ALVA: A Successful Program for Increasing the Number of Minority Undergraduates who Earn Engineering Degrees

Cathryne Jordan, Lisa Peterson, Scott Pinkham,
College of Engineering, University of Washington

Abstract

A highly successful minority outreach and support program for incoming college freshmen in engineering is described. The University of Washington, College of Engineering has been running ALVA (Alliances for Learning and Vision for underrepresented Americans) for 11 years and continuously tracks its participants. Partners and friends of ALVA come from the government, education, and industry. This recruitment program targets talented underrepresented minority students and addresses four major hurdles that face minority students in engineering and the physical sciences: lack of vision of themselves as an engineer, finances, community, and academic preparation. We will present ALVA as a model that has been a strong and successful tool for the recruitment and retention efforts at the UW within engineering and can be duplicated at other colleges and universities.

Introduction

Many studies have proven that underrepresented minority undergraduates drop out of engineering at a higher rate than their Caucasian and Asian peers (Morning and Fleming, 1994; Astin, 1996; Reichert, 1997). For those who are retained, one of the most accurate predictors of success in engineering is GPA, both for high school, and especially for the first year in college (LeBold and Ward, 1998).

In 1993, the University of Washington's Minority and Science Engineering Program (MSEP) began a new initiative – the Alliance for Learning and Vision for underrepresented Americans (ALVA). The purpose of ALVA is to increase students' success during their first year in college and address multiple factors that negatively impact minority students' success in engineering (Seymour, 1997). These factors include finances, academic preparation, no vision of themselves as engineers, and lack of community on campus (Padilla, 1997; Reichert, 1997; Bean, 1986).

Background

Underrepresented minorities (African American, Hispanic/Latino, Native American, Hawaiian/Pacific Islander, Alaskan Native) comprise 19% of the US population, but only 6% of the professionals in engineering (Bachnak, 2004). The State of Washington enjoys many opportunities for engineers to work, and ranks 13th in the nation in the number of engineers with doctorates (NSF, 221-2003), so there are many career opportunities for engineers in the Pacific Northwest. However, few underrepresented minorities receive degrees in engineering. Nationwide, 7% of the bachelor's degrees awarded are in engineering. Whites earn 77% of these degrees, while African Americans earn 2.4% and Hispanic/Latinos earn only 1.5% (Kaplan, 2003).

Colleges of engineering across the country struggle with disproportionately low numbers of minority students. The demographics of the area around the University of Washington make the situation even more challenging, as the underrepresented minority population in the state, county, and city is significantly lower than the national average (Table 1). The percentage of minority students drops even further for enrolled students at the University of Washington, and as is common at most universities, drops even further in the College of Engineering. Another barrier at this institution is that the departments in the College of Engineering all have competitive admission. The retention and graduation rate for underrepresented students once they get into their departments is extremely high (over 95%), but historically many underrepresented students have not been offered admission because of lower GPAs. To address this challenge, for many years, the College of Engineering has made significant efforts towards increasing the numbers of underrepresented students enrolled, and graduating from the College of Engineering. In the past year, the College has established the goal of achieving parity: first with the university population, and secondly, with the local population. One key component of this ambitious and worthy goal is the success of the ALVA program.

Table 1: Demographics of the country, state, county, city, campus, and college

	White	Asian	Under represented	Two or more	Internat'l	Other

			Minority	races		
US, 2000[18]	62.6%	3.6%	27.3%	2.4%		
Washington St, 2000 [18]	74.3%	5.5%	15.6%	3.6%		
King County, 2000[18]	70.2%	10.8%	15.8%	4.1%		
Seattle, WA, 2000[17]	64.8%	13.1%	17.6%	4.5%		
Univ. of Washington, Autumn 2004[19]	62.2%	20.3%	11.1%	N/A	6.4%	
UW College of Engr. undergrads, Autumn 2004*	47.1%	29.3%	4.5%	N/A	9.2%	9.9%

**Does not include Pre-Engineering or Pre-Major students*

The ALVA Model

The Minority Science and Engineering Program began ALVA in 1993 with a pilot group of four students at the Fluor Hanford company and now serves over 50 students each year. The nine to ten week program is an intensive, hands-on, residential experience.

Recruitment: Letters are sent to every underrepresented freshman applicant to the University of Washington who indicates an interest in engineering, or who does not declare an initial major. These letters describe the ALVA program, and include an application form. Application packets are also distributed through the state MESA programs to high school seniors and to high school science/math teachers.

Selection: All students who are accepted into ALVA must also be accepted into the University of Washington. Students are chosen based upon a review of their transcripts, letters of recommendation, and essay. The essay is used to measure problem-solving capabilities, creativity, writing ability, and student interest in exploring engineering fields.

Notification: All applicants are notified of their decision with either an acceptance or rejection letter. Those students who are accepted then go through another round of selection with the corporate partners and are placed as closely as possible to their stated interests.

