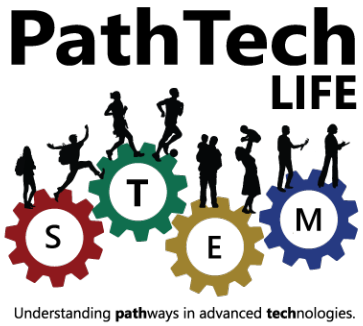

Final Report
Attachment 3

Publications
Manuscript in Progress
Conference Papers

Publication:
Fletcher, Edward C. and Will Tyson. 2020. "Examining Enrollment Decisions and Life Challenges of Adult Learners in Advanced Technologies Programs." Accepted for publication in *Journal of Vocational Education & Training*.

Manuscript in Progress:
Tyson, Will and Kristopher Oliveira. "Knowledge and Utilization of Campus Resources and Program Satisfaction Among Community College Technician Education Students."

Conference Papers:

Orozco, Danielly, Will Tyson, Lakshmi Jayaram, Marilyn Barger. 2018. "PathTech LIFE (Learning, Interests, Family and Employment): Understanding Advanced Technology Students." Conference Proceedings – American Society for Engineering Education Southeastern Section Conference http://www.asee-se.org/proceedings/ASEE2018/papers2018/151.pdf

Tyson, Will, Lakshmi Jayaram, and Marilyn Barger. 2019. "PathTech LIFE: Overview of Findings from National Survey of Technician Education Students." Conference Proceedings – American Society for Engineering Education. https://www.asee.org/public/conferences/140/papers/27933/view

Jayaram, Lakshmi. 2019. "Educational Background and Future Aspirations of Technician Students in Two-Year Programs: Emerging Findings from PathTech LIFE," Annual Meeting of the American Sociological Association, New York, NY

Abstract

The majority of students in the United States completing advanced technologies coursework, certifications, and AS/AAS degree programs within two-year colleges are adults with complex lives. They have to balance an array of challenges including health, children, and work. These school-work-life challenges can be informed by a body of knowledge related to adult decision-making patterns. Based on a national study of students in advanced technologies, we found females were significantly more likely to participate based on personal reasons. African American/Black students were significantly more likely to participate based on personal, life circumstances, and program fit. Hispanic/Latino students were more likely to participate based on personal, life circumstances, and program fit factors. Thus, enrollment and recruitment strategies at the two-year institutional and program levels should prioritize adults/working professionals, females, and ethnic and racial minority students as a critical component of their support system, and faculty need to be knowledgeable about adult life patterns and transitions to accommodate working adult learners in their courses and programs.

Keywords: adult learners, community colleges, STEM, vocational education

Examining Enrollment Decisions and Life Challenges of Adult Learners in Advanced Technologies Programs

Introduction

The national investment in Science, Technology, Engineering, and Mathematics (STEM) in the United States is founded on the value it provides in regards to economic prosperity, national security, international competitiveness, environmental sustainability, and health advancements (President's Council on of Advisors on Science & Technology, 2012). For the United States to develop a prosperous STEM workforce, it must strengthen its workforce development system – one that seamlessly enables students interested in STEM to transition from K-12 schools into two- or four-year colleges and universities, and eventually into the workforce (Colleague & Author, 2013). Indeed, a major lynchpin in helping students transition from schooling to work is the two-year college.

In 2011, forty-two percent (seventy-five million) of the total number of undergraduate students in the United States were enrolled in a two-year college (National Center for Education Statistics, 2013). In addition, the majority of students were older, from diverse ethnic and racial backgrounds, first-generation, and low socioeconomic status (Kena, Aud, Johnson, Wang, Zhang, Rathbun, Wildinson-Fliker, & Kristapovich, 2014; National Academies of Science, Engineering, & Medicine, 2016). In fact, 57% of African American/Black students were enrolled in two year colleges and 69% of Hispanics; while, 41% of White and Asian/Pacific Islander students enrolled (Witham et al., 2015). The high percentage of students enrolling at two-year colleges is likely attributed to its accessibility, affordability, and variety of degree pathways leading to both middle- and high-skilled jobs (National Academies of Science, Engineering, & Medicine, 2016). Within two-year colleges, students have the opportunity to major in STEM and STEM-related technician programs (including advanced technologies). Those students in STEM programs usually intend to transfer to a four-year university and earn a baccalaureate degree; while, students in STEM-related technician programs typically enter immediately in the workforce after completion of a certificate or associate's degree in applied science (National Academies of Science, Engineering, & Medicine, 2016).

A renewed interest in exploring the experiences, challenges, and motivations of two-year college students that major in STEM has recently occurred. This interest has been sparked by an understanding of the need to diversify the STEM workforce and to broaden participation of females and underrepresented ethnic and racial groups. Specifically, the emphasis on two-year colleges is due to the fact that these institutions educate a much more diverse student population compared to four-year universities; thereby having arguably the most likely opportunity to assist in broadening the participation of underrepresented students in STEM fields (Packard & Jeffers, 2013). Even so, compared to research focused on students in four-year universities, the research base examining two-year college students is dismal.

In this study, we examined the motivational factors of two-year college students in advanced technologies programs. The purpose of the study was to predict students' motivation for enrolling in advanced technologies programs based on their demographic, educational background, employment, and personal (school-employment-life) characteristics. These school-employment-life challenges are important as two-year colleges have the highest rates of adult learners (non-traditional students) compared to four-year universities. And, these individuals

oftentimes must grapple with the need to balance school, employment, and life challenges. The following research questions guided the implementation of this study:

Research Questions

1. Who are advanced technologies students with respect to their demographic backgrounds?
2. What are the motivational factors related to students participation in advanced technologies programs?
3. What is the relationship between demographic characteristics and participation factors (academic, employment, family, financial, personal, skill development) for advanced technologies students within two-year colleges?

Review of Literature

Transitions of the Adult Learner

Adkisson and Monaghan (2014) reminded us that "how our culture thinks about particular events as linear, normal, and expected does not always fit with the experiences of every learner, particularly underserved urban adult learners" (p. 25). In fact, two year college students in STEM (as well as those in advanced technologies) navigate varied pathways to earn degrees. To that end, adult learners oftentimes transfer from one institution (both two and four-year) to another, pursue concurrent enrollment at multiple colleges and universities, and access multiple points of entry, exit, and reentry before accomplishing their intended goals (National Academies of Science, Engineering, & Medicine, 2016). Adult learners' lived experiences as well as their socio-demographic characteristics are pertinent to their abilities to access and transition into higher education programs.

Thus, adult students in two-year colleges pursue higher education with varied goals in mind. For some students, they plan to earn an associate's or baccalaureate degree. Others are returning to higher education (many already with degrees) with a desire to strengthen their knowledge and skills in their fields. Despite their varied reasons for enrolling in the two-year college, all of these individuals are faced with transitions within their personal or professional lives – whether positive or negative. To that end, students may participate in the two-year college due to career advancement opportunities, while others may engage as a result of corporate downsizing. On a more personal level, some students transition into college after a divorce or loss of partner. These individuals are likely to participate with the desires to improve their life circumstances. Therefore, for students who participate because of a negative transition, they may indeed experience college as an additional stressor. And, many adult learners must attempt to balance parenting, employment, and schooling challenges, to name a few (Hardin, 2008).

Participation Factors

There are a variety of motivational factors that contribute to adults participating in educational activities and programs, and these assessments are complicated by individuals' beliefs, intrinsic desires, and external influences (Kasworm, 2003). In the literature, a myriad of rationales provided for participation in programs include a desire to acquire knowledge, skills, and dispositions to compete in the workforce; students aspiring to earn associates' and advanced

degrees; a need for remediation to successfully obtain employability and general competence skills; or opportunities for individuals to improve their overall lives (Hardin, 2008; Kim, Hagedorn, Williamson, & Chapman, 2004).

Stein and Wanstreet (2006) developed a conceptual model to identify decision-making factors that predict enrollment of adults in postsecondary education. Stein and Wanstreet's (2006) model identified four primary themes that adults use when contemplating whether to pursue postsecondary education. The conceptual framework was named the PRiSM Decision Model for Adult Enrollment.

The first theme, ***P****athway to a Better Life*, includes adults' evaluations of whether their cognitive and economic conditions might be improved as a result of participating in a postsecondary education program. This theme focused on adults' reflecting on the possibility of whether the route would indeed lead to an advancement in a career, and therefore, would provide security in the workforce. Within that context, adults oftentimes reflect on whether their participation in a postsecondary degree program would lead to a return on their investmentin terms of enhancing their social status as well as their occupational status and earnings potential. In addition, adult students typically decide to pursue a postsecondary for personal development reasons, to raise their senseof academic self-esteem, to revisit their educational pursuits that was not feasible in prior life stages, or to become more knowledgeable in their fields (Anderson & Swazey, 1998).

The second theme, *the **R**eflective Learner*, referred to students' assessments of their own academic abilities and readiness for re-entering into a postsecondary educational environment. Stated differently, adults' oftentimes decide to enroll programs due to a heightened perception of competence, self-efficacy, and effort needed to successfully finish a program of study. According to Hensley and Kinser (2011), "adult learner persistence is related to several variables, including commitment to the student role, possessing adequate study skills, and possessing clear, focused academic goals" (p. 90). Adults often cycle in and out of the educational environment as they contemplate and reflect on their own abilities, strengths and weaknesses.

The third theme, ***S****ynchronizing Learning, Earning, and Living*, emphasized adults' specific life stages and challenges as well as their capabilities of balancing learning in an academic environment, employment, and life challenges. Thus, adults usually decide to enroll in academic programs when they believe their life challenges are balanced. Thus, some of the factors associated with a sense of equilibrium include timing, personal resourcefulness, and family obligations.

The fourth theme, ***M****atch with an Academic Life*, stressed the essentiality of adults seeking a fit within their chosen academic program's curriculum, policies, requirements, supports, and accommodation with their active lifestyles. To this end, institutions that provide students with adequate services beyond initial recruitment and orientation activities are much more likely to be effective in retaining students (Polson, 2003). Therefore, aadults pay attention to the extent of accommodations and flexibility in the course delivery system as well as fit within their families and work life (Author, 2013).

Methods

Research Design

We used a correlational research design for the implementation of this study. We collected data by developing, validating, and distributing a questionnaire. To analyze our data, we used descriptive statistics to describe the demographic and participation factors of respondents in response to research questions one and two. And, we used simultaneous multiple regression to respond to research question three.

Sampling

We used purposive sampling to target two-year college students in advanced technologies programs across the nation (Ary, Jacobs, Razavieh, & Sorensen, 2006). Purposive sampling was used to gain access to a national sample of two-year college students. More specifically, we sent out informational materials to Principal Investigators (PIs) from advanced technologies centers. These PIs sent our questionnaire to instructors from their associated two-year colleges. We sent recruitment flyers and emails to members of the expert panel; then, these individuals forwarded the information to administrators at affiliated programs. There were a total of 1,872 respondents representing 26 two-year colleges across the nation in the following advanced technologies programs: engineering technology, energy and environmental technology, micro and nano technology, and advanced manufacturing.

Instrumentation

We constructed an online questionnaire (using Qualitrics) based on the PRiSM Model.Items on the questionnaire included students' life stages and transitions, demographic items (i.e., age, gender, race/ethnicity, socioeconomic (SES) factors, academic discipline within advanced technologies, employment status, marital status, number of dependents, prior academic background), and career and educational aspirations. The questionnaire was designed to capture the socio-demographic profile, life stages, life transitions, and motivating factors of students in advanced technologies programs at two-year colleges.

