AC 2010-1414: USING AN ADAPTIVE TINTO FRAMEWORK TO INTERPRET SUCCESSES OF TWO-YEAR INSTITUTIONS IN RETAINING ENGINEERING STUDENTS

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Using an Adaptive Tinto Framework to Interpret Successes of Two-Year Institutions in Retaining Engineering Students

Abstract

Low enrollment of underrepresented minority (URM) and female students in engineering is of national concern. One of the most untapped resources for potential science and engineering students is community college students. A statewide study demonstrates that roughly 50% of students in upper division engineering and related programs are transfer[9]. Almost one-fifth of engineering students began their college careers at a community college[1]. In light of these issues, a statewide collaborative project among four community colleges and two universities was undertaken in Washington State in 2004 to increase the number of students earning undergraduate engineering degrees statewide, with special attention on URMs and females. Using assessment data, the assessment team examines how differing institutional settings impact students' feelings of integration into social and academic engineering communities. Previous research suggests that students are more likely to persist to graduation if they are socially and academically integrated into STEM disciplines[23].

Cross sectional data analysis of four years of the program's Student Experience Survey (formative assessment data) revealed some surprising institutional differences. Our findings show significant differences by institution type in students' academic experiences and participation in professionalization activities. There was no difference, however, in students' social (peer-based) experiences or their perceptions of discrimination. Student tracking needs to continue to measure the successful outcomes in order to do further analysis on differences among successful and unsuccessful graduates and/or transfer students. These findings suggest that involving lowerclassmen and community college students into professionalization activities such as research experiences and conferences would contribute to their ongoing satisfaction with engineering study.

I. Introduction

Low enrollment of underrepresented minority (URM) and female students in engineering is of national concern. One of the most untapped resources for potential science and engineering students is community college students. A statewide study demonstrates that roughly 50% of students in upper division engineering and related programs are transfer students[9]. Almost one-fifth of engineering students began their college careers at a community college[1]. These data suggest four year engineering programs have overlooked an important source for recruiting: community colleges. Community colleges are not only an important feeder for engineering programs at universities, but an important source of diverse, talented students as well.

In light of these issues, a statewide collaborative project among four community colleges and two universities was undertaken in Washington State in 2004. The main goal of the project was to increase the number of students earning undergraduate engineering degrees statewide, with special attention on URMs and females. More explicitly, its goals were to:

1. Increase by 10% over five years the total number of students in the State of Washington that earn an undergraduate engineering degree.

2. Increase by 100% the number of underrepresented minorities (URMs) earning undergraduate engineering degrees.
3. Increase by 20% the number of women earning undergraduate engineering degrees.
4. Implement a statewide strategy to fully utilize the capacity of all engineering programs.

As previous research suggests that students are more likely to persist to graduation if they are socially and academically integrated into STEM disciplines[23], participating schools worked to achieve their goals by implementing a variety of strategies designed to provide academic support and to create a 'community' of engineering and pre-engineering students, specifically targeting women and URMs.

This partnership between community colleges and universities provides a unique opportunity to examine how differing institutional settings impact students' feelings of integration into social and academic engineering communities. Analysis of cross sectional survey data collected over a four year period revealed some surprising institutional differences, including that community college participants appeared to be more active in conferences and professional mentoring programs than their university counterparts. Using an adaptive Tinto framework to understand our results sheds light on ways in which Universities can both ease the transfer from community college and better help all URM students persist to graduation.

II. Literature Review

Institutions of higher education have long recognized the need to retain students through graduation. The cost of losing a student has been estimated at thousands of dollars to the institution[10]. Not only is there an economic cost of attrition to the institution and local economy, there is a cost to society as certain populations of students appear to drop out at higher rates than others. As such, models and theories of retention abound and have been refined over the course of years to identify factors influencing the persistence of students in higher education. This paper uses program evaluation survey data to test whether elements of social and academic integration differentially impact the student experience at community colleges and universities.

