What drives engineers? A qualitative study on the adult engineering student experience

Student Paper

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Abstract

Literature has shown that adult students aged 25 and older are an important demographic of the undergraduate engineering student population. Yet, current trends in the field suggest there is a growing disproportional movement in the number of students graduating with an engineering degree as compared to the amount of students needed in the field. With that said, it is an aim of this study to seek to determine the motivation that drives these students to return to the university setting with the goal of degree completion, and to identify ways in which to better recruit, retain, and support adult students in engineering degree programs. Undergraduate engineering students at the University of New Haven were interviewed in a semi-structured interview with the aforementioned questions in mind. It was the assumption of the researchers that qualitative research may yield greater insight into this subject area that may otherwise not have been made available if using quantitative results alone. Although this study is still in progress, preliminary findings have suggested that students may be encountering an inter-role conflict (primarily between the work and school commitments, but also putting much consideration on family life) in which time (or rather, the lack thereof) has become a great issue of frustration for most. Our data also reveals some of the varied ways adult students perceive their fit within a university setting geared toward serving traditional students. This study lays groundwork for future research concerning the direction of the engineering field and where engineering students’ motivation lies, as well as ways in which to better adjust an engineering degree program to better suit the learning styles of students of all ages.

Introduction and Background

For this study adult students are defined as undergraduate students above the age of 25. Adult students can add a valuable dimension to the University, enriching the classroom dynamics by sharing real-world experiences, presenting a different model of faculty-student interactions, and bringing a set of perspectives, accomplishments, priorities, and expectations compared to their younger classmates.

Adult learners are an important pool of potential engineering professionals, and it is critical that these students are recruited to engineering programs and persist until degree completion. Ample studies have sounded the alarm that the U.S. is not preparing enough individuals in STEM disciplines to address future national needs. Keeping the United States competitive in the areas of technology and engineering requires us to draw from a broad-based talent pool, including
adult undergraduate students. By engaging interested students of all ages, we can fuel the development of the economy by advancing the educational level at all ages. The need to include a more diverse student body in higher education goes beyond the boundaries of engineers and scientists. Dennis Jones of the National Center for Educational Management Systems stated, “Unless the US finds ways to improve its performance, it will fall farther behind” (Jones, Mortimer, & Sathre, 2007). In areas rich with manufacturing and industry, many young people may enter the workforce directly out of high school to work in engineering-related functions such as assembly. In the recent past, it was common to have a career path that led to engineering positions within the same company or industry. Today, the majority of entry-level engineering positions require a BS degree, and technical experience alone is not enough to be competitive for such jobs.

There is a concern regarding recent national trends in engineering education. According to a recent U.S. Department of Education report (Aud, Hussar, Planty, Snyder, Bianco, Fox, Frohlich, Kemp, & Drake, 2010), over the last decade undergraduate degrees awarded in the fields of Engineering have dropped from 6.3 to 5.4 percent of the total degrees conferred in the country (p. 297). The numbers are easily misconstrued by the fact that the raw numbers of engineering degrees have actually risen during the same time period. However, this rise in number of degrees is due to the larger number of total degrees conferred. The proportion of students pursuing engineering degrees is declining with students instead populating fields such as business (with 21.4 percent of total degrees conferred) and Communication Technologies (experiencing a ten percent growth over the last decade). Engineering has actually suffered the second-greatest loss of students (percentage wise) over the last decade (after Education which lost 2.3 percent) (p.297). While these percentages are small, over a ten year period (1998-2008), the country has steadily seen a decline in interest in these programs despite an increase in demand.

Additionally, adult student and graduate student enrollment traditionally increases during periods of financial recession, with some programs seeing adult education applications double over the last few years (Master’s programs in Education at Texas State University). These students represent a growing segment of the population. They are often unable to attend classes during the day, due to work and family obligations, meaning that there are fewer opportunities for adult students to pursue undergraduate engineering degrees. At the same time, colleges and universities have more opportunities than ever before to engage non-traditional students through use of technology. Important issues include whether institutes of higher education are fully utilizing those resources and, if so, how adult learners are responding to not only the scheduling options but to other potential obstacles.