To establish content validity for the entire survey, we compiled an expert panel, with two administrators each, from seven two-year college AS/AAS degree programs in advanced technologies. The expert panel included Principal Investigators from national advanced technologies centers representing advanced manufacturing, engineering technologies, micro and nano technologies, and energy and environmental technologies. These individuals reviewed the instrument and provided feedback following a three stage iterative process known as the Delphi technique. In addition, we distributed the questionnaire in a pilot study as well as conducted a think-aloud with six advanced technologies students to provide feedback on the items of the instrument. A second pilot study was conducted to determine the feasibility of distribution methods.

To establish construct validity with respect to PRiSM, we started with 41 items representing factors influencing decisions to enroll based on the PRiSM model (Stein & Wanstreet, 2006). The instrument was developed using theory from adult education with explanatory models derived from qualitative research and socio-demographic survey research. The instrument components used the PRiSM Decision Model for Adult Enrollment (Stein & Wanstreet, 2006) conceptual framework as a lens. We also conducted a factor analysis to establish construct validity related to the PRiSM model (decisions to enroll) in advanced technologies degree/certificate program. We used factor analyses of pilot data to collapse the 41 items into

four items per PRiSM category, 16 items total. To that end, we assessed each factor loading, and items that had below a 0.60 standardized regression coefficient were removed.

Pathway to a Better Life (Cronbach's α = .630).

- I want to improve my self-esteem
- I want to expand my knowledge in my field
- I want to improve my personal growth
- I want to increase my opportunities for a better life

Reflective Learner (Cronbach's α = .695).

- I can overcome academic challenges
- I am willing to make the effort to complete the program
- I have always liked to build and fix things with my hands
- I want to build my technology skills

Synchronizing Learning, Earning, and Living (Cronbach's α = .785).

- A change in employment or job responsibilities
- A change in finances or financial concerns
- A change in family commitments
- Some other major life change (aside from employment, finances, or family)

Match with an Academic Life (Cronbach's α = .845).

- The support I receive in my program
- My fit within my program
- The academic requirements of my program
- The program accommodates my lifestyle

The generally agreed upon rule for the lower limit of Cronbach's alpha is .70, although it decreases to .60 for exploratory factor analysis (Hair, Black, Babin, Anderson, & Tatham, 2006; Robinson, Shaver, & Wrightman, 1991). Respondents (N = 1344) were asked "How important are the following reasons why you chose to enroll this semester?" and instructed to answer: *Not Important*, *Somewhat Important*, *Very Important*, or *Extremely Important* on a scale of 1 through 4. We re-named the *PRiSM* constructs to better represent the items of the questionnaire based on the factor analysis results. As such, we re-named the *Pathway to a Better Life* construct: *Personal*; *Reflective Learner*: Academics; *Synchronizing Learning, Earning, and Living*: Life Circumstances; and *Match with an Academic Life*: Program Fit. Scores within each category were added together to create a score ranging from 4 to 16 for each category as reported in table 1 below:

Table 1
Scores based on Construct

Construct	*N*	Minimum	Maximum	Mean	Std. Deviation
Personal	1344	5.00	16.00	12.8348	2.188
Academics	1344	4.00	16.00	13.118	2.327
Life Circumstances	1344	4.00	16.00	10.872	3.281
Program Fit	1344	4.00	16.00	11.584	3.082

Data Analysis

We performed factor analysis to establish construct validity with regard to motivational domains two-year college students rated related to their reasons for pursuing an advanced degree in advanced technologies. The objective of the research was to predict two-year college students' motivations for enrolling in advanced technologies programs based on their demographic characteristics. We used descriptive statistic to respond to the first two research questions, and inferential statistics (simultaneous multiple regression analyses) to examine research question three.

Results

Response to Research Question One

Table 2 indicates the demographic characteristics of students in advanced technologies programs in the sample. The majority of students (55.13%, *n* = 741) are in the age range of 18 to 25 years old. Respondents of the sample were 78.65% (*n* = 1057) male. With regard to ethnic and racial backgrounds of the students, it is important to note that respondents had the opportunity to select multiple categories, thus, making the entire sample more than 100%. The largest ethnic and racial group was White (*n* = 947, 70.46%) and the largest minority group was Hispanic/Latino (*n* = 222, 16.52%). In regards to employment status, the majority of students worked either part-time (*n* = 517, 38.47%) or full-time (*n* = 442, 32.89%). Thus, most advanced technologies students in this sample were 18 to 25 years old White males that held full-time employment.

Table 2
Demographic Characteristics of Advanced Technologies Students

Age	*n*	*%*
Traditional (18-25)	741	55.13
Non-traditional (26-35)	367	27.31
Older (36+)	236	17.56
Gender		
Female	274	20.39
Male	1057	78.65
Non-gender conforming	13	00.97
Race/Ethnicity		
African American/Black	146	10.86
Native American/American Indian	50	03.72
Asian	95	07.07
Hispanic/Latino	222	16.52
Middle Eastern/North African	24	01.79
Native Hawaiian/Pacific Islander	21	01.56
Other	36	02.68
White	947	70.46
Employment Status		
Active duty military	5	0.37

Employed seasonally	50	3.72
Full-time	442	32.89
Part-time	517	38.47
Unemployed but actively looking	165	12.28
Unemployed but not actively looking	165	12.28

Response to Research Question Two

Table 3 shows the mean scores (on a scale of 4 to 16) on the four motivational factors (Personal, Academics, Life Circumstances, and Program Fit) as it relates to student demographic characteristics (age, gender, and race/ethnicity). It is important to note that the mean scores are not intended to show correlations, statistically significant differences, or relationships within groups, between groups, or among variables (i.e., gender and ethnic and racial background). Instead, these statistics highlighted are intended to describe the mean scores based on key demographic characteristics. Overall, respondents rated personal and academics as the highest factors for enrolling in advanced technologies programs.

Across all age categories, students rated academics as the highest factor for enrolling in advanced technologies programs and life circumstances as the lowest.

For gender, females rated personal (M = 13.26) as the highest reason for enrolling in advanced technologies programs, and males, females, and non-gender confirming students rated life circumstances (M = 11.48; 10.74; 08.77, respectively) as the lowest. On the other hand, males and non-gender confirming students rated academics (M = 13.20) as the highest reason for enrolling in advanced technologies programs.

In comparison to students from other ethnic and racial backgrounds, Middle Eastern or North African students rated personal (M = 14.04) as the highest reason for enrolling in advanced technologies programs. Native Hawaiian and Pacific Islander (M = 10.33) students rated program fit as the lowest factor for enrolling in advanced technologies programs.

Table 3
Motivation Factors based on Demographic Characteristics

	Personal		**Academics**		**Life Circumstances**		**Program Fit**	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age								
Traditional (18-25)	12.76	02.17	13.21	02.20	10.45	03.37	11.60	03.02
Non-traditional (26-35)	12.97	02.16	13.10	02.46	11.33	03.26	11.47	03.27
Older (36+)	12.86	02.28	12.86	02.48	11.49	02.82	11.72	02.99
Gender								
Female	13.26	02.16	12.86	02.46	11.48	03.25	12.45	02.75
Male	12.74	02.17	13.20	02.28	10.74	03.27	11.39	03.12
Non-Gender Confirming	11.37	02.69	11.54	02.50	08.77	02.92	09.08	02.56
Race/Ethnicity								
African American/Black	13.46	02.22	13.33	02.42	12.27	02.99	12.60	02.85
Asian	13.07	02.14	13.18	02.41	11.21	03.21	11.97	03.15
Hispanic/Latino	13.08	02.15	13.42	02.23	11.75	03.14	11.97	03.15
Middle Eastern or North African	14.04	02.22	13.42	02.62	11.79	03.72	11.33	03.48

Native American or American Indian	12.44	01.85	12.36	02.27	10.70	03.14	11.44	02.66
Native Hawaiian or Pacific Islander	12.19	02.40	12.24	03.05	11.29	03.77	10.33	03.26
White	12.62	02.15	12.94	02.34	10.36	03.21	11.27	03.04

Response to Research Question Three

As shown in Tables 4 and 5, predictor variables represent respondents' demographic characteristics, namely: age, ethnic and racial background, sexual identity, residential status, educational background, marital status, number of children, employment status, and household income. The dependent variables were categorized based on respondents' motivations for pursuing advanced technologies programs based on the factors identified from the factor analysis, namely: personal, academics, life circumstances, and program fit.

Motivational Factors Related to Personal. A simultaneous multiple regression analysis produced a significant model to explain motivation for pursuing advanced technologies programs based on personal factors. Through a linear combination of predictor variables (R^2= 0.074, $F_{(31, 1344)} = 3.185$, $p < .001$), the regression model with 31 independent variables (see Table 4 for a list of independent variables) accounted for 7.4% of the variance in explaining motivation for pursuing advanced technologies programs based on personal factors. Of the total independent variables in the model, six of them significantly predicted motivation for pursuing advanced technologies programs based on personal factors: female students were significantly more likely ($\beta = 0.098$; $SE = 0.154$; $p < 0.001$) compared to males to pursue advanced technologies programs based on personal factors; African American/Black students were significantly more likely ($\beta = 0.055$; $SE = 0.164$; $p = 0.001$) compared to Whites to pursue advanced technologies programs based on personal factors; Hispanic/Latino students were significantly more likely ($\beta = 0.092$; $SE = 0.193$; $p = 0.047$) compared to Whites to pursue advanced technologies programs based on personal factors; Middle Eastern/North African students were significantly more likely ($\beta = 0.0088$; $SE = 0.461$; $p = 0.002$) compared to Whites to pursue advanced technologies programs based on personal factors; students who preferred not to disclose their LGBT status were significantly less likely ($\beta = -0.105$; $SE = 0.337$; $p < 0.001$) compared to LGBT students to pursue advanced technologies programs based on personal factors; and those who did not know their household income were significantly more likely ($\beta = -0.069$; $SE = 0.152$; $p = 0.018$) compared to students that indicated their household income based on personal factors.

Motivational Factors Related to Academics. A simultaneous multiple regression analysis produced a significant model to explain motivation for pursuing advanced technologies programs based on academic factors. Through a linear combination of predictor variables (R^2= 0.074, $F_{(31, 1344)} = 2.554$, $p <. 0.001$), the regression model with 31 independent variables accounted for 7.4% of the variance in explaining motivation for pursuing advanced technologies programs based on academic factors. Of the total independent variables in the model, six of them significantly predicted motivation for pursuing advanced technologies programs based on academic factors: female students were significantly less likely ($\beta = -0.060$; $SE = 0.702$; $p = 0.044$) compared to males to pursue advanced technologies programs based on academic factors; Native American or American Indian students in advanced technologies programs were significantly less likely ($\beta = -0.067$; $SE = 0.342$; $p = 0.016$) compared to White students to pursue advanced technologies programs based on academic factors; students that indicated

"Other" as their ethnic and racial background were significantly more likely (β = -0.055; *SE* = 0.398; p = 0.046) compared to Whites to pursue those programs based on academic factors; students in advanced technologies programs that had enrolled in a four year university were significantly less likely (β = -0.058; *SE* = 0.219; p = 0.043) compared to students that had not enrolled in a prior university to pursue those programs based on academic factors; students in advanced technologies programs that had earned a baccalaureate degree were significantly less likely (β = -0.105; *SE* = 0.253; p < 0.001) compared to those that did not have a baccalaureate degree to pursue advanced technologies programs based on academic factors; students that were living with a partner were significantly more likely (β = 0.071; *SE* = 0.254; p = 0.036) compared to students that were not living with a partner to pursue advanced technologies programs based on academic factors; and students that did not know their household income were significantly less likely (β = -0.080; *SE* = 0.162; p = 0.007) compared to students that did indicate their household income to pursue advanced technologies programs based on academic factors.