Much of the research concerning student retention draws upon the theory of social and academic integration first articulated by Vincent Tinto. Many researchers have tested and found support for this theory, suggesting that lack of integration is a critical predictor of student persistence[3, 4, 5, 6, 15, 16, 17, 18, 19, 24]. Drawing on an earlier theory regarding why individuals commit suicide[11], Tinto argued that the level of a student's integration into the social and academic structure of an institution of higher education, in addition to their pre-college preparation and experiences, has a direct impact on his/her successful retention at that institution. According to Tinto, academic integration relates to student learning, courses, classroom climate, advising, and intellectual development while social integration relates to peer culture, campus social activities and clubs, study groups, and the development of close friends on campus. The degree to which the student "commits" to the institution and educational goals or undergoes rites of passage[25] has a direct impact on graduation. The institution can negatively or positively influence this process through student service offerings, faculty training, and advising, among other interventions.

Over time, others argued that Tinto's model is more appropriate for traditional populations (i.e. "school-age" majority students attending four year institutions). Early studies have shown

indicators of social and academic integration to be salient at the community college level although the specific mechanisms may vary by gender or race[14, 16]. Thus, the Tinto model has been adapted to address nontraditional students who may be older, attend community colleges, or be of a different racial or ethnic group among other differences. For older students who may be returning to college, the depth of integration may be lessened because they do not spend much time on campus. Additionally, students of different ethnicities show a strong commitment to family and their home communities so that they may resist shedding this allegiance during the "rite of passage" at an institution[20].

Additional research and anecdotal evidence of diverse student populations in science and engineering have noted issues faced by non-majority students. Non-majority students may experience isolation and a chilly climate due to their minority status. Minority students may switch cultural codes to try to fit in better with their science and engineering peers (e.g. acting more "white" by changing speech patterns and attire) [12]. The greater the incongruence between the student's home culture and institutional culture, the greater stress a student may experience in adaptation[20].

Thus, institutions seeking to recruit and retain nontraditional populations may choose to direct their interventions by following suggestions of the basic Tinto model. The rise of student services targeting women and minorities is an attempt to develop sub-communities within the greater university setting in order to create a more welcoming environment for non-majority students. Some institutions have gone even further by trying to bring the family more into the institutions, recognizing that family involvement and acceptance is critical to the success of Native students[13].

This paper uses student survey data to examine which elements of the student experience contribute to success. Differences among community college and university students are identified in order to make suggestions on what changes can be made to improve student satisfaction and retention.

III. Project Description

Funded by a five-year grant from the National Science Foundation, the Northwest Engineering Talent Expansion Partnership (NW-ETEP) is a partnership among eight institutions of higher education in Washington State. Institutions include: Washington State University, University of Washington, Seattle Central Community College, Yakima Valley Community College, Highline Community College, and Columbia Basin College.

Since the start of programmatic interventions related to recruitment, retention, and transfer, the six participating NW-ETEP schools have registered over 3100 students. Twenty-six percent are females, and fifteen percent are from under-represented minorities (URMs include African-Americans, Hispanics, and Native Americans). As of the 2008-2009 academic year, 76 NW-ETEP students have transferred to the University of Washington or Washington State University.

Although interventions have largely been institution-specific, outreach to high schools and community colleges (speakers, open houses, and parental involvement), tutoring, mentoring, and advising are main components of the program. Some NW-ETEP sites have engaged students in hands-on activities (e.g Human Powered Paper Vehicle Competition), conferences, living-learning communities, and site visits to industry. A key strategy of this program, however, is to connect students to existing opportunities, not offering many new services.

In terms of reaching the statewide goals of the grant, the data from WSU and UW suggest that goals 1 and 3 above may be achieved in the next two years. The data to accurately assess these goals lags two years behind (Department of Education IPEDS most recent year available is 2006-07). Baccalaureate engineering degrees granted over the grant period show that degrees granted overall and to URMs have increased by 3.5% and 54%, respectively while female degrees granted have declined by 20% at WSU and UW.

Changes in upper division engineering enrollments yield very positive findings at WSU and UW. They have increased in total, for women, and for URMs throughout the five year grant period by 15%, 21%, and 37%, respectively. The female degrees granted will most likely continue to lag for several more years, consistent with national trends. Additionally, findings from the Student Experience Survey, administered annually for four years, reflect statistically significant improvements in student attitudes regarding perceptions of teaching quality, student services participation, and self-confidence in academic abilities over the grant period.

