64 responses were collected. The faculty polled included all members of Bucknell's Engineering College, as well as participants in two NSF-sponsored Engineering Education workshops hosted by Bucknell. Finally, the survey was sent to a number of female engineering faculty at both research and liberal arts institutions, in an attempt to collect a significant number of female responses. The race of respondents was not known. Respondents were from a range of engineering fields, most of whom (60%) had gone directly to graduate school immediately after completing their undergraduate education.

The survey asked about a number of factors that may have influenced a persons' decision to enter academe, and asked the respondent to rate the strength of this factor in their choice, on a scale of 1-5 (five being the strongest). Factors which were not marked as having any influence received a value of zero. Respondents were also asked, in written form, to describe the three biggest influences on their decisions to become professors.

For analysis, responses were broken into three categories; those factors which a person deemed completely unimportant (no answer circled at all) were considered "not influential" and given a weight of "0", while values of 1, 2, or 3 were considered "slightly influential" and values of 4 or 5 were considered "influential" on a given persons' decision to pursue a career in academe. A factor was considered important if greater than half of the respondents marked it as at least slightly influential, and very important if more than half marked it as "influential". The data of which factors were considered important is shown in Table 3, with factors which were also found to be *very important* in bold. Note that not all factors are very important for both men and women, and some factors were much more widely experienced by one gender than the other.

Table 3: Factors influencing the decision to pursue a graduate degree / career in academe*.

Factor	% important, Male	% important, Female
7A:Desired academic career	74%	62%
7B: Desired research career	53%	38%
7C: More meaningful work with advanced degree	67%	67%
7E: Advancement in profession	65%	38%
7F: Enjoyed research	53%	33%
7G: Enjoyed school	72%	67%
7I: Encouraged by advisor	35%	57%
9F: Undergraduate research	44%	52%
9G: Graduate research	77%	100%
9H: Publish a paper	74%	95%
9I: Present a talk at a national meeting	70%	100%
9K: Act as a TA	84%	90%
9L: Prepare a lecture	67%	71%
9M: Teach a lecture/class	81%	76%

*Values are percentage of all responses which assigned some importance to the factor (defined as responses with a weight of 1 or above from over half of respondents). Very important factors (that is, those given a weight of 3 or above by over half of respondents) are shown in bold. Factors starting with “7” were important for perusing a PhD, while factors starting with “9” were important for pursuing an academic career.

In general, there is a correlation between the responses from both male and female faculty; the correlation factor for the responses of both genders to importance of all factors (not only those in Table 3, but also those with low “importance” which are not shown) is 0.85. However, there are some clear differences, especially when considering the factors that were very important. As can be seen in Table 3, while both men and women assigned some importance to faculty activities (preparing class, publishing papers, etc) performed as students, these were scored much more highly by women, indicating they had a greater influence on their career decision. While both men and women scored the desire for more meaningful work highly as a factor in their decision to attend graduate school, men were more strongly influenced by the desire for an academic career from the outset, as well as advancement in their profession. While both men and women faculty enjoyed school, a larger number of the men felt this was a significant factor in their career choice.

Some of the factors are notable even though they did not have a large portion of respondents rate them as very important. For example, there is a large discrepancy between the fraction of women and men who cite the influence of an advisor or other faculty member on the decision to continue their education; women were far more likely to report that they benefited from the guidance of an advisor. This was again brought up in the written responses, where women consistently cited the influence of one or more individuals on their choices (67%), a factor that was less prevalent for the male respondents (53%). Women were also more specific about their mentors, with several

respondents specifically citing female mentors as having been inspiring, while the gender of the mentor was not specifically mentioned by any male respondent. In the written responses, several male faculty cited dissatisfaction with industry and the faculty lifestyle as important factors, neither of which were specifically mentioned by women.

Additionally, surprisingly few of the faculty entered graduate school anticipating pursuing a PhD from the start. 62% of the women and 51% of the men responding to the survey entered graduate school either specifically to obtain a terminal masters or without being definitely committed to obtaining a PhD.

The survey also polled faculty on resources they wish they had had to help them choose a career in academe. The responses to this part of the survey (which were just yes/no, and were not weighted) are summarized in Table 4; note that responders were allowed to say “yes” to as many ideas as they liked.

Table 4: Activities which current faculty felt would have been helpful to them*.

Activity	% valuable, Male	% valuable, Female
A: Career panel	51%	57%
B: Mentoring relationship with professor	70%	90%
C: Mentoring relationship with other students	26%	14%
D: Tutoring by other students	28%	14%
E: Seminar series	51%	76%
F: Cultivation of student professional societies	30%	14%
G: cultivation of minority engineering societies	26%	19%
H: Networking between students and alumni	30%	33%

*Values are a percentage of all responses which agreed that an activity would have been valuable to them. Responses were not weighted

From Table 4 it can be seen that the responses for both genders were similar, with the exception of the two activities which were perceived as most valuable, the mentoring relationship and the seminar series, both of which were more strongly endorsed by women. The very strong agreement with the mentoring program was no surprise, given the strength attributed to the actions of mentors in the data above.