Motivational Factors Related to Life Circumstances. A simultaneous multiple regression analysis produced a significant model to explain motivation for pursuing advanced technologies programs based on life circumstances, through a linear combination of predictor variables (R^2= 0.113, $F_{(31, 1344)}$ = 5.066, p < 0.001). The regression model with 31 independent variables accounted for 11.3% of the variance in explaining motivation for pursuing advanced technologies programs based on life circumstances. Of the total independent variables in the model, eight of them significantly predicted motivation for pursuing advanced technologies programs based on life circumstances: older students in advanced technologies programs were significantly more likely (β = 0.068; *SE* = 0.011; p = 0.047) compared to younger students to pursue advanced technologies programs based on life circumstances; male students were significantly more likely (β = 0.071; *SE* = 0.225; p = 0.011) compared to female students to pursue advanced technologies programs based on life circumstances; Hispanic/Latino students were significantly more likely (β = 0.133; *SE* = 0.241; p < 0.001) compared to White students to pursue advanced technologies programs based on life circumstances; African American/Black students were significantly more likely (β = 0.144; *SE* = 0.284; p < 0.001) compared to White students to pursue advanced technologies programs based on life circumstances; LGBT students were significantly less likely (β = -0.057; *SE* = 0.437; p = 0.043) compared to non-LGBT students to pursue advanced technologies programs based on life circumstances; students that were not currently employed and not actively looking were significantly less likely (β = -0.083; *SE* = 0.302; p = 0.008) compared to students that were employed to pursue advanced technologies programs based on life circumstances; students that had higher household incomes were significantly less likely (β = -0.109; *SE* = 0.034; p < 0.001) to pursue advanced technologies programs based on life circumstances; and students that were in a related job to advanced technologies were significantly less likely (β = -0.061; *SE* = 0.217; p < 0.039) to pursue advanced technologies programs based on life circumstances.

Motivational Factors Related to Program Fit. A simultaneous multiple regression analysis produced a significant model to explain motivation for pursuing advanced technologies programs based on program fit. Through a linear combination of predictor variables (R^2= 0.072, $F_{(31, 1344)}$ = 3.097, p < 0.001), the regression model with 31 independent variables accounted for 7.2% of the variance in explaining motivation for pursuing advanced technologies programs based on program fit. Of the total independent variables in the model, six of them significantly predicted motivation for pursuing advanced technologies programs based on academic factors: male students in advanced technologies programs were significantly more likely (β = 0.132; *SE* =

0.217; $p < 0.001$) compared to female students to pursue advanced technologies programs based on program fit; Hispanic/Latino students were significantly more likely ($\beta = 0.067$; $SE = 0.231$; $p = 0.017$) compared to White students to pursue advanced technologies programs based on program fit; African American/Black students were significantly more likely ($\beta = 0.112$; $SE = 0.272$; $p < 0.001$) compared to White to pursue advanced technologies programs based on program fit; Native Hawaiian and Pacific Islander students were significantly less likely ($\beta = -0.058$; $SE = 0.693$; $p= 0.038$) compared to White students to pursue advanced technologies programs based on program fit; students who preferred not to indicate their LGBT status was significantly less likely ($\beta = -0.061$; $SE = 0.475$; $p= 0.032$) compared to non-LGBT students to pursue advanced technologies programs based on program fit; and students in advanced technologies programs who had previously enrolled in a four-year university were significantly less likely ($\beta = -0.103$; $SE = 0.289$; $p < 0.001$) compared to students that had not enrolled in college before to pursue advanced technologies programs based on program fit.

Limitations. It is important to note that the variance explained in each of the aforementioned models is low (11% or lower). As such, there are variables that account for the motivational factors that are not included in our analysis. Some variables that might contribute to students' motivational factors to pursue advanced technologies programs, coursework, and certificates could include curricula taken in high school, the influence of academic advisors, and prior life transitions (positive or negative).

[Place Table 4 here]

[Place Table 5 here]

Discussion

There is widespread concern associated with providing access to, serving the needs of, and promoting the success of ethnic and racial minority students as a pathway to develop skilled workers in science, technology, engineering, and mathematics (STEM) fields within two-year college programs (Colleague & Author, 2013). In fact, two-year colleges play a substantial role in building the STEM workforce as well as widening opportunities to both youth and a large percentage of returning adults (Wang, 2013). While two-year colleges serve as the initial entry point into higher education for the majority of underrepresented college students – many who have aspirations to eventually transfer into four-year universities and earn bachelor's degree as well as some who would like to go on and earn graduate degrees (Bensimon & Santiago, 2013) – programs like advanced technologies still suffer from a large shortage of females and ethnic and racial minorities (Digest of Educational Statistics, 2009).

Findings revealed the profile of students in advanced technologies programs. These programs are critical within the overall STEM enterprise. Therefore, it is important to understand who decides to participate, their reasons for participation, and the conditions facilitating such decisions to encourage wider participation, and to better serve participants' needs (Merriam, Cafarella, & Baumgartner, 2007). We found that the majority of advanced technologies students in the sample were White males with full-time employment; these individuals were primarily between the ages of 18 and 25. These demographic characteristics are similar to national data (National Academies of Science, Engineering, & Medicine, 2016; National Science Board, 2014). In fact, according to the National Science Board, 72% of the STEM population was

White, 9% were African American/Black, 8% Hispanic, and 4% Asian. In regard to gender, 86% of STEM students were male. Our findings demonstrate a slight higher percentage of females and ethnic and racial minorities represented in advanced technologies disciplines – 20.39% of advanced technologies students were female, 16.52% Hispanic/Latino, 10.86% African American/Black, and 7.07% Asian. While the uptick in females and ethnic and racial minorities is promising, the disparities in gender and ethnic and racial representation are still quite vast, signaling a continuing concern for broadening participation efforts in STEM fields within two-year degree programs (Colleague & Author, 2013; Wang, 2013). Our findings also demonstrate the need for two-year college administrators to pay attention to school-work-life balance issues of advanced technologies students given the high percentage (71.36%) that are employed full-time or part-time.

We also found that advanced technologies students in general pursued their certificate, courses, and degree programs because of both personal (wanting to improve self-esteem/personal growth, expand their knowledge in the field, and increase opportunities for a better life) and academic reasons (overcoming academic challenges, willingness to make the effort to complete the program, interest in building and fixing things, and wanting to develop their technological skills). While not surprising, these findings signal that students are contemplating how an advanced technologies career pathway could lead to career advancement potential both cognitively and economically (Anderson & Swazey, 1998; Author, Colleague, & Colleague, 2013; Patton, 2012; Stein & Wanstreet, 2006). Therefore, two-year college administrators could emphasize how pursuing certificates, courses, and degrees in advanced technologies could promote knowledge acquisition, social capital through building relationships, the expansion of professional community networks, and the learning of critical technological skills needed to compete in the new knowledge based economy. Further, supports (i.e., academic advising, technological support, tutoring and writing services) are needed to facilitate students' abilities to overcome academic challenges and complete the programs in a timely fashion.

While we did not assess statistically significant differences, females rated personal factors as their highest reason for participating in advanced technologies programs. Personal factors is comprised of items such as: wanting to improve self-esteem/personal growth, expand their knowledge in the field, and increase opportunities for a better life. Therefore, to attract female students to advanced technologies programs, two-year college administrators could communicate the benefits of pursuing certificates, courses, and degrees based on the impact and value it would have on them individually (potential increase in knowledge and self-esteem) and their opportunities for a better life both socially and economically. Older students were significantly more likely to pursue advanced technologies programs due to life circumstances. Stated differently, older students chose to participate when a financial change, shift in employment opportunities, change in family commitments, or a major life event occurred in their lives. Thus, two-year college administrators and faculty could discuss individuals' life stages, obligations, and goals and how their programs could accommodate their life challenges (Stein, Wanstreet, & Trinko, 2011).

Given the underrepresentation of females and ethnic and racial minorities in advanced technologies and other STEM fields/programs, it is important to understand the motivational factors these individuals have for pursuing certificates, courses, and degrees. For females, they rated academic and personal factors highest. Females were also significantly more likely than males to decide to enroll in advanced technologies programs based on personal factors (i.e. wanting to improve self-esteem/personal growth, expand their knowledge in the field, and

increase opportunities for a better life). Therefore, to attract female students to advanced technologies programs, two-year college administrators could communicate the benefits of pursuing certificates, courses, and degrees based on the impact and value it would have on them individually (increase in knowledge acquisition, self-esteem, personal growth, and opportunities for a better life). In addition, program administrators and faculty could assist female students in seeing the clear linkage between an advanced technologies program of study/background and their own individual goals.

In terms of ethnic and racial backgrounds, African American/Black students were significantly more likely than Whites to participate based on personal (i.e. wanting to improve self-esteem/personal growth, expand their knowledge in the field, and increase opportunities for a better life), life circumstances (change in employment/job responsibilities/finances/family commitments), and program fit (support from the program, fit with program, accommodation of lifestyle) factors. In addition, Hispanic/Latino students were significantly more likely to pursue advanced technologies programs based on life circumstances and program fit factors. Therefore, to attract African American/Black students to advanced technologies programs, two-year college administrators could communicate the benefits of pursuing certificates, courses, and degrees based on the impact and value it would have on them individually (potential increase in knowledge and self-esteem) and economically. For both African American/Black and Hispanic/Latino students, programs could also communicate the benefits participation could have on their families, the fit between pursuing advanced studies and a working lifestyle, and by providing services to accommodate working professionals – such as the opportunity for online courses and degree programs (Stein et al., 2011).

In summary, enrollment and recruitment strategies at the two-year institutional and program levels should prioritize adults/working professionals, females, and ethnic and racial minority students as a critical component of their support system, and faculty need to be knowledgeable about adult life patterns and transitions to accommodate working adult learners in their courses and programs (Stein et al., 2011). Similar to Stein et al. (2011), we found that two-year college students pursuing advanced technologies programs considered an array of factors simultaneously when considering important decisions to improve their occupational and social statuses. These decisions included personal, academics, life circumstances, and program fit. In fact, Lundberg (2003) found that adult learners were most influenced by relationships with administrators and faculty compared to younger students that relied more heavily on peer relationships and campus social activities. Thus, findings provide two-year college administrators and faculty with a better understanding of the students they serve in terms of their unique motivational factors that lead them to advanced technologies programs as they begin to contemplate navigating a postsecondary education landscape toward a pathway to a better life.

Findings from this research study are important as this was the first attempt to develop and validate an instrument based on the PRiSM model of adult decision-making as outcome variables to determine how these motivational factors relate to demographic characteristics of advanced technologies students participating in two-year colleges. As a result, our findings should make theoretical contributions to STEM program research by introducing concepts from the adult education literature to explore the motivations of adult learners through six integral factors leading to their participation: academic, family, financial, personal, and opportunity. In addition, this study helps explain adult transitions, motivational factors, challenges these students face, and its impact on students' personal and professional lives. To that end, results of our study have the potential to provide institutional knowledge regarding the reasons for students to pursue

two-year degrees/certificates in advanced technologies programs for the purpose of broadening participation of underrepresented students. As such, two-year colleges can begin to encourage and provide supports for recruiting diverse student applicants to STEM related courses, programs, and certificates, and to accommodate their current diverse student population as well as to assist with their persistence in completing courses, degrees, and certificates.