IV. Methodology

The Student Experience Survey was administered as an online survey and was open to all students registered with NW-ETEP at their institutions. These students were emailed a web link that takes them to the SES, hosted on the University of Washington's Catalyst website. Students who had previously consented to be in the research portion of NW-ETEP were taken directly to the SES, while students who had not consented to be part of the research were first directed to a research statement, which asked for their consent. The SES was open to students for six to eight weeks.

This annual survey assessed student experiences at their institutions and in NW-ETEP programs. The SES asked questions to determine the effectiveness of the NW-ETEP intervention over time in order to assist the institutions in learning what aspects of the services could be improved in order to increase the retention of all students, including NW-ETEP registrants.

SES survey administration took place every spring from May 2006 to 2009. The SES data enables comparisons both within and between institutions. Table 1 below shows a summary comparison of the 2008-2009 SES respondents, as a whole and broken out by institution type, and all NW-ETEP registrants.

Table 1. Comparison of 2008-2009 SES Respondents and All NW-ETEP Registrants

	Community College SES Respondents (%)	University SES Respondents (%)	All SES Respondents (%)	All NW-ETEP Registrants (%)
Female	25.0	34.2	30.8	25.9
URMs	20.5	5.3	10.9	14.9
African American	9.1	1.3	4.2	5.1
Hispanic	11.4	2.7	5.9	8.2
Native American	0.0	1.3	0.8	1.6
Mean Age (Yrs)	24.6	21.1	22.4	*
Has Disability	14.6	10.7	12.1	*
US Citizen	77.3	100	91.7	*
Married or Partnered	18.1	10.5	13.3	*
No children	79.5	95.7	89.8	*
1 Child	7.7	0.0	2.8	*
More than 1 Child	12.8	4.3	7.3	*
Total Participants	44	77	121	3,124

*These data were not consistently collected across all institutions in the registration process

The demographic composition of SES respondents closely mirrored that of the total NW-ETEP registrants, making us confident that SES respondents are a representative group of NW-ETEP participants. Women are slightly more represented among SES respondents, with more than one-third consistently responding to the SES while comprising only one-quarter of all registrants. In 2009, nearly 11% of SES respondents were underrepresented minorities, compared to 15% of total registrants. These similarities show that SES respondents are demographically representative of NW-ETEP registrants, suggesting that inferences about registrants as a whole can reasonably be made from the experiences of the SES respondents.

As the literature would lead us to expect, there are some important demographic differences between NW-ETEP participants at community colleges and those attending universities. African Americans and Hispanics are in attendance at community colleges in far greater proportions than at universities[2].This is reflected in our sample: URM community college respondents comprise four times the proportion of URM respondents at universities. The average age of community

college participants is slightly older than their university counterparts (25 compared to 21 years), and almost one-fifth of the community college respondents are married or partnered, compared to 10.5% of respondents attending a university. Nearly 13% of community college respondents have more than one child at home as a dependent, while only 4.3% of those attending university indicate the same.

These differences across institutional settings suggest that engineering students attending two versus four year schools may have different concerns and face slightly different obstacles to persistence. The larger proportions of minority students and those with household and parental responsibilities suggest that students attending community colleges may have greater challenges in achieving academic and social integration into the STEM community. To test for these differences, we examine NW-ETEP SES data for the last year of the project, focusing our analysis on data collected in 2008-2009. Differences between groups are measured using Pearson chi-square and two-tailed asymptotic significance tests. Adhering to social science convention, significance is determined by an alpha or p-value smaller than 0.05. When statistical significance is indicated, adjusted standardized residuals are used to identify cells (or specific scale levels) in which significant difference lies. All tables or figures reported in this paper focus on levels or scales indicating significant difference.

V. Findings

As previously stated, a variety of institutional factors have been found in general to affect the retention of women and URM students, including gender and ethnic isolation, lack of mentorship, absence of peer support, low expectations and unsupportive attitudes of science and engineering faculty who are predominantly white and male[8].Community colleges serve as important pipelines into university engineering programs, and NW-ETEP was sensitive to the impact of these factors at both institution types. As community colleges can often offer more intimate learning environments through small class sizes and lower professor to student ratios, we tested for differences between student experiences on these dimensions.