Program launch: The program begins with an initial orientation at each corporate and campus site. Students are introduced to their math instructors, corporate/campus mentors, and dormitory counselors. Ice breaker activities begin the process of building community among the students, and they are given the chance to ask questions and learn from previous ALVA students.

Mathematics: While average mathematics scores have risen for all racial and ethnic groups since 1990, the gap between minority and white students still remains, and underrepresented students begin college less prepared for math than their majority peers (Vetter, 1994; Schneider, 2000). In 2000, only 4% of Hispanic/Latino, 3% of African American, and 10% of Native American high school seniors scored at or above the Proficient level (NSB/NSF, 2002). Math skills are key to an engineering career, so every ALVA student is placed in a math workshop. Two levels of math are offered, and students are assigned to the workshops based on their University of Washington math placement test scores. The math workshops prepare students for calculus on

this campus, and much of Treisman's (Treisman, 1992) research work is incorporated into the design of these workshops. As other schools have noted, it is key that these workshops not be remedial (Ohland, 2002). They are challenging, group-oriented, and since class size is small (max=8), there is plenty of room for individual attention. At the end of the summer students retake the placement exam and typically jump up one course level, and continue to do well in their math courses throughout their college career. The paid instructors are a combination of MSEP staff members, graduate students in science and engineering, and high school mathematics teachers.

Work/placement: Many underrepresented minority students do not see engineering as a career for them (Seymour, 1997). They know few minority engineers themselves, and know that the minority community at the University of Washington is a small one. The ALVA program gives students the opportunity to work as an engineering intern in a corporation or a campus lab. They work side by side with engineers, and learn to picture themselves as professionals in this field. They explore the field and begin to realize new career opportunities. This professional, positive self-image helps the students stay focused on their long-term career goals and not veer off track when the coursework is difficult. Quote from a former ALVA student now pursuing their engineering degree:

> *Being a part of the ALVA program was one of the best decisions I have ever made in my life. The internship that I received from the program introduced me to the engineering community, a place I had never considered. Working side by side with real professionals in a real workplace helped me realize that I had a real passion for an engineering career.*

Housing: Students are housed together in either dormitories or secure apartment complexes, depending on the site. Each group of students has a paid counselor living with them. The peer counselors are college juniors or seniors who are majoring in engineering and have already participated in ALVA. The counselors have successfully completed their prerequisite coursework, and have been accepted into competitive departments. They have participated in and benefited from not only ALVA, but also from the follow-up academic workshops, and membership in college chapters of professional engineering societies (American Indian Science Engineering Society {AISES}, Society of Hispanic Professional Engineers {SHPE}, National Society of Black Engineers {NSBE}, Society of Women Engineers {SWE}). With this rich background, they understand the importance of building a community, the benefit of group workshops, the challenges of the coursework, and the skills it takes to make it into engineering. As a peer counselor, they are very accessible to the ALVA students, and since they live with the students, they can help them adapt to living away from home for the first time, adjusting to life in a large city, and dealing with roommate issues.

Finances: Funding for college is a critical barrier for many underrepresented students at the University of Washington. Padilla *et al.* (Padilla, 1997) and Reichert and Absher (Reichert, 1997) have found that lack of financial resources has a strong negative impact on minority students' retention in engineering. To address this factor, students who participate in ALVA are paid for their summer experience. They are paid for both their time working as an intern, and their two hours/day of mathematics workshops. Housing and travel expenses are also covered by

the program, so the students are able to save a significant amount of money towards their college expenses. Very few of the ALVA students have to work during their freshman year because of the money they were able to earn over the summer. As a result, their grades are very competitive and they frequently receive scholarships to help support the rest of their college career. The wages vary depending on the corporate partner, but students typically save over $3000 during the summer.

Program closing: On the last day of the program, students give an oral presentation about their summer work and research, either using Powerpoint presentation or a printed poster as a resource. The audience at these presentations include all of the ALVA staff, teachers, and corporate/campus mentors, students' families, and the local corporate or campus community. Reflecting on their summer experience and explaining to those outside the field gives students the opportunity to internally incorporate their experience at a deeper level. Katz *et al.* (Katz, 2003) have found that students who learn in a reflective manner outperform their peers, and have more efficient learning processes. Students receive training and practice prior to their closing talks, so they have ample opportunity to engage in these reflective processes.

Follow-up: After ALVA, students begin their academic career at the University of Washington with a well-established support system. Transitioning into a large metropolitan and majority institution the size of the University of Washington, minority students often find themselves lost and overwhelmed. Over the summer, ALVA students have established a community of peers and established various relationships among COE staff and faculty. Once they arrive this community becomes aligned and broadens with a host of former ALVA students now MSEP and GenOM students. Students are already connected with academic support facilities on campus, they take courses in clusters, they enroll in MSEP's academic enrichment workshops, tutoring, and an engineering survival skills course, and they receive intensive advising. MSEP and GenOM advisors staff track the students every quarter until they graduate, and maintain contact with them as they move on to graduate school or professional careers.