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Table 4: *Motivational Factors based on Demographic Variables*

	Personal				**Academic**				**Life Circumstances**			
Independent Variables	*β*	*S.E.*	*t*	*p*	*β*	*S.E.*	*t*	*p*	*β*	*S.E.*	*t*	*p*
Intercept		0.363	36.048	<.001		0.389	34.147	<.001		0.533	20.417	<.001
Age	-0.015	0.007	-0.420	.675	-0.012	0.008	-0.346	.729	0.068	0.011	1.990	.047
Female	0.098	0.154	3.453	.001	-0.053	0.165	-1.876	.061	-0.053	0.962	-1.844	.065
Gender Non-Conforming	-0.048	0.656	-1.629	.103	-0.060	0.702	-2.014	.044	0.071	0.225	2.558	.011
Hispanic/Latino	0.055	0.164	1.989	.047	0.052	0.176	1.852	.064	0.133	0.241	4.879	<.001
African American/Black	0.092	0.193	3.351	.001	0.044	0.207	1.599	.110	0.144	0.284	5.360	<.001
Asian	0.044	0.241	1.554	.120	0.035	0.259	1.222	.222	0.042	0.354	1.499	.134
Native American or American Indian	-0.046	0.319	-1.676	.094	-0.067	0.342	-2.414	.016	-0.033	0.469	-1.220	.223
Middle Eastern or North African	0.088	0.461	3.168	.002	0.023	0.494	0.814	.416	0.032	0.676	1.177	.240
Native Hawaiian or Pacific Islander	-0.041	0.491	-1.469	.142	-0.044	0.527	-1.578	.115	0.012	0.721	0.439	.661
Other Race/Ethnicity	0.026	0.371	0.942	.346	0.055	0.398	1.999	.045	0.044	0.545	1.634	.103
LGBT	0.003	0.298	0.090	.928	-0.006	0.319	-0.199	.842	-0.057	0.437	-2.022	.043
LGBT (Prefer not to say)	-0.105	0.337	-3.698	<.001	-0.039	0.361	-1.384	.166	-0.008	0.494	-0.307	.759
Number of Children	0.009	0.068	0.213	.832	0.032	0.072	0.718	.473	-0.074	0.099	-1.723	.085
Permanent Residence	0.017	0.262	0.636	.525	0.026	0.280	0.940	.347	0.033	0.384	1.231	.219
Other Residence	0.029	0.388	1.031	.303	0.009	0.416	0.321	.748	-0.001	0.570	-0.033	.974
Community College Enrollment	0.043	0.161	1.485	.138	0.173	0.173	-0.519	.604	0.044	0.237	1.568	.117
Associate Degree Enrollment	0.021	0.225	0.739	.460	0.241	0.241	0.783	.434	0.014	0.331	0.508	.612
Four Year Enrollment	-0.012	0.205	-0.410	.682	0.219	0.219	-1.936	.053	-0.031	0.301	-1.112	.266
Bachelor degree	-0.057	0.236	-1.918	.055	0.253	0.253	-3.532	<.001	-0.015	0.346	-0.506	.613
Living with Partner	0.030	0.237	0.894	.372	0.071	0.254	2.095	.036	0.063	0.348	1.921	.055
Separated	0.019	0.592	0.696	.487	0.007	0.635	0.245	.807	-0.005	0.870	-0.181	.857
Divorced	0.007	0.324	0.231	.818	0.054	0.347	1.848	.065	-0.007	0.476	-0.235	.814
Single	-0.007	0.187	-0.159	.874	0.073	0.200	1.745	.081	-0.066	0.275	-1.618	.106
Widowed	-0.039	1.100	-1.440	.150	-0.023	1.179	-0.848	.396	-0.025	1.615	-0.917	.359
Any Children	-0.043	0.199	-0.954	.340	-0.008	0.213	-0.185	.853	0.068	0.292	1.523	.128
Employed part-time	-0.002	0.030	-0.047	.963	0.000	0.032	-0.006	.995	-0.023	0.044	-0.706	.480
Employed seasonally	-0.006	0.064	-0.206	.837	-0.027	0.068	-0.963	.336	0.003	0.094	0.119	.906
In the Military	0.004	0.217	0.152	.879	0.018	0.232	0.674	.500	-0.003	0.318	-0.126	.900
Not currently employed/ but looking	-0.043	0.102	-1.373	.170	-0.006	0.109	-0.182	.856	-0.038	0.150	-1.237	.216
Not currently employed/not looking	-0.047	0.205	-1.464	.143	-0.027	0.220	-0.83	.407	-0.083	0.302	-2.672	.008
Household Income	-0.044	0.023	-1.521	.129	-0.042	0.025	-1.418	.156	-0.109	0.034	-3.807	<.001
Don’t Know Household Income	-0.069	0.152	-2.371	.018	-0.080	0.162	-2.721	.007	-0.033	0.222	-1.148	.251
Job Related	-0.008	0.148	-0.274	.784	-0.023	0.158	-0.749	.454	-0.061	0.217	-2.066	.039

Table 5: *Motivational Factors based on Demographic Variables*

	Program Fit			
Independent Variables	*β*	*S.E.*	*t*	*p*
Intercept		0.512	21.694	<.001
Age	0.011	0.011	0.323	.747
Female	0.132	0.217	4.667	<.001
Gender Non-Conforming	-0.054	0.925	-1.854	.064
Hispanic/Latino	0.067	0.231	2.399	.017
African American/Black	0.112	0.272	4.070	<.001
Asian	0.042	0.341	1.484	.138
Native American or American Indian	-0.009	0.451	-0.321	.748
Middle Eastern or North African	-0.005	0.650	-0.184	.854
Native Hawaiian or Pacific Islander	-0.058	0.693	-2.076	.038
Other Race/Ethnicity	0.019	0.524	0.690	.490
LGBT	-0.020	0.420	-0.701	.484
LGBT (Prefer not to say)	-0.061	0.475	-2.147	.032
Permanent Residence	0.014	0.369	0.504	.614
Other Residence	0.011	0.548	0.397	.619
Community College Enrollment	-0.017	0.227	0.504	.567
Associate Degree Enrollment	0.008	0.318	-0.573	.773
Four Year Enrollment	0.103	0.289	0.288	<.001
Bachelor degree	-0.038	0.333	-3.640	.195
Living with Partner	0.036	0.335	1.078	.281
Separated	0.025	0.835	0.919	.358
Divorced	0.006	0.457	0.210	.834
Single	-0.003	0.264	-0.082	.935
Widowed	-0.012	1.552	-0.441	.660
Number of Children	-0.018	0.095	-0.409	.682
Any Children	0.073	0.281	1.609	.108
Employed part-time	0.034	0.042	1.022	.307
Employed seasonally	0.002	0.090	0.071	.943
In the Military	-0.007	0.306	-0.263	.793
Not currently employed/ but looking	0.031	0.144	0.970	.332
Not currently employed/not looking	0.029	0.290	0.917	.359
Household Income	-0.055	-1.881	-1.881	.060
Don’t Know Household Income	0.010	0.343	0.343	.732
Job Related	0.010	0.339		.735

Knowledge and Utilization of Campus Resources and Community College Technician Education Student Program Satisfaction

Will Tyson
Kristopher Oliveira
University of South Florida

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Data and Methods

We examine community college student utilization of career/job placement services (i.e. career centers) using data collected from a national survey of community college students enrolled in technician education AS/AAS degree programs. The full dataset includes 3,216 students enrolled in 96 colleges from through the United States enrolled in programs broadly identified as engineering technology, advanced manufacturing, micro & nanotechnologies, and energy & environmental technologies. Students were recruited through program faculty and administrators and completed the survey over three rounds of data collection in 2017 and 2018[i]. Students who completed rounds 2 and 3 (N = 2,777) completed questions about campus resource. The analytical sample is comprised of 45 colleges from which 20 or more students completed the rounds 2 and 3 surveys (N = 2,336). We chose 20 or more in order have enough students from each college who gave the responses in the dependent variable below.

Dependent Variable

The primary dependent variable in this study is the *use* of career/job placement services. The survey asked two questions about 15 different campus resources[ii]:

(1) "Are the following resources available at your college?"
(2) "Do you utilize them or would you utilize them if they were available?"

These responses yield four responses:

(1) Available, do use
(2) Available, do not use
(3) Not available, would use
(4) Not available, would not use

Table 1 shows that among the 2,333 respondents, 17.6% said career centers were available and they do use them and 55.7% said career centers were available and they do not use them. So among the 1,714 students who knew career centers were available, only 412 (24.0%) actually used them. With respect to internship opportunities, 20.3% used them and 48.4% did not use them despite knowing these opportunities were available. Among the 1,605 students who knew internship opportunities were available, only 475 (29.6%) actually took advantage of them. Analyses determine characteristics of students who used these services compared to those who did not.

Academic Experiences

This study examines how student academic experiences, job and finances, and life changes at enrollment are associated with use of career centers. Academic experiences include students' self-reported *GPA* (grade point average), *courses taken* within the last 12 months, and hours spent on *homework* and course-related work outside of class. Table 1 shows 38% of students reported a GPA between 3.5 and 4.0 and another 29% had a GPA between 3.0 and 3.49 meaning most students were A or B students. GPA is included in the model as a continuous

variable in which 1 = Less than 2.0 and 5 = Between 3.5 and 4.0. In indicator variable is included for students who did not know or did not have a GPA[iii].

Students listed the number of courses taken within the last 12 months from one up to more than 12. There was a wide range of responses with 34% of students having taken five to eight courses and around 25% who took one to four and 9-12 courses. An additional 15% took more than 12 courses. This variable is included as a continuous variable. We decided to include this measure of intensity of enrollment over the last year as opposed to part-time or full-time in the current semester because students with a greater academic connection to the college may have been more likely to use campus services in the past and present. Homework is also measured as a continuous variable ranging from 1 to 4 in five hour increments (1 = 0 to 5 hours per week and 4 = 16 or more hours).

Job and Finances

Employment status is measured in the eight categories in Table 1. These categories note if students were currently unemployed or employed, looking or not looking for a job, employed part-time or full-time, and employed in a job related or unrelated to their field of study. The majority of students work working while enrolled with a close to even split between part-time (38%) and full-time (36%) employment. Most part-time workers were in a job unrelated to their field. Most full-time workers were in a job related to their field. Employment status is included in the model as a series of indicator variables with employed full-time in a job related to field as the reference group. Current military employment and seasonal employment are omitted from the model due to few respondents. *Military* status is measured by another question in which students indicated if they were active duty, active reserves, or a veteran. All three were grouped together in an indicator variable. Table 1 shows that 10% of students had a military background.

Students were asked to check all that apply among a variety of ways to pay for college, the most common of which were scholarships (53%), primary job (41%), and personal savings (27%) as indicated in Table 1. Given the high correlation between some of these college funding sources and employment variables, models include indicator variables for *scholarships*, *income from primary job*, *family contribution*, *personal savings*, *income from a second job*, and *other* sources. The rest of the variables were omitted.