A. Academic Integration

While both groups participating in the NW-ETEP program reported positive experiences, community college students found their interactions with faculty to be more positive than did university students. For example, in the last year of the survey, community college students reported statistically significantly higher ratings than university students on overall quality of teaching and feeling that instructors cared whether they learned course material. Community college students were also more comfortable meeting instructors after class or during office hours and were significantly more satisfied with the assistance they received from instructors outside of class (see Table 2.)

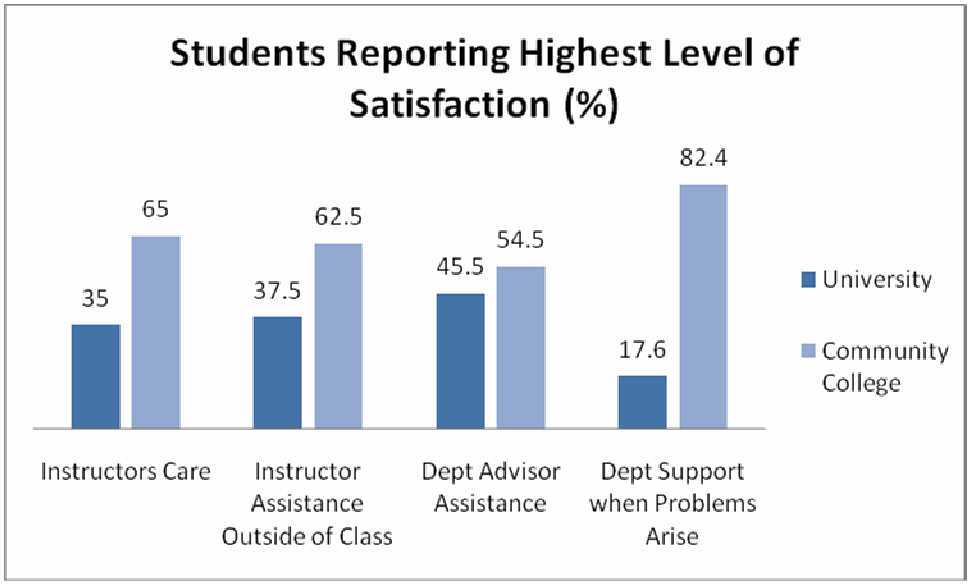
Table 2. Means, Student Reporting on Quality of Interaction with Faculty broken out by Institution Type

	Quality of Teaching	Instructors Care	Comfortable Attending Office Hours	Assistance Outside of Class	N
Community College	4.18	4.48	4.55	4.02	44
University	3.59	3.83	3.71	3.64	77
Significance level (p)	.003	.000	.000	.022	

**Scale: 1=Very Poor 2=Below Average 3=Average 4=Above Average 5=Excellent*

Interaction with faculty is an important part of a student's academic integration, particularly for underrepresented students. Cabrera et al. construct a metric of 'academic integration' using six items measuring the nature and quality of interaction with faculty, arguing that "low involvement with the different campus communities…impinges on the minority student's cognitive and affective development as well as his or her decisions to persist in college" [7]. Students' decisions to persist – whether to continue in an engineering program through transfer to a university or persistence to baccalaureate graduation – are greatly impacted by their feelings of integration into and support by their department. NW-ETEP community college students reported not only more positive interactions with faculty, but also reported statistically significantly higher levels of satisfaction with help received from department/division advisors and assistance from the department when problems arose. Figure 1 demonstrates the proportion of community college and university students who reported the highest level of satisfaction on these measures.

Figure 1: Students who Reported Highest Level of Satisfaction on Questions Related to Interactions with Teachers and Department, Broken Out by Institution Type



Importantly, students reported no significant differences in the impact they experienced by the size of their classes (p=.23), suggesting the more positive interactions reported by community college students do not reflect an intimacy produced merely by lower teacher to student ratios. There was also no difference in the level of instructor encouragement for students to attend office hours or seek additional assistance outside of class (p=.51).

B. Social Integration

In addition to formal interactions with faculty and advisors in the classroom and at the institution, student interactions with their peers also serve to help students persist in higher education. While this occurs casually and informally, institutions and departments can facilitate opportunities for students to interact with their peers in order to build a community and a sense of belonging. This belonging contributes to a student's ongoing commitment to the institution.