Discussion

Based on the conclusion from alumni data that a disproportionate number of our female graduates are *not* going on to graduate school, and that the previous activities sponsored by the GE-FFF did not appear to alleviate this, we examined the results from the faculty survey to determine: 1) what

factors most influence women to go on to graduate education and 2) which activities might most influence engineering undergraduates to go on to graduate school and from there on to careers in academe?

Based on the information in Table 3, it seems clear that a key factor influencing women to choose academic careers is early participation in key elements of those careers, such as teaching and publishing and presenting research. Also important for both men and women was the idea that with a PhD, one can perform more meaningful work. Additional factors which seemed more important for the men than the women were the desire, from the outset, to have an academic career and their intrinsic enjoyment of school.

From the summary given above, it is possible to begin to draw conclusions about what activities would be most helpful to encourage more of our graduates to explore academic careers. A primary goal should be to insure students have the opportunity to participate in research and teaching activities, with special attention given to encouraging presentation and publication of student work. Fortunately, Bucknell already has a strong tradition of undergraduate research; in Chemical Engineering, for example, over 25% of the class has taken at least one research credit. While this is encouraging, new emphasis must be placed on student publication and presentation. It may also be valuable to increase student awareness of academic jobs, and that meaningful work can be completed in that environment. A key should be to make the undergraduate learning environment as welcoming as possible to diverse styles of learning, in an effort to increase student enjoyment of school, another key factor in the decision to continue one's education.

Based on the data from Table 4, it is clear that mentoring should be our first priority, followed closely by a seminar series and a career panel from which students gain exposure to diverse fields of research and where students can hear many views on the various possibilities of academic careers. Finally, the data suggest that we should encourage our students to enter graduate school, but that we do not have to worry so much whether they are looking to stop at an MS or to continue, as the data showed that most professors were not committed to a PhD upon entrance to graduate school.

Implementation

Table 5 shows the activities deemed most valuable based upon our survey data, and the activities being planned or carried out at Bucknell in order to address those findings. The most important activity, mentoring, is the most difficult to address. Mentoring appears to be a key influence for women pursuing a career in academia, and while this was not cited by all respondents, a *female* mentor within academia was very important for many of those polled. However, there are only two tenured women faculty in the Bucknell College of Engineering (there are typically an additional two-to-four untenured or visiting women in any semester). There is not realistically the time for a valuable mentoring relationship between these faculty and those students who ought to be encouraged to explore graduate school. Therefore we sought a middle road, in which female students could have an individual mentor through Mentornet, which pairs women students with industry mentors in the same major, and faculty lunches, in which small, interested groups of female students are invited to a lunch with a female faculty member for a discussion of career

planning and an open forum for student questions on any topic.

Table 5: Programs in development or in place at Bucknell to encourage female graduates to follow careers in academia*.

Goals	In development	In action
Mentoring	- Informal faculty lunches - Greater emphasis on attracting a diverse faculty	- Participation in Mentornet
Student participation in and presentation of research	- Encouraging/ funding for expanded presentation possibilities for women - SWE sponsored student research presentations	- Undergraduate research projects - Attendance/ research presentation at national meetings common (some majors)
Informing students about graduate study/ careers		- Seminar on how/ why one goes to graduate school - Connection of BU undergrads to PSU graduate students.
Maintaining a positive learning environment	- Greater emphasis on attracting a diverse faculty	-Encouragement of faculty to explore new and diverse pedagogies
Seminar series		- Seminars offered within many majors
Career panel	- Specific career panel for women in academic careers	- Career panel as a part of homecoming

*Programs that are new as a result of this study are highlighted in bold.

As mentioned above, student research is already an important part of the undergraduate experience at Bucknell. However, not all students have an opportunity to publish or otherwise present their work at the national level. We have therefore set the ambitious goal of helping to fund student trips to national meetings to present research. For those students who cannot travel, we would offer an internal forum through the Bucknell branch of the Society of Women Engineers (SWE). In the end-of-the-year “research festival”, students will have an opportunity to present their findings to a diverse audience, and hopefully get a taste of what it is like to give a formal research presentation.

There are other developments within the College of Engineering which will help achieve the goals shown in Table 5. For example, there is an ongoing initiative, originally funded by the NSF, to “reinvent” engineering education, with an emphasis on teaching to diverse learning styles. This fits nicely with our goal of maintaining a positive learning environment.

As Fall 2002 was the first semester of implementation/planning for the activities listed in Table 5, it is not possible to offer an analysis of their success at this time. However initial feedback from the mentoring project is positive and we hope to be able to show progress within the next two years.

Acknowledgements

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Biographical Information

Margot A-S. Vigeant is a graduate of Cornell University (BS) and The University of Virginia (MS, PhD) and a professor of Chemical Engineering at Bucknell University. Her interest in women's issues in engineering stems from personal experience.

Karen T. Marosi is a graduate of Lafayette College (BS) The Pennsylvania State University (MS, PhD) and the Associate Dean of Engineering at Bucknell University. Her interest in women's issues in engineering stems from her administrative position and personal experience.

Candice R. Stefanou is a graduate of Penn State University (BS and PhD) and Bucknell University (MS) and an Assistant Professor of Education at Bucknell University. Her interests include the effects of classroom environments and teacher behaviors on student motivation.