Life Changes at Enrollment

We asked students two separate sets of questions about whether or not they had experienced life changes and if life changes were important factors in their decision to enroll in the current semester. The survey asked students "How important are the following reasons why you chose to enroll this semester?" based on the PRiSM Decision Model for Adult Enrollment (Stein and Wanstreet 2006)[iv]. The reasons below were derived from the Synchronizing Learning, Earning, and Living theme which emphasizes students' particular life stages as well as their abilities to balance learning, earning, and living as critical determinants in their decisions to pursue enrollment in higher education:

- A change in employment or job responsibilities
- A change in finances or financial concerns
- A change in family commitments
- Some other major life change (aside from employment, finances, or family)

Responses to each were on a Likert scale in which 1 = not important and 4 = extremely important. We summed responses and created a *Synch scale* with values ranging from 4 to 16 and a mean of 13.04 with a Cronbach's alpha of .791.

The survey also asked students if they experienced life changes 12 months before their initial enrollment related to their job responsibilities, financial concerns, family commitments, or other major life changes and if so, if those changes were for the worse, neutral, or for the better. A minority of students experienced each type of life change including 39% who experienced a change in job responsibilities and 37% who experienced a change in financial concerns. Most of the job changes were for the better whereas more financial changes were for the worse than better. Only 20% of students experienced family changes with half of those changes being positive and 26% experienced some other type of life change. Although fewer than half of students experienced any one specific life change, a majority of students experienced some life change (64%). The model includes indicator variables for worse, neutral, and better compared to no change for job responsibilities, family commitments, and other life changes. Family [v]commitments are omitted due to high correlations with job responsibilities.

Control Variables

The model controls for age, gender, race/ethnicity as well as family status. Survey respondents ranged from ages 18-74. Table 1 shows age quintiles that indicate about 40% of students were age 18-21, firmly within traditional age for community college students. The oldest quintile was age 34 and above. *Age* is included in the model as a continuous variable. *Gender* is self-reported by students as male, female, and gender non-conforming with male as the reference group in the model. Survey recipients were instructed to check all that apply among the race/ethnicity options listed in Table 1. White and Hispanic were the two largest groups follow by Black/African-American and Asian students.

Students indicated their marital status as single, widowed, divorced, separated, living with a partner, or married. The majority of students were single (66%) and 20% were married. Widowed, divorced, and separated were collapsed into one category (WDS) in the analysis. Single was the reference group. Students were asked about the number of children in their household. Students with at least one child in the household were compared to students without a child in the household. It is important to note that younger students may have been living with their parents and thus counted siblings as children in their household.

Analyses

This study examines how students' academic, professional, and personal lives are associated with their use of career centers and internship opportunities. Since these students are nested within community colleges, we estimate models using hierarchical linear modeling, a binominal logistic regression model predicting use of these resources compared to not using these resources among students who knew they were available. Level 1 variables are described above. Level 2 variables at the college level include the percentage of students who said each resource was available. A majority of students surveyed at each college reported that career services and internships were available at their school. This a significant level-2 variable in each career center model ($p < .01$), but not internships. Preliminary analyses indicated that other potential level-2 variables were not significant (urbanicity, percent part-time enrollment, type of program) and thus were omitted from the model.

Each model below includes the demographic and family status control variables as a baseline model. Six remaining models include one or more of the sets of independent academic, job, and life changes variables as shown in Tables 2 and 3.

Results

The baseline model indicates that age is significant at $p < .10$ in the baseline model, but significant at $p < .05$ when accounting for academic and/or financial factors. Age is not a significant predictor of use of internship opportunities. Gender and race are not significant predictors of career center; however, the internship baseline models shows women and students who identify as non-gender conforming were more likely to use internships. Effects for non-gender conforming students remain when accounting for academics, finances, and life changes whereas effects for women do not. WDS students had higher usage of career centers. Table 1 indicates that divorced students made up 6% of students who used career centers and 3% of students who did not which likely accounts for the significant findings. In addition, students who reported having a child in the household were less likely to use career centers and internship opportunities.

Academic Experiences

There is no significant association between GPA and career center use, but high GPA is associated with internship use throughout models. Students who had taken more courses over the last 12 months were more likely to use career centers. Interestingly, this effect is significant at $p < .001$ in Table 2B but significant at $p < .05$ when adding financial effects and $p < .01$ when adding life changes effects in Table 3. Similarly with respect to internships, courses taken are significant at $p < .05$ unless finances are included in the model. The same is true for hours spent on homework or course-related work when finances and/or life changes are included in the model. These findings suggest that a student's personal situation, particularly finances, account for some of the positive impact of more intensive course enrollment and coursework completion.

Financial

Variables that represent students' financial situations are relatively consistent across models within each dependent variable. All students except for unemployed students who were not looking for a job were more likely to use career centers than students with a full-time job in a field related to their studies. These two groups represent the edges of the continuum of employment, those who aren't looking for a job and those who may have the job they want. Unemployed students looking for a job and students with a part-time job related to their field were around twice as likely to use career centers as students with a full-time job in their field according to the odds ratios in Table 2. This effect diminishes when other variables are added. Students working full-time in unrelated fields were significantly more likely to use career centers at $p < .05$ compared to students working full-time in related fields until accounting for life changes. In short, students who seemingly want and need assistance in getting a job are most likely to get it. Unemployed students looking for work and working part-time in a field related to their studies were most likely to use internship opportunities. These effects were consistent across models.

Students use various methods of paying for college that are dependent on other facets of their life. Students who used scholarships, income from a primary job, family contributions, personal savings, income from a second job, and other sources (besides loans, military assistance, and working overtime) were more likely to use internships. Students who paid for college with scholarships, personal savings, and income from a second job were more likely to use career centers. Table 1 shows large gaps in payment methods between those who used and did not use. For example, 63% of students who used career centers were on scholarship compared to half of those who did not use. Interestingly, these payments methods also account for differences in use between students with military background and those who do not.

Analyses of financial situation that do not include methods of paying for college indicate that veterans and active military were less likely to use career centers than students who never served ($p < .05$). This is because veterans and active military were much less likely to pay for college using scholarships, savings, income and other methods except employer or military assistance. In effect, military students were less likely to seek out career/job placement services because of their financial ties to the military, not necessarily because of social and personal aspects of military service.

Life Changes

Synch score is a significant predictor of career center use across models. This indicates that students who enrolled due to changes in their job, finances, family, and/or other reasons were more likely to utilize career center and internship resources. The direction of changes matters as well, primarily with respect to career center use. Students who experienced job changes for the worse were about twice as likely to use career centers as students who experienced no job changes and also more likely than students who experienced neutral or positive job changes. For example, Table 1 shows 14% of students who used career centers had a negative job change compared to 7% of students who did not. Table 2 shows that students with neutral or positive changes in family commitments were more likely to use career centers compared those with no changes ($p < .05$). These effects were only significant at $p < .10$ in the full model when accounting for financial factors. Lastly, students who experienced positive life changes in other areas besides job, finances, and family were more likely to use career centers and internships in all models. Students did not have to specify what these changes were.

So Who Uses These Resources?

Logistic regression helps identify the characteristics of students who are more likely than their peers to use career centers and internships, but this approach has limited utility given what we know from Table 1. The vast majority of students who know career centers and internships are available just do not use them. Calculating probabilities from coefficients reveals that even students with relatively common characteristics and experiences including some deemed significant in the analyses are not highly likely to use these resources. For example, a fairly typical student with what could be considered median characteristics[vi] has only a 28% predicted probability of using a career center. A similar student who had experienced negative job changes, neutral family changes, and positive other life changes living off personal savings and income from a second job would have a 76% predicted probability of using a career center. That is high but not extremely high even for a student who dealt with considerable drama before enrolling. In this respect, there is a rather narrow profile of students highly likely to use career centers and internships and that profile depends on factors that campus and programs administrators may not know about students personal life changes (and challenges) and finances.

Tables to Insert

Table 1 – Descriptive Statistics

Career Centers

Table 2 Model A – Baseline (Demographics + Family)

Table 2 Model B – Baseline + Academic

Table 2 Model C – Baseline + Financial
Table 2 Model D – Baseline + Life Changes
Table 2 Model E – Baseline + Academic + Financial + Life Changes

Internships
Table 3 Model A – Baseline (Demographics + Family)
Table 3 Model B – Baseline + Academic
Table 3 Model C – Baseline + Financial
Table 3 Model D – Baseline + Life Changes
Table 3 Model E – Baseline + Academic + Financial + Life Changes

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[i] Participating students were paid $25 to complete the 15 minute survey. Participating colleges were given report of findings. Participating colleges with a high response rate were also given a findings report for their college and a $250 research stipend.

[ii] The complete list of resources was Flexible courses/schedules, Online courses, Hybrid courses, Online textbooks, Advising, Tutoring services (i.e. writing center), Mentoring, Career/job placement services, Internship opportunities, Mental health services/counseling, Student resources centers (i.e. multicultural center, veterans center, women's center), Disability services, Food pantry, Childcare, and Financial support.

[iii] The survey also included questions about coursework difficulty and time spent on homework. Preliminary analyses indicated these variables were not significant and collinear with GPA and therefore omitted from the model.

[iv] The PRiSM Decision Model for Adult Enrollment (Stein and Wanstreet 2006) includes four themes: ***P****athway to a Better Life*, ***R****eflective Learner*, ***S****ynchronizing Learning, Earning, and Living*, and ***M****atch with an Academic Life*. The survey included four items each in response to the question "How important are the following reasons why you chose to enroll this semester?"

[v] The survey also included questions about disability, sexual orientation, residency and other factors that were not significant in primarily analyses.

[vi] This is a median age (24 years old) single white male student with no children, median academic experiences (eight courses in the last 12 months and a 3.0 to 3.49 GPA), and mean Synch score (13) but no reported life changes in a part-time job unrelated to field paying for college with scholarships but not savings or a second job at a college at which 75% of respondents reported career/job placement services were available.

PathTech LIFE (Learning, Interests, Family and Employment): Understanding Advanced Technology Students

Danielly Orozco, Will Tyson, Lakshmi Jayaram, Marilyn Barger
Florida Advanced Technological Education Center of Excellence, University of South Florida, University of South Florida, Florida Advanced Technological Education Center of Excellence

Abstract

Educators can create better learning experiences if they understand more about the students in their classrooms. In most two-year college technical courses and programs, student diversity is particularly high for most demographic characteristics including age, gender, ethnicity and socioeconomic background. The PathTech LIFE project seeks to understand how learning, interests, family, and employment (LIFE) experiences of two-year college students studying various engineering technology related disciplines impact their decisions to enroll, return for further coursework, and/or pursue a certificate or degree. Among other early results, one primary motivator for enrollment in the technical programs is a stronger, more stable and more secure career pathway for supporting the students' families. This paper represents a work in progress effort that will report on the initial data from a survey as well as the findings of from the "pilot" study conducted regionally in the greater Tampa Bay area.