Slightly more than half (56%) of all respondents report involvement in study groups. Almost all felt that their comments were taken seriously by their peers, and most felt that the students in their major demonstrated some competitiveness. There is no significant difference between community college and university students in terms of their involvement in peer activities.

Table 3. Percent of Students Reporting Affirmative to Social Integration Indicators, Broken Out by Institution Type

	Study Groups	Peer Mentoring	Peer Competitiveness	Taken Seriously by Peers	N
Community College	65.2%	40.0%	85.7%	92.9%	44
University	50.7%	26.4%	96.1%	96.1%	77
Significance level (p)	.223	.136	.295	.685	

C. Professionalization

Professionalization activities provide students with ways to become familiar with the culture of science and engineering. These types of activities serve to give students more confidence and knowledge to conduct research on their own and, eventually, self-identify as scientists and engineers. Through participation in hands-on research, attendance at conferences, and science competitions, students develop their self-identification as science and engineering professionals.

Our findings show that NW-ETEP students are aware of professional activities and services offered on campuses: 90% of all respondents reported they were at least 'a little' informed about student professional societies and engineering related activities. More than three-quarters (76.9%) reported being involved in these activities. While there is no statistical difference between how well informed community college students are compared to university students, our data suggest some discrepancies in participation across institutional settings.

When broken up by institution, community college students were significantly more likely to be involved in professional societies, professional mentoring services, and conferences. Table 4 shows the proportion of respondents who reported being aware of and involved in professional societies and activities to some degree. Again, our data suggest no differences between students' knowledge of these activities, and there appears to be no difference in the use of career services. However, a significantly larger proportion of community college students reported involvement in these services (p=.017). Almost half (47.5%) of community college respondents indicated involvement in professional mentoring programs, while only 13% of university students reported the same. While only 12.3% of university NW-ETEP students reported involvement in conferences, one-third (32.5%) of NW-ETEP students attending community college said they were involved in conferences to some degree.

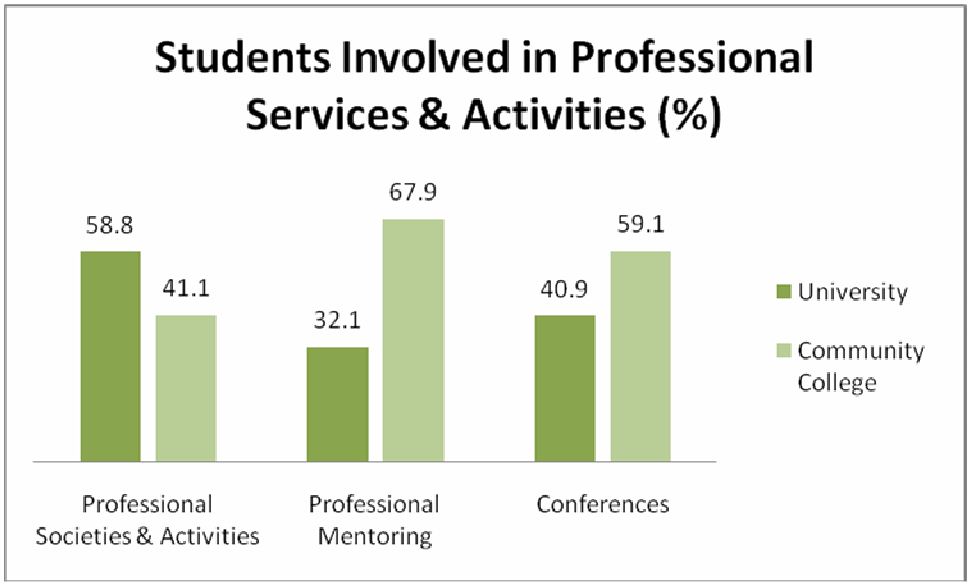
Table 4. Percentage of Students Reporting Some Involvement in Professional Services, broken out by Institution Type

	Knowledge of Professional Societies &	Involvement in Professional Societies &	Career Services	Professional Mentoring	Conferences	N

	Activities	Activities				
Community College	97.7%	88.1%	27.5%	47.5%	32.5%	44
University	96.1%	70.7%	22.2%	12.7%	12.3%	77
Significance level (p)	.532	.017	.532	.000	.010	

Figure 2 presents these data sliced in a slightly different way, displaying the breakdown between university and community college students among those who reported at least some involvement in professionalization activities. For example, of those NW-ETEP students who reported involvement in professional societies or engineering activities, more than half were university students. On the other hand, more than two-thirds of the students who participated in professional mentoring services were community college students. Of those involved in conferences, 60% of those students were attending a community college, and 40% were enrolled in a university. This figure highlights discrepancies between student involvement at two and four year schools in services and activities that provide professionalizing experiences.