Adult students make up a significant fraction of all US college students. In 2007, adults aged 25 and older composed 37.6% of all students enrolled in degree-granting institutions, with slightly stronger representation in 2-year institutions (40.3%) compared to 4-year institutions (36.1%). One would expect that adults, who often are balancing educational pursuits with work and/or family commitments, may be primarily enrolled as part-time students. In fact, 59.3% of part-time students at all degree-granting institutions are adults, but adults also account for 24.2% of full-time students at all degree-granting institutions. Most engineering colleges and programs reside at 4-year institutions, where a full 69.6% of part-time students are age 25 or over (United States Department of Education, 2008).
Improving the levels of retention and recruitment of engineering students has been a major focus area lately in engineering education research. Reasons for students to enter engineering programs include the influence of family, high school teachers, and peers; previous success in math and science courses; and interests in the career track (Seymour & Hewitt, 1997). Related work has demonstrated that a primary reason that students persist in engineering programs is because they identify engineering with their sense of self (Matusovich, Streveler, & Miller, 2010), an attainment value as described by expectancy-value theorem. (Eccles, 2005). It is interesting to consider the differences between traditional-age students and adult students in these motivations and persistence trends. Adult students, especially those already engaged in technology and manufacturing fields, may have a more realistic view of what an engineering career means, or may have a stronger sense of identity with the engineering profession compared to younger classmates.

Learning style theories, such as the Kolb and the Felder-Silverman models, have been applied to explore typical engineering student learning styles, and to develop teaching strategies to engage a variety of learners through meaningful activities which capitalize on student strengths and build student skills in new areas. Harb, Hurt, Terry, & Williamson (1991) have found that engineering students tend to favor abstract conceptualization over concrete experience when learning, meaning that they favor learning activities such as instructor-led example problems, guided laboratory experiments, textbook reading, and demonstrations, while on average they do not prefer role-playing activities, open-ended design problems, and group discussions. Felder and Spurlin (2005) find that engineering student typically have a strong preference for visual learning over verbal learning, compared to humanities students. Knowledge of these learning style tendencies should inform curricular and course-level development to engage students not only in the dominant preferred style, but across the various styles to help students grow in new learning skills. Having an awareness of student preferences and differences between learning and teaching styles can help instructors to be more aware of potential areas of difficulty. Because experience shapes learning styles, there may be differences in the ways in which students of different ages are accustomed to working and learning.

Adult students can experience high levels of stress and inter-role conflict stemming from their responsibilities in work, personal, and academic domains. Kohler Giancola, Grawitch, & Borchert (2009) explored the interactions between stressors, inter-role conflict, coping behaviors, appraisal styles, life satisfaction, and general well-being by surveying a sample of 159 adult students at Saint Louis University’s School for Professional Studies. Students reported the highest levels of stressors related to work (as opposed to academic or personal stressors), which is believed to be related to the limited control the students have over work demands. Students reported the greatest levels of inter-role conflict from school to family (example, “Because my school work is demanding, at times I am irritable at home”), with significantly lower levels of stressors from family to school, work to school, and school to work. The authors present some implications for researchers and institutions, noting a need for a qualitative study to gather student stories and experiences to create depth and direct hypothesis testing, as well as an integration of social and academic spheres, such as peer and faculty relationships. They recommend the creation of a model which examines sources of stress including classroom
instruction, academic advising, admissions and financial aid, safety and security, etc., and examines learning outcomes, GPA, course drops, persistence, and graduation rates. Programs to help with stress and time management including support services geared toward adult students such as their own orientations, academic and financial aid advisors, peer advisors, and support staff and faculty who understand their needs without loss of academic rigor (Johnson, Schwartz, Bower 2000; Kaplan & Saltiel 1997), campus day care, families invited to campus events, etc.