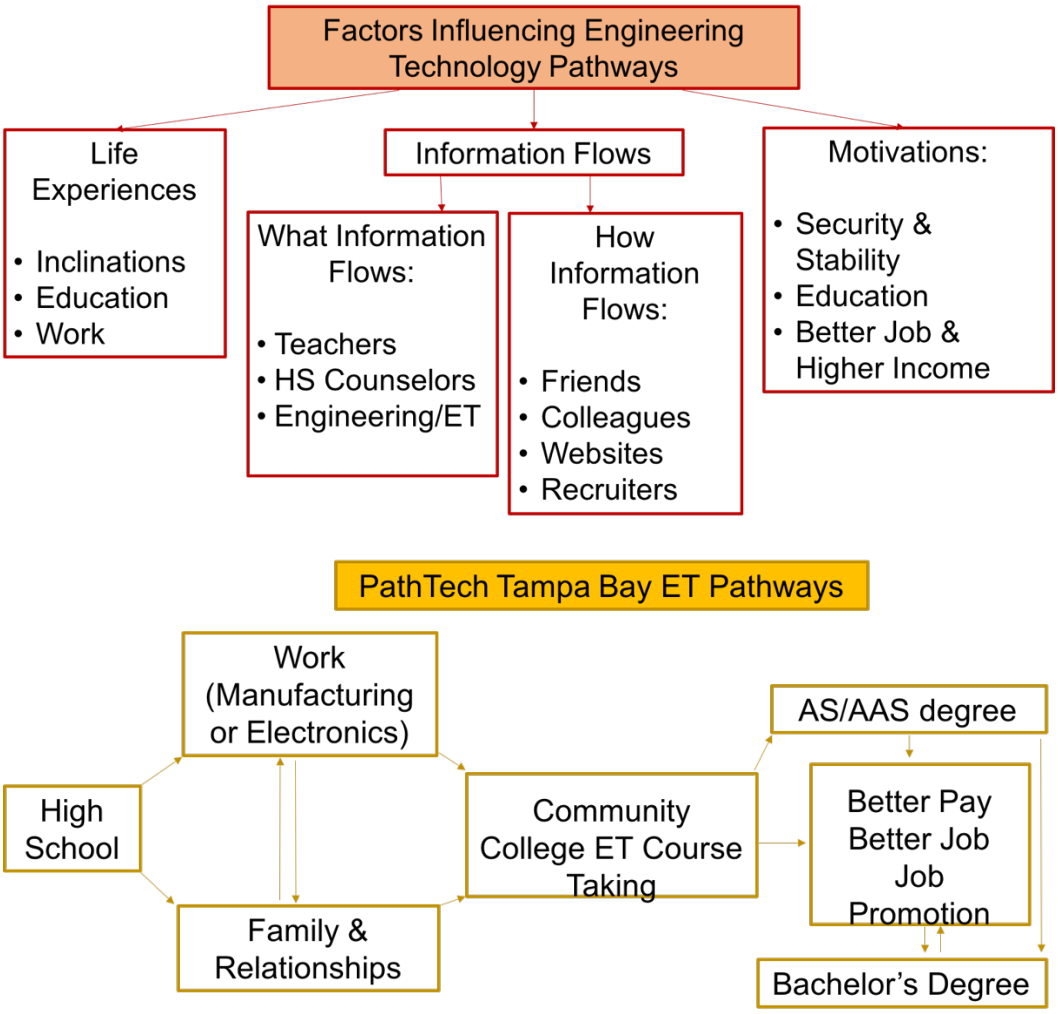
Keywords

Engineering Technology, education, pathways, student motivators, research

PathTech Tampa Bay Background

In 2011, researchers in the Sociology Department at the University of South Florida began studying the education and employment pathways of students entering 2-year engineering technology programs through interviews of all stakeholders associated with the pathway. Graduates of these programs are engineering technicians and in high demand for high wage positions across the country. These technicians build, maintain, operate and troubleshoot automated equipment in a number of different industry sectors including manufacturing, energy, material handling, transportation and many more. This first targeted research project focused on career pathways from high school to 2-year programs and beyond to baccalaureate degrees or to the workplace in a five-county region that directly serves the University of South Florida in Tampa Bay.

Five state/community colleges were included in this initial project in which interviews were conducted with high school and 2-year college faculty; students at both levels; administrators at both levels; and industry partners of the various programs. The project team conducted 174 in-depth qualitative interviews. The influencing factors defined by the interview results are summarized in the following diagram. The second diagram illustrates the emerging pathways for two-year associate engineering technician education. These results also supplied strong support for the direction and scope of the current project, PathTech LIFE.



PathTech LIFE Overview

The PathTech LIFE project was funded by the National Science Foundation (NSF) Advanced Technological Education (ATE) program in 2015 and seeks to understand how learning, interests, family, and employment (LIFE) experiences of two-year college students impact their decisions to enroll, return for further coursework, and/or pursue a certificate or degree. It is a partnership between the University of South Florida, Florida Advanced Technological Education Center (FLATE) at Hillsborough Community College and other ATE Centers and projects. This project expands the PathTech Tampa Bay to a national focus of community college students in advanced technology fields that are considered to be sub-disciplines of engineering technology using an in-depth online survey. A project pilot engaged with these colleges through appropriate Advanced Technological Education (ATE) grantees. The pilot survey instrument revealed a limited number of colleges in the spring of 2017. Preliminary data from this pilot informed a number of changes both in the survey questions themselves and the logistics of implementation that were modified during the summer of 2017 and are implemented in the national survey deployed in September 2017.

PathTech LIFE Survey Topics and Strategies

Colleges with engineering technology programs were recruited through the NSF ATE centers and projects. College program that achieve milestones in percent participation get a stipend and/or a specific program report. The survey delves into a number of aspects of students personal, student and professional lives with questions covering academic background, college experiences, employment background and current status, motivation for enrollment, program evaluation, academic and career goals and demographics. To entice students to participate in the 15-minute survey, each student responding to the complete survey receives $25.

Pilot Survey Results

A small pilot of 528 students from 26 different colleges responded to the survey between April 3 and May 2, 2017. Students identified with engineering technology programs that were categorized as focused on energy and the environment, advanced manufacturing, micro and nano technologies, general engineering technology or none of the above. The survey results indicated that Most students were between the ages of 18 and 30 years old, with 84% of respondent identifying as male. Demographic data also revealed that 63% identified as white. Employment information revealed that only 34% of students employed full time had jobs in their field of study while 48% of part time students have positions in engineering technology. Most students are happy with their program and acknowledged that the class offerings accommodate their work schedule. Additionally, 71% had an associate degree as their goal with 55% of all respondents having a long-term goal of a bachelor's degree and to stay in the engineering technology field.

Student Motivation

A number of survey questions addressed student's motivation to enrolled in their specific program. Students were asked to select from a list of sixteen items any/all that motivated them to enroll in the program. These results were analyzed using the PRISM Decision Model for Adult Enrollment (Stein & Wanstreet, 2006). PRISM categorizes 16 different responses in one of four categories: Pathway to a Better Life, Reflective Learner, Synchronizing Learning, Earning, and Living, and Match with an Academic Life. A strong majority of respondents wanted to increase their opportunities for a better life, a response that falls into the PRISM "Pathway to a Better Life" category. Least important motivator in this pilot was "wanting to improve my self-esteem", which also falls into the category "Pathway to a Better Life". The responses to the various student enrollment motivation questions were further distilled to five reasons for why students enrolled as identified by demographic categories. These categories are:

- Personal well-being
- Academic effort
- Skill building
- Job and financial concerns
- Family and other concerns

Next Steps

As a work in progress, the survey was slightly revise after the spring semester pilot and re-opened in the fall of 2017. Most notably, a few questions were modified slightly for clarity and the survey was reduced from 25 to 15 minutes to enhance completion by students. After the University IRB (Instructional Review Board) approved revised survey, the survey was re-opened and an aggressive student recruitment campaign began. The goal is to get at least 2,000 student responses from across the country and conduct the same analysis of the data. A national summary as well as regional and individual college reports will be generated where there is a significant sample size and response rate.

Project Impact

Individual college reports on their student responses can inform local educators about their student population with reliable statistical data about their students. This can certainly lead to a better understanding of the students a particular college is serving and provide some context and comparison with other colleges (similar or dissimilar) as well as the national norm. One anonymous faculty member in a strong and mature A.S. Engineering Technology degree program participating in the survey observed: "We have to be aware of and deal with the fact that many of the students enrolled in our programs are just one paycheck away from some kind of financial disaster." How faculty support their students through these "life events" is critical to their completion of the courses and/or programs as well as their future career success. Success of our students is vital for the students as well as the industries we server. The research team is planning a longitudinal study of a small group of those surveyed in PathTech LIFE.

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Danielly Orozco, is the Associate Director of the Florida Advanced Technology Education Center-FLATE, a National Science Foundation Center of Excellence in high-technology education focused on manufacturing. She holds B.S. and M.S. degrees in Sanitary Engineering and Environmental Engineering. Mrs. Orozco has worked for FLATE for over 8 years as a subject matter expert and curriculum coordinator. In her current role as associate director, Danielly helps to promote manufacturing and advanced technical education, participates in research on engineering technology recruitment and retention best practices by ensuring the continuation of exemplary industry partnerships, workforce opportunity, and educational synergy in Florida.

Will Tyson is an Associate Professor of Sociology at the University of South Florida. Dr. Tyson's research examines STEM educational and career pathways with a focus on student- and institutional-level influences on high school and college science and math course taking and STEM degree attainment. Dr. Tyson was the Principal Investigator of the NSF-funded project "Successful Academic and Employment Pathways in Advanced Technologies" (#1104214) or PathTech. Dr. Tyson is also the Principal Investigator of the follow-up study "PathTech LIFE: Constructing a National Survey of Engineering Technology Students through Regional and Statewide Testing" (#1501999).

Lakshmi Jayaram is a Research Associate at the University of South Florida working on the NSF-funded project "PathTech LIFE: Constructing a National Survey of Engineering Technology Students through Regional and Statewide Testing" (#1501999). Dr. Jayaram has 25 years of experience in education, as a professor, researcher, evaluator, curriculum developer, and program analyst. Dr. Jayaram is a recognized expert in qualitative research methodologies, has given several invited talks about qualitative research design, conducted coding and data analysis workshops, and provides methodological training and mentorship for student research. Dr. Jayaram's research interests include studying the experiences of under-represented and non-traditional groups in STEM fields.

Marilyn Barger is the Principal Investigator and Executive Director of the Florida Advance Technological Education Center of Excellence (FLATE) housed at Hillsborough Community College in Tampa, Florida. FLATE is funded by the National Science Foundation (NSF, #1204751) and serves technical education pathways and programs in Florida that support the manufacturing industry. Dr. Barger has over 20 years of experience developing and delivering STEM curriculum for K-20 students and educators and has initiated long-term, systemic education reforms. She is a licensed professional engineer in the state of Florida, holds a licensed patent and is a registered engineer in Florida.

PathTech LIFE: Overview of Findings from a National Survey of Technician Education Students

Dr. Will Tyson, University of South Florida

Will Tyson is an Associate Professor of Sociology at the University of South Florida. Dr. Tyson's research examines STEM educational and career pathways with a focus on student- and institutional-level influences on high school and college science and math course taking and STEM degree attainment. Dr. Tyson was the Principal Investigator of the NSF-funded project "Successful Academic and Employment Pathways in Advanced Technologies" or PathTech (4 years, $1.2 million). PathTech was a collaboration with Tampa Bay area high schools, community colleges, and local technology and manufacturing industry to better understand pathways from into engineering technology AS degree and certificate programs and back into the local workforce. Dr. Tyson is also the Principal Investigator of the follow-up study PathTech LIFE: Constructing a National Survey of Engineering Technology Students through Regional and Statewide Testing (3 years, $778,031), a national survey of community college students completing coursework, certificates, and degrees in engineering technology and related technology fields. Dr. Tyson is co-editor of Becoming an Engineer in Public Universities: Pathways for Women and Minorities (2010) based on NSF-funded research in colleges of engineering in Florida universities. Dr. Tyson has published on secondary and post-secondary pathways to engineering and other STEM bachelor's degrees as well as faculty climate in STEM programs.