Figure 2: Students who Reported Involvement in Professional Services & Activities, broken out by Institution Type



D. Perceptions of a Welcoming Climate

Campus climate, as experienced by students, is often used to provide context for examining the social and academic integration of students. Research has also consistently found that feelings of discrimination or prejudice impact students' social integration into an academic community[7]. Indicators of climate are also used to determine if groups of students feel treated differently than their peers. The Student Experience Survey included a number of questions exploring students' experiences with discrimination and expectations at their current institution. For example, using scales from 1 to 5, students were asked to rank the degree to which they felt instructors treated them with respect, judged them based on their race, and judged them based on their gender. NW-ETEP students in both community colleges and universities indicated positive experiences in this regard, with no significant difference between the institutional settings (see Table 5.)

Table 5. Means, Student Reporting on Feelings of Discrimination and Respect by Faculty, broken out by Institution Type

	Judged Based on Race	Judged Based on Gender	Faculty Treat You with Respect	N
Community College	1.63	1.65	4.56	44
University	1.32	1.83	4.22	77
Significance level (p)	.329	.675	.084	

**Scale: 1=Not at All 2=A Little 3=Somewhat 4=Quite a Bit 5=Very Much*

On average, students in both settings indicated they felt 'not at all' or 'a little' judged on the basis of their race and gender, while also reporting high levels of feeling treated with respect by faculty. Unfortunately, our small sample does not provide statistical power to compare racial, ethnic, and gender groups within and between institutions, potentially blurring important differences in those groups in different institutional settings.

V. Discussion

The demographic breakdown of NW-ETEP participants and survey respondents are consistent with national enrollments by institution type in that the community college participants are, on average, more "non-traditional" than their university peers: the NW-ETEP community college students are older, more likely to be partnered, and more likely to have children. Thus, due to time constraints on the part of students, one might expect the level of integration to be lower at the community college level than the university. However, our findings show that community college students undergo a higher level of academic integration and professionalization than do university students in our sample.

Our findings show significant differences by institution type in students' academic experiences and participation in professionalization activities. There was no difference, however, in students' social (peer-based) experiences or their perceptions of discrimination. Table 6 below summarizes these findings. Each NW-ETEP member institution implemented programs aimed at the retention of students. In examining the level of participation of students using a framework of social and academic integration and professionalization, we have seen differences based on the institution type. Given these programs, how do we make sense of the discrepancies found between community colleges and universities?

Table 6. Summary of Findings

Factor	Significant Difference by Institution Type?	Metrics Examined
A. Academic Integration	yes	Quality of interaction; do faculty care; comfort attending office hours; instructor assistance outside of class; advisor assistance; department support when problems arise.
B. Social Integration	no	Utilization of study groups; peer mentoring; peer competitiveness; being taken seriously by peers.
C. Professionalization	yes	Knowledge and involvement of professional societies and activities; career services;

		professional mentoring; conferences.
D. Perceptions of Climate	no	Feeling judged based on race or gender; faculty treat you with respect.

In examining the inventory of events, programs, services, and activities offered at each NW-ETEP campus, it would appear that the community college students benefited from two advantages: 1) smaller advisor to student ratios to promote events and encourage attendance, and 2) a wider variety and frequency of engineering-specific events. Smaller student to staff ratios may enable community colleges to provide more intensive advising to students, contributing to academic integration through direct, hands-on involvement with students. Beyond smaller student to staff ratios, however, community colleges also offered more events specifically aimed at NW-ETEP participants.