Additional research supports the hypothesis that the balance adult students face between work, school, family, and other commitments is an additional cause of stress for adult students, but the difficulty of the coursework was also a factor. A research project in 2009 that surveyed 72 adult graduate students at Texas State asked students an open-ended question: “______ are the most common sources of stress in my life.” 51 of 72 respondents listed school or school work as their primary answer (Hollis, 2009). It is important to note here that half of these students were doctoral students and the other half masters students. All were adult commuters. Compared to the literature on undergraduate students, we see that with more challenging academic areas (i.e. graduate school), academics becomes the leading stressor (with the work, school, life balance being second). Presumably, in a difficult course of undergraduate study, such as engineering, similar results might be found that would change the way that we look at the services we provide these students. At the very least, this justifies why we should ask the questions in a guided, open-ended format.

The theoretical framework for this project builds upon two predominant concepts in adult learning literature; experiential learning and self-directed learning. The significance to these concepts is that most traditional engineering undergraduate programs are designed for traditional students (a rapidly declining proportion of the undergraduate population) and may not meet the unique needs and strengths of an adult student population. One of the fundamental concepts of andragogy is the concept that adult learners are more inclined towards self-directed learning than their younger counterparts (Merriam, Caffarella, & Baumgartner, p. 84, 2007). Dating back to the 1930’s, education pioneers such as John Dewey recognized that ‘all genuine education comes about through experience’ and this is echoed by modern literature that emphasizes the need for adult education programs to capitalize on this life experience that adult students bring to the classroom (p.162). It is important for us however to ask how best to use this experience to enhance an adult engineering students’ experience in degree programs.

Extensive work in the field of Adult Education has focused on areas where adults are well represented, including workplace training, and community colleges, but less literature has taken adult engineering students as the focus. Furthermore, within engineering education, various special groups have been studied at some length, including women and ethnic minorities, but less has centered on adult students. A recent report from Eduventures educational consultants indicates that among a group of 899 survey respondents who were pursuing or primarily interested in pursuing continuing education in engineering fields, “Improving performance or pay in a current job is the most common primary motivator for engineering students and prospects.” Other common primary motivators for these engineering students included personal enrichment, and pursuit of a license, credential, or certificate in their field. Over 80% of the respondents of this report had already attained a bachelor’s degree or higher levels of education (Eduventures, 2007).
The University of New Haven was founded in 1920, initially offering engineering and business training, with an emphasis on evening classes offered for working adult students. The University has grown to include both day and evening classes and a wider variety of coursework, but its commitment to adult engineering students has not waned, and students over the age of 25 comprise about 19% of students in the undergraduate engineering programs. However, even with a strong commitment to adult learners, smaller universities must cope with providing support for very limited demand upper-division core classes since part-time students move through the curriculum at various paces. How can institutions successfully meet the competing demands between allocating limited resources across the university while still allowing students access to needed coursework?

**Methods**

**Participants**

Participants were recruited via an e-mail invitation which were sent to all adult (aged twenty-five and over) engineering students at the University of New Haven. Within the e-mail, they were told what would be requested of them if they agreed to participate in the study, why the study was taking place, and that there would be monetary compensation (ten dollars) for the participant’s time. The content given in the e-mail was also displayed in fliers which were hung through-out campus. In a further aid to recruit participants, a researcher was invited to speak to a few engineering classes which were known to have adult students present. The content of the e-mail was simply reiterated. The recruitment process, especially the latter of the three approaches (in-vivo invitation), may have led to a non-random sampling of the population of adult engineering students attending the university, which poses a threat to this study’s external validity. This study currently has eight participants, seven of which are male. The participants range in age from 28 to 32 years of age.