Dr. Marilyn Barger, National Science Foundation ATE Centers

Dr. Marilyn Barger is the Principal Investigator and Executive Director of FLATE, the Florida Regional Center of Excellence for Advanced Technological Education, funded by the National Science Foundation and housed at Hillsborough Community College in Tampa, Florida since 2004. FLATE serves the state of Florida as its region and is involved in outreach and recruitment of students into technical career pathways; has produced award winning curriculum design and reform for secondary and post-secondary Career and Technical Education programs; and provides a variety of professional development for SETM and technology secondary and post-secondary educators focused on advanced technologies. She earned a B.A. in Chemistry at Agnes Scott College and both a B.S. in Engineering Science and a Ph.D. in Civil Engineering (Environmental) from the University of South Florida, where her research focused on membrane separation science and technologies for water purification. She has over 20 years of experience in developing curricula for engineering and engineering technology for elementary, middle, high school, and post secondary institutions, including colleges of engineering. Dr. Barger has presented at many national conferences including American Association of Engineering Education, National Career Pathways Network, High Impact Technology Exchange, ACTE Vision, League of Innovation and others. Dr. Barger serves on several national panels and advisory boards for technical programs, curriculum and workforce initiatives, including the National Association of Manufacturers Educators'Council. She is a Fellow of the American Society of Engineering Education, a member of Tau Beta Pi and Epsilon Pi Tau honor societies. She is a charter member of both the National Academy and the University of South Florida's Academy of Inventors. Dr. Barger holds a licensed patent and is a licensed Professional Engineer in Florida.

Dr. Lacksmi Jayaram, University of South Florida

is a Research Associate at the University of South Florida and Co-Principal Investigator of PathTech LISTEN: Mixed Methods Longitudinal Investigations of Students in Technician Education (NSF #1801163, 2018-21). Dr. Jayaram has 25 years of experience in education, as a professor, researcher, evaluator, curriculum developer, and program analyst. Dr. Jayaram's research interests include studying the experiences of under-represented and non-traditional groups in STEM fields.

PathTech LIFE: Overview of Findings from National Survey of Technician Education Students

Dr. William Tyson, University of South Florida
Dr. Lakshmi Jayaram, University of South Florida
Dr. Marilyn Barger, Florida Advanced Technological Education Center (FLATE)

ABSTRACT: PathTech LIFE is a national survey of 3,216 students from 96 two-year colleges enrolled in advanced technology programs nationwide. The survey includes questions about **L**earning, **I**nterests, **F**amily, and **E**mployment (LIFE) and data was collected about students' sociodemographic background, enrollment status, program satisfaction, campus resource knowledge and utilization, motivation to enroll, career and educational aspirations, employment status, and school-work-life balance issues. A subset of findings will be reported here that have implication student recruitment, retention, and completion in advanced technology programs at two-year colleges. We also provide a focus on students in Advanced Manufacturing in particular.

Introduction

This study is a partnership between the University of South Florida, the Florida Advanced Technological Education Center (FLATE) at Hillsborough Community College and national ATE Center Partners. This research is funded through National Science Foundation (NSF) Advanced Technological Education (ATE) Targeted Research in Technician Education grant. We administered a national survey to community college students in advanced technology fields in collaboration with a national network of colleges. PathTech LIFE seeks to understand how **L**earning, **I**nterests, **F**amily, and **E**mployment (LIFE) experiences of two-year college students impact their decisions to enroll, return for further coursework, and/or pursue a certificate or degree.

Data & Methods

The data for this study comes from the PathTech LIFE dataset. PathTech LIFE is a survey study that is part of a trilogy of projects funded by the National Science Foundation (NSF) Advanced Technological Education (ATE) Targeted Research in Technician Education. PathTech is a partnership between University of South Florida, Florida Advanced Technological Education Center (FLATE) at Hillsborough Community College and national ATE Center Partners. We administered a national survey to 3,216 community college students in advanced technology programs across 96 two-year colleges. Overall, the sample shows that technician students are a diverse group, and includes about 20% women, 30% racial-ethnic minorities, 10% reporting disabilities, 5% LGBT students, and an age range of 18 to 65+. Technician students are also "non-traditional" in higher education settings by way of their life experiences, with the majority simultaneously juggling school, work, and parenthood.

We used purposive sampling to target two-year college students in advanced technologies programs across the nation. We sent recruitment flyers and emails to members of the expert panel; then, these individuals forwarded the information to administrators at affiliated programs in the following advanced technologies programs: engineering technology, energy and environmental technology, micro and nanotechnology, and advanced manufacturing.

We constructed an online questionnaire (using Qualitrics). To establish content validity, we compiled an expert panel, with two administrators each, from seven two-year college AS/AAS degree programs in

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The original pilot survey was constructed by the USF research team with help from an expert panel made up of the FLATE team and two representatives from six other two-year colleges with AS/AAS degree programs in advanced technologies. Most of the expert panel was made up of Principal Investigators from national advanced technologies centers representing the four advanced technology fields represented in this study: advanced manufacturing, engineering technologies, micro and nano technologies, and energy and environmental technologies. Each of the expert panelists were also funded by NSF ATE. These individuals reviewed the instrument and provided feedback following a

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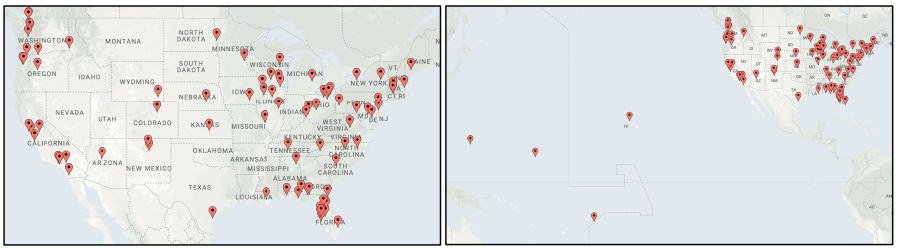
three-stage iterative process known as the Delphi technique in which panelists selected questions to include in the survey. After the first pilot survey was sent to six colleges, the research team analyzed the data and then conducted a "think-aloud" exercise in which four survey respondents were interviewed while completing the survey to get their immediate feedback on the survey. After considering the interview responses, the second pilot was sent to 18 colleges. After shortening the survey from 25 minutes to 15 minutes at the request of community college administrators, the survey was distributed three times in 2017 and 2018 to students at 96 colleges.

Sample

We used purposive sampling to target two-year college students in advanced manufacturing, engineering technologies, micro and nano technologies, and energy and environmental technologies AS/AAS degree programs. Interested college administrators received recruitment flyers and a link to the survey to pass on to students. In the end, 3,216 students from 96 different colleges in 38 states and three US territories completed the survey.



Students identified their programs as follows: 53% Engineering Technology, 19% Energy/Environment, 19% Advanced Manufacturing, 2% Micro/Nano, 19% None of the Above. It is interesting to note that almost one-fifth of respondents did not identify within a particular program area.

Findings

Demographic Background

The majority of students in the study were full-time students -- 63% of students were full-time while 37% enrolled part-time. In addition, the majority of students were aged 35 years or younger. When looking at gender, 79% of students are men, 20% are women, and 1% identify as non-gender conforming. Race/ethnicity of the sample is comparable to the US as a whole as shown below. Students were able to select all that apply.

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We constructed an online questionnaire (using Qualitrics). To establish content validity, we compiled an expert panel, with two administrators each, from seven two-year college AS/AAS degree programs in advanced technologies. The expert panel included Principal Investigators from national advanced technologies centers representing advanced manufacturing, engineering technologies, micro and nano technologies, and energy and environmental technologies. These individuals reviewed the instrument and provided feedback following a three stage iterative process known as the Delphi technique. In addition, we distributed the questionnaire in a pilot study as well as conducted a think-aloud with six advanced technologies students to provide feedback on the items of the instrument. The questionnaire was designed to capture the socio-demographic profile, life stages, life transitions, and motivating factors of students in advanced technologies programs at two-year colleges. Other sections of the questionnaire included open-ended questions in an attempt to capture information on students' life stages and transitions, demographic items (i.e., age, gender, race/ethnicity, socioeconomic (SES) factors, academic discipline within advanced ... [1]

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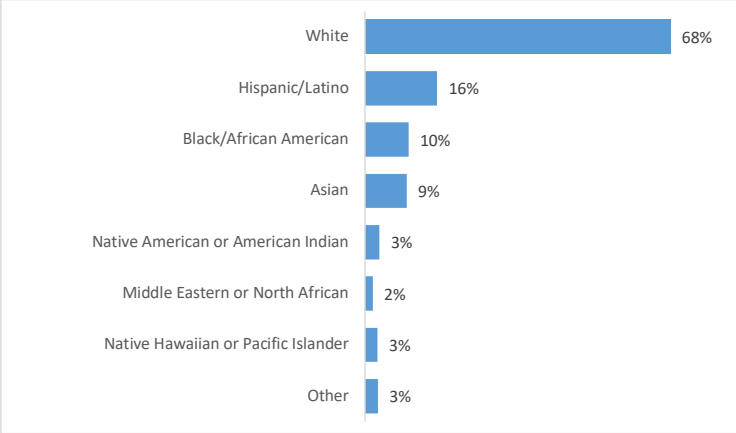
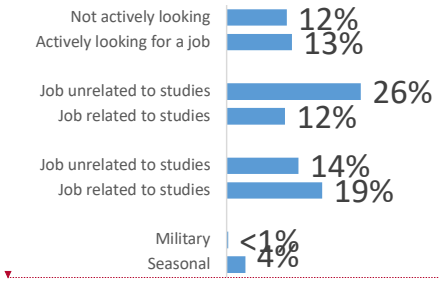


Educational Background and Future Aspirations

We also examined students' educational backgrounds as well as their educational aspirations going forward. For the majority of students, we see that participation in their current program is their first experience in higher education: 58% had never enrolled in college, 17% had previously enrolled in community college, 8% had earned an associate's degree, 10% had enrolled in a four-year college, and 7% had earned a Bachelor's degree. Furthermore, when analyzing future educational aspirations, the majority were degree-seeking, with only 10% reporting that they did not aspire for a degree, 27% aiming for an associate's degree, 38% for a Bachelor's degree, and 25% aspiring for the Masters/PhD level. In addition, 55% of students in the sample were "extremely committed" and 32% were "very committed" to stay in the technician field. Taking these findings together, we see that students in this sample are vey committed to both technician education and occupational pathways.