Most of the community colleges hosted some form of an 'engineering orientation day' at the beginning of each year designed to coalesce the NW-ETEP participants and inform them of upcoming professionalizing activities. For example, Highline Community College hosted an annual "Pizza Feed Kickoff" during which NW-ETEP students met each other and mingled with STEM faculty. Similarly, Columbia Basin Community College implemented an "Engineering Recruitment Day" in which students learned about the discipline as well as the NW-ETEP program, and were introduced to math and physics instructors. These types of events served not only to create a sense of community among NW-ETEP participants but also gave students the opportunity to interact with STEM faculty in less formal, positive environments. While the universities also offered services that provided students the opportunity to meet faculty, such as Washington State University's "Team Mentoring" program, these programs emphasized one-on-one relationships between a student and a faculty member, rather than the faculty as a whole. These programs may help explain why community college students reported feeling to a greater degree that their instructors cared or were more comfortable attending office hours and interacting with faculty outside of class. (Although community college students state higher positive interactions with faculty than university students, it should be noted that university means were never lower than at least somewhat satisfied (3 on a 5 point scale). This is interesting given that the University of Washington and Washington State University are both large universities. One might expect lower means in larger institutions; however, even NW-ETEP university students are generally satisfied with their departments. It is also important to note there were no significant differences between community college and university students when asked if they felt their instructors treated them with respect, or were encouraged to attend office hours.)

There was a large discrepancy in the number of professional activities targeting NW-ETEP participants reported by university and community colleges. While access to and information about conferences and professional activities was available to all students, community college students may have again benefited from more direct involvement of site coordinators encouraging them to participate and even arranging group attendance. Community colleges in the program hosted a number of engineering 'guest speakers' from both academia and industry (examples include speakers from Boeing, Kimberly Clark Engineering, and Open Access Network Services Engineering.) Community colleges incorporated other activities designed to expose students to and excite them about engineering, such as Seattle Central Community

College arranging off-campus fieldtrips for NW-ETEP students to local engineering facilities. Highline Community College involved their students in the "Human Powered Paper Vehicle Competition", giving NW-ETEP participants opportunities to put their engineering skills to work. These types of activities may have been offered at the universities as well, but if so, may not have directly solicited NW-ETEP participants. Activities specifically designed for and targeting NW-ETEP students may further strengthen a sense of community among these students and help individuals develop an identity as not only a STEM student, but as an engineer.

VI. Recommendations for Future Research & Practice

This study utilizes assessment data that was initially intended to inform program administrators about areas for improvement in the services provided to target populations of engineering students. As such, the survey dataset used has some limitations that future research should address. For example, NW-ETEP students are self-selected and may be the more highly motivated students so the sample of students may not be representative of a "typical" undergraduate engineering student at either type of institution. If possible, more effort should be made to obtain a representative sample of students to test these hypotheses. Other data limitations include developing an appropriate metric to capture the depth and breadth of student involvement in various activities. Rather than using this Student Experience Survey, more intentional measures of social and academic integration and professionalization could be developed. While these students persisted in their institutions, it is too soon to measure the successful graduation of this pool of students in order to do further analysis on differences among successful and unsuccessful graduates and/or transfer students. Tracking needs to continue to further develop this dataset. This data set is also too small to test other areas of differences suggested by the research literature such as gender, different racial/ethnic categories, and age by institutional setting.

These findings point to recommendations for institutions as well. They suggest that participating community colleges succeeded in giving their students convenient access to academic and social integration and professionalization activities in which one might automatically assume two year students would not participate. In early years of engineering study, students are looking for ways to become involved in professionalization activities which get them involved in the culture of science. Both university and community college students should be encouraged to participate in engineering co-ops, internships, and undergraduate research opportunities. Research and professional experiences in engineering may help with the retention of students to degree completion. Host universities offering undergraduate research opportunities may tailor some of the projects to serve underclassmen and community college students.

Many of the services that the community college partners made available to NW-ETEP students are offered on the university campuses. The NW-ETEP university cohorts may not have developed as strong a student community to encourage participation in related student services. At the university-level, encouraging faculty to be more accessible, proactive, and welcoming to students in class and during office hours may help. Programmatic activities should emphasize building self-confidence levels and reducing isolation to increase retention. Specific activities may include increasing access to tutoring, peer networks, seminars with engineering professionals, and mentoring.

Bibliography

[1] Adelman, C. (1998). *Women and Men of the Engineering Path: A Model for Analyses of Undergraduate Careers.* Washington, DC: U.S. Department of Education and The National Institute for Science Education.