Funding for ALVA

ALVA is an intensive program, and would not be possible without the support and partnership of corporate and federal partners who have participated in the past and currently: Bechtel Corporation, the Boeing company, EE Just, the Environmental Protection Agency, Ernst & Young, Fluor Hanford Inc., the Ford Motor company, IBM, Intel Corporation, Hewlett-Packard, Microsoft, NASA's Jet Propulsion Laboratory, the National Science Foundation (NSF), Sandia National Laboratories, Shell, Siemens Building Technologies and Westinghouse Hanford company. The College of Engineering and its departments have also contributed funding, and faculty have mentored many students. NSF's Alliance for Minority Participation funding has been critical to the continuity of this program. Costs for the program are given in the following table.

Table 2: ALVA Program Costs

Cost per student	
Salary	$3,000-$5,000 (varies with site)
Room and Board	$1,850

Books	$22
Incentives	$20
Overall Program Costs	
Supplies	$400 (classroom/instruction/tutoring)
Mailings	$200 (recruitment/offers/invitations)
Transportation	$1,500
Math Instructor	$4,000-$5,000 (DOE)
Counselor	$3,750 (each lives with and is responsible for ~8 students)
Counselor's Room and Board	$2,040 (single room)
Tutor	$1,750 (generally 1 tutor for ~8 students)
Student Assistant	$2,000 (helps with mailings and general coordination)
Miscellaneous	$1,500 (room rentals, certificates, social events, etc.)
Staff coordinator	0.25 FTE

Results

The average retention rate nationwide for underrepresented students interested in science and engineering from the freshman to senior years in college is only 32% (Seymour, 1997). The retention rate of ALVA participants in science and engineering fields is nearly 80% since the program's inception in 1993. This is an exceptional achievement.

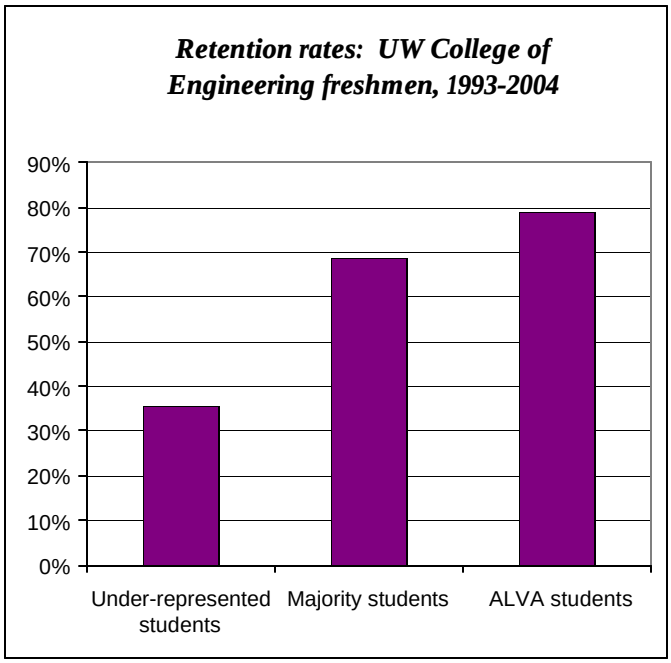

Figure 1: Retention rates of University of Washington's College of Engineering Freshmen, 1993-2004

Table 3: Graduation and enrollment figures of ALVA Students

	# of participants	Still enrolled	Graduated with engineering or science degree	Graduated with non-engr. or science degree
1993	4	0	4	0
1994	7	0	4	2
1995	10	1	6	3
1996	21	1	6	7
1997	41	5	20	12
1998	31	7	13	10
1999	39	12	14	12
2000	40	7	20	7
2001	39	26	5	2
2002	30	25	1	0
2003	46	44	0	0
2004	41	41	0	0

Students who have participated in ALVA are much more competitive for internships than their peers because they already had a summer experience prior to their freshman year. Their grades are higher than students who did not participate in ALVA, and so they are also more competitive for academic scholarships. Many of the students receive ongoing scholarship support through COE Emerging Leaders program and The National Action Council for Minorities in Engineering (NACME).

"I don't know how I would have survived my first year of college without the MSEP/GenOM ALVA program. Not only did it help ease my anxieties about undergraduate studies through academic counseling and tutoring workshops, it also introduced me to laboratory research which has now become an integral part of my academic studies. My studies here have been greatly enriched through my involvement"

Conclusion

ALVA has proven to be a very successful program for retaining underrepresented minority students in engineering. The percentage of participants graduating with engineering degrees is orders of magnitude higher than those of students who do not participate. It requires partnerships between academic departments, corporations, and minority student programs, and is not inexpensive. The authors feel however, that the investment is well justified since the results are so strong.

Other schools have adopted the ALVA model in whole or part (University of Michigan, Chicago, University of Alaska-Fairbanks), and the authors would welcome the opportunity to develop ALVA at other colleges and universities around the country.

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Contact Information

Cathryne Jordan *jordan@engr.washington.edu.*
Lisa Peterson *lisapete@u.washington.edu.*
Scott Pinkham *spinkham@u.washington.edu.*