**Measure**

The behavioral method includes the demographics survey, which was administered at the end of the study. It includes questions about the participant’s year in school, class load, employment, and general questions about the participant, themselves.

**Procedure**

Participants e-mailed the researcher, either responding to the mass e-mail, flier, or in-vivo invitation, stating their willingness to participate. Once a date and time was agreed upon, they were welcomed into a conference room (in two instances, the principal investigator’s office was used due to the unavailability of the conference room) and consented to the study. The hour-long, semi-structured interview then began and was audio recorded via a digital recorder. The interview consisted of questions pertaining to the participant’s reason(s) for pursuing a bachelor’s degree, challenges and strategies they have encountered, and degree to which they feel connected to others in their program. (Please see appendix A for the full list of interview questions.) Once the interview concluded, participants were then given the demographics form, debriefed, and given ten dollars as a compensation for their time.
To preserve the participant’s anonymity, the transcription of the interviews did not begin until after a few interviews had taken place. They were transcribed by the interviewer or principal investigator.

Results

It was an aim of this study to seek to determine the motivation that drives adult engineering students to return to the university setting with the goal of degree completion, and to identify ways in which to better recruit, retain, and support adult students in engineering degree programs. Albeit only preliminary, data suggests there may be a few themes participants have in common in relation to motivators. There appears to be a strong determination, on behalf of the participant(s), to complete their degree. They seek to find a better life for themselves as well as their families (for those who are married or have a significant other). They want a career in which there will be personal satisfaction (exemplifying itself as an intellectual challenge), and one which can sustain family life. They have a strong belief an engineering degree meets all of the aforementioned qualifications; ergo, typifying strong positive mentality.

However, adult students do recognize challenges they must bear through. Most of the participants have in some way noted time commitment as an adversity. Specifically, this has come up when talking about the commute they must make when going to campus from home. Students feel as though this becomes a strain on them and even impedes group work – having to schedule meetings with other students. This leads into the inter-role conflict they experience as a result thereof. Finding the comfortable balance between school, work, and family life creates a certain level of stress. The most common coping mechanism students have adapted is lack of sleep. The financial aspect of going back to school also plays a role. Some students see this as a burden, if they have difficulty paying for their education, and it results in part-time attendance so that they may also work. Some of the [financial] burden is taken off when employees are allowed flexibility in work schedule.

It has also been noted that there may be a suggestion of an age divide. This has been eluded through participants’ word choice of “kids” when referring to “traditional-aged” classmates. It brings forth the initial concern of “fit” within the community – university setting. In the future, a dichotomous definition may be more appropriate when referring to “students,” so as to not alienate the adult population.

Conclusions

This work seeks to identify the motivators and challenges to engineering undergraduate students over the age of 25 through semi-structured interviews. While the work is ongoing, the results to date indicate that a desire for a better life for the students and their families are strong motivators for this group. Challenges and areas for increased university response are related to financial and commuting issues. Future work will continue to describe the adult undergraduate engineering
student experience and to identify strategies for improving institutional support for these students throughout the degree process.

References Cited


Hollis, M.J. (2009). Unpublished data from Graduate Student Stress Survey, Texas State University, San Marcos, TX.


Appendix A: Interview Questions

- What are the major reasons for your decision to pursue a Bachelors degree in engineering? Why? How important are these factors relative to one another?
- What have been the major challenges to completing your degree work?
- Have there been moments of doubt along the way in which you considered discontinuing your degree? If so, what made you feel that way? What influenced your decision to persist?
- What are the most effective strategies you have experienced for taking advantage of your work and life experience in the engineering classroom? What are the tasks where you have shined? Design? Projects? Problem sets?
- Are there any occasions in which you feel especially connected or disconnected to your engineering student peers, professors, or the University?
- Do you experience “inter-role conflict” in which you experience pressure related to one of your roles (ie student, worker, parent, etc) negatively impacts your performance in another role?
- In what ways can the University improve its services to help you achieve your goals?