[2] American Association of Community Colleges web site, accessed on February 26, 2007 http://www.aacc.nche.edu/Content/NavigationMenu/AboutCommunityColleges/Fast_Facts1/Fast_Facts.htm

[3] Bers, T.H., and Smith, K.E. (1991). Persistence of community college students: The influence of student intent and academic and social integration. *Research in Higher Education,* 32, 539-56.

[4] Braxton, J.M., Brier, E.M., and Hossler, D. (1988). The influence of student problems on student withdrawal decisions: An autopsy on 'autopsy' studies. *Research in Higher Education,* 28, 241-53.

[5] Cabrera, A.F., Castaneda, M.B., Nora, A., and Hengstler, D. (1992). The convergence between two theories of college persistence. *Journal of Higher Education,* 63, 143-64.

[6] Cabrera, A.F., Nora, A., and Castaneda, M.B. (1992). The role of finances in the persistence process: A structural model. *Research in Higher Education,* 33, 571-93.

[7] Cabrera, Alberto, Amaury Nora, Patrick Terenzini, Ernest Pascarella, and Linda Hagedorn. (1999). "Campus Racial Climate and the Adjustment of Students to College," *The Journal of Higher Education*. 70(2): 134-160.

[8] Campbell, Jr., George. (1997). "Engineering and Affirmative Action: Crisis in the Making", NACME Research Letter, Special Edition, NACME, Inc., New York, NY.

[9] Crain, R.W.and Prouty, R. (1994). "Community College and University cooperation in engineering and engineering technology in the State of Washington." *Frontiers in Education Conference*, 1994. Twenty-fourth Annual Conference Proceedings. IEEE: San Jose, CA.

[10] DeBerard, S., & Spelmans, G. (2004). Predictors of Academic Achievement and Retention Among College Freshmen: A Longitudinal Study. *College Student Journal*, 38, (1), 66-80.

[11] Durkheim, Emile. (1961). *Suicide,* trans. John A. Spaulding and George Simpson. New York: Free Press.

[12] Guiffrida, D. A. (2003). African American student organizations as agents of social integration. *Journal of College Student Development, 44*(3), 304–320.

[13] HeavyRunner ,Iris and Richard DeCelles. (2002). "Family education model: meeting the student retention challenge." *Journal of American Indian Education*, 41 (2).

[14] Nora, A. (1987). Determinants of retention among Chicano college students: A structural model. *Research in Higher Education,* 26, 31-59.

[15] Nora, A., Attinasi, L.C., and Matonak, A. (1990). Testing qualitative indicators of pre-college factors in Tinto's attrition model: A community college student population. *Review of Higher Education*,13, 337-56.

[16] Pascarella, E.T., Smart, J.C., and Ethington, C.A. (1986). Long term persistence of two-year college students. *Research in Higher Education,* 24, 47-71.

[17] Pascarella, E. T., & Terenzini, P. T. (1979). "Interaction effects in Spady's and Tinto's conceptual models of college dropout." *Sociology of Education, 52,* 97-210.

[18] Pascarella, E.T., Terenzini, P.T., and Wolfe, L.M. (1986). Orientation to college and freshman year persistence/withdrawal decisions. *Journal of Higher Education, 57,* 155-75.

[19] Stage, F.K. (1989). Motivation, academic and social integration, and the early dropout. *American Educational Research Journal,* 26, 385-402.

[20] Tierney, W. G. (1999). Models of minority college-going and retention: Cultural integrity versus cultural suicide. *Journal of Negro Education*, 68(1), 80–91.

[21] Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research*, 45 (1), 89-123.

[22] Tinto, V. (1987). *Leaving college.* Chicago: University of Chicago Press.

[23] Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition.* 2nd ed. Chicago: University of Chicago Press.

[24] Williamson, D.R., and Creamer, D.G. (1988). Student attrition in 2- and 4-year colleges: Application of a theoretical model. *Journal of College Student Development,* 29, 210-17.

[25] Van Gennep, Arnold. (1960). *The Rites of Passage* (1909), trans. Monika B. Vizedon and Gabrielle L. Caffee. Chicago: University of Chicago Press.