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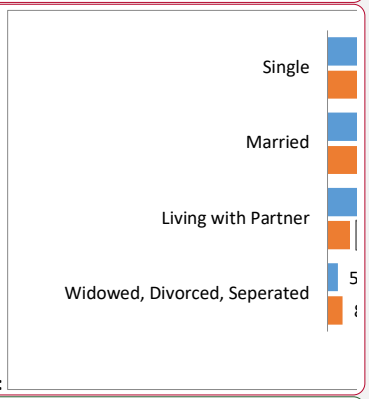

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We also examined students' educational backgrounds as well as their educational aspirations going forward. For the majority of students, we see that participation in their current program is their first experience in higher education: 58% had never enrolled in college, 17% had previously enrolled in community college, 8% had earned an associate's degree, 10% had enrolled in a four-year college, and 7% had earned a Bachelor's degree. Furthermore, when analyzing future educational aspirations, the majority were degree-seeking, with only 10% reporting that they did not aspire for a degree, 27% aiming for an associate's degree, 38% for a Bachelor's degree, and 25% aspiring for the Masters/PhD level. In addition, 55% of students in the sample were "extremely committed" and 32% were "very committed" to stay in the

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Spotlight on Advanced Manufacturing Students

Students in the Advanced Manufacturing programs are similar in many ways to the overall sample, such as expressing high degrees of satisfaction with their programs, having similar part-time and full-time enrollment status and educational backgrounds, as well as similarities in family life. However, there are also differences in some key ways. For example, there are more 18-19 year olds in Advanced Manufacturing in comparison to the overall sample. In addition, there are more men than women. In fact, while the overall sample is composed of 20% women, only 10% of students in advanced manufacturing are women. There are also more White students in Advanced Manufacturing in comparison to the overall sample, and comparatively fewer Black, Latino, and Asian students. Another area of key difference has to do with employment. A greater percentage of students in Advanced Manufacturing are working full-time *in their field* than their peers in other fields, while in the overall sample, a greater percentage of students work full-time in an *unrelated* field. Lastly, a greater percentage of students in Advanced Manufacturing do not aim to complete a degree or plan to complete an Associate's degree in comparison to the overall sample, where the majority are aiming to complete either an Associate's or Bachelor's degree. **Taking these descriptive differences together, we see a younger group of students in Advanced Manufacturing, more men than women, less racial and ethnic diversity, more students working full-time within manufacturing, and lower levels of degree aspirations.**

Comparison of Advanced Manufacturing Students with Full Sample

		Adv Manufctrng	Total
Enrollment status	Full-time student	64%	63%
	Part-time student	36%	37%
Age Quintiles	18-19	27%	22%
	20-21	15%	17%
	22-26	18%	21%
	27-33	17%	19%
	34+	22%	21%
Gender	Male	89%	80%
	Female	10%	20%
	Non-gender conforming	1%	1%
Race/Ethnicity (check all that apply)	White	81%	68%
	Hispanic/Latino	11%	16%
	Black/African American	5%	10%
	Asian	4%	9%
	Native American or American Indian	2%	3%
	Middle Eastern or North African	1%	2%
	Native Hawaiian or Pacific Islander	1%	3%
	Something else, please specify	3%	3%
Marital status	Single	67%	66%
	Widowed	0%	0%
	Divorced	3%	3%
	Separated	1%	1%
	Living with a partner	10%	10%
	Married	20%	20%
	Child(ren) in Household	51%	52%
Employment	Not currently employed and not actively looking	9%	12%
	Not currently employed, but actively looking for a job	11%	13%
	In the military	0%	0%
	Employed seasonally	3%	4%
	Employed part-time in job unrelated to studies	25%	26%
	Employed part-time in job related to studies	14%	12%
	Employed full-time in job unrelated to studies	9%	14%

	Employed full-time in job related to studies	28%	19%
Prior Education	Never enrolled	60%	58%
	Enrolled in CC	19%	17%
	Earned Assoc degree	8%	8%
	Enrolled in 4 Year	8%	10%
	Earned Bach degree	5%	7%
FutureHighestDeg (degrees earned not incld)	None	18%	12%
	Associates	38%	28%
	Bachelors	29%	34%
	Masters	12%	19%
	PhD	3%	6%

Another set of questions asked in the survey measure students' knowledge and utilization of campus resources. When looking more closely at Advanced Manufacturing students, we see some interesting patterns. Students appear aware of campus resources such as flexible courses/schedules, online courses, hybrid courses, online textbooks, advising, tutoring, mentoring, career/job placement services, and internship opportunities, yet will say that they do not use these resources. This pattern among Advanced Manufacturing students is consistent with the overall sample's responses to these questions as well.

	Advanced Manufacturing				
Campus Resources	Not available, would not use	Not available, would use	Available, do not use	Available, do use	Use among those who say it is Available (column 3/(column 3 + column 4)
Flexible courses/schedules	15%	12%	38%	34%	47%
Online courses	11%	5%	55%	29%	35%
Hybrid courses	33%	5%	45%	17%	28%
Online textbooks	18%	12%	43%	27%	39%
Advising	9%	3%	49%	40%	45%
Tutoring services (i.e. writing center)	9%	2%	70%	18%	21%
Mentoring	26%	7%	59%	8%	12%
Career/job placement services	10%	6%	60%	24%	29%
Internship opportunities	17%	9%	53%	21%	28%
Mental health services/counseling	32%	4%	59%	5%	7%
Student resources centers (i.e. multicu	13%	3%	68%	16%	19%
Disability services	23%	2%	70%	5%	6%
Food pantry	43%	6%	45%	5%	11%
Childcare	43%	7%	48%	3%	5%
Financial support	10%	7%	60%	24%	28%

Implications for Recruitment, Retention, and Completion

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These findings from the PathTech LIFE Survey reveal many important aspects of technician students' lives and experiences. First, the majority of students have children in their households as well as employed while in their programs. The majority of students indicate appreciation for the way their programs fit into their schedules and lifestyles. Second, the majority of students in the overall sample also indicate interest in completing a degree, commitment to the field, and high levels of program satisfaction. Taken together, this indicates a likelihood that students in technician education programs will be focused on completion as well as opportunities that may allow them to gain entry to jobs in the field, such as internships and co-ops. Third, the socio-demographic data indicates an increasingly diverse student body, including growing numbers of women and racial-ethnic minorities in the programs. Taking these findings together, recommendations for recruitment, retention and completion would include 1) creating programs and policies that support students with families and jobs, 2) create programs and policies that facilitate movement into technician jobs, and 3) create a program climate and environment that is welcoming to students of all social backgrounds.

In looking more closely at students in Advanced Manufacturing programs, we see that greater numbers of students are younger, men, and White, working full-time in manufacturing and aspiring for either no degree or an Associate's degree. These key differences do stand in contrast with the overall sample and require a more tailored approach in developing programs to facilitate recruitment, retention, and completion of programs.

Finally, when examining students' knowledge and utilization of campus resources, we see similar patterns of under-utilization occurring within the sub-group of Advanced Manufacturing students and the overall sample. This is another key area to implement programmatic change. Utilizing resources such as flexible/online/hybrid courses and advising/career services/mentoring/tutoring will likely increase program retention and completion, as well as entry into the technician field.

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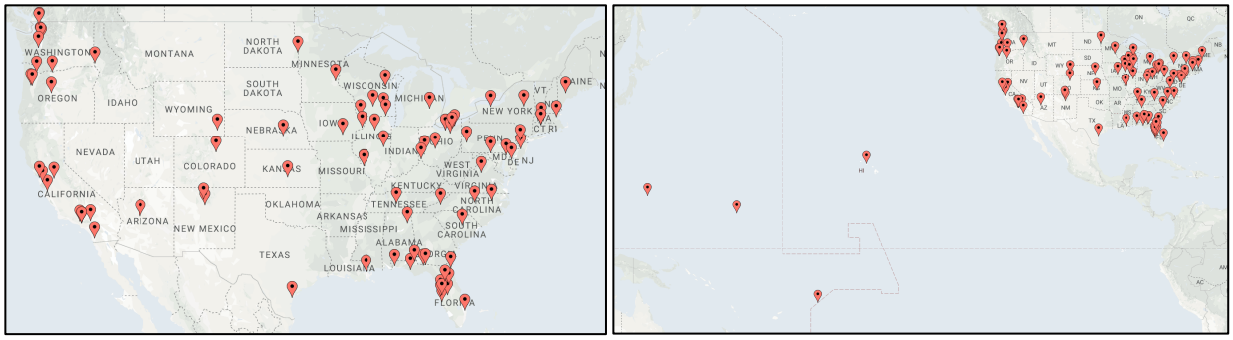
advanced technologies. The expert panel included Principal Investigators from national advanced technologies centers representing advanced manufacturing, engineering technologies, micro and nano technologies, and energy and environmental technologies. These individuals reviewed the instrument and provided feedback following a three stage iterative process known as the Delphi technique. In addition, we distributed the questionnaire in a pilot study as well as conducted a think-aloud with six advanced technologies students to provide feedback on the items of the instrument. The questionnaire was designed to capture the socio-demographic profile, life stages, life transitions, and motivating factors of students in advanced technologies programs at two-year colleges. Other sections of the questionnaire included open-ended questions in an attempt to capture information on students' life stages and transitions, demographic items (i.e., age, gender, race/ethnicity, socioeconomic (SES) factors, academic discipline within advanced technologies, employment status, marital status, number of dependents, prior academic background), and career and educational aspirations.

Sample

Students in the study sample were enrolled in one of four programs: Advanced Manufacturing, Engineering Technology, Micro/Nano Technology, and Energy/Environmental Technology. These programs were housed in colleges from across the country. In the end, 3,216 students from 96 different colleges completed the survey.

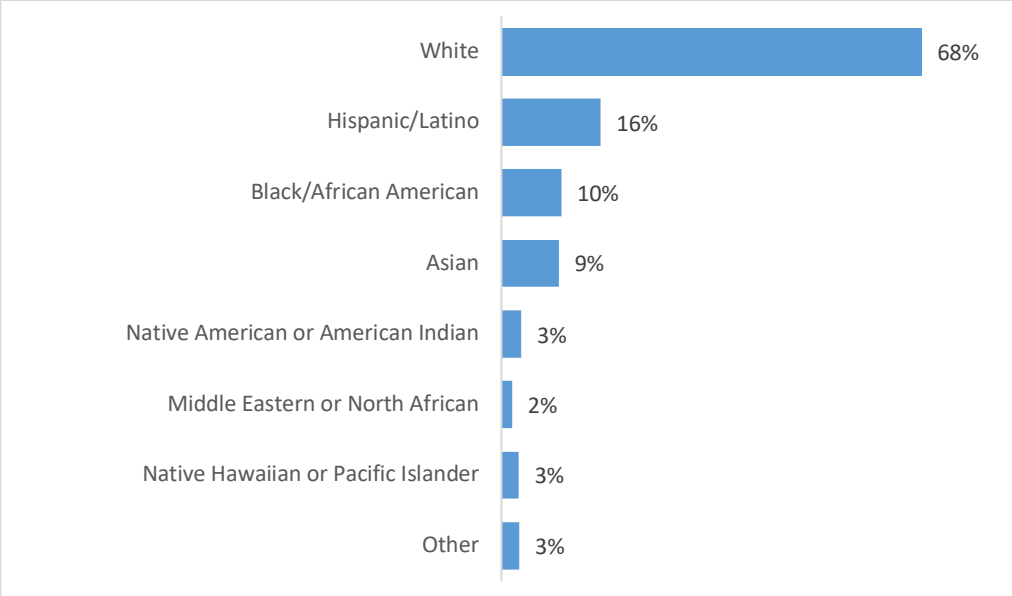


The program composition of students broke down this way: 53% Engineering Technology, 19% Energy/Environment, 19% Advanced Manufacturing, 2% Micro/Nano, 19% None of the Above. It is interesting to note that almost one-fifth of respondents did not identify within a particular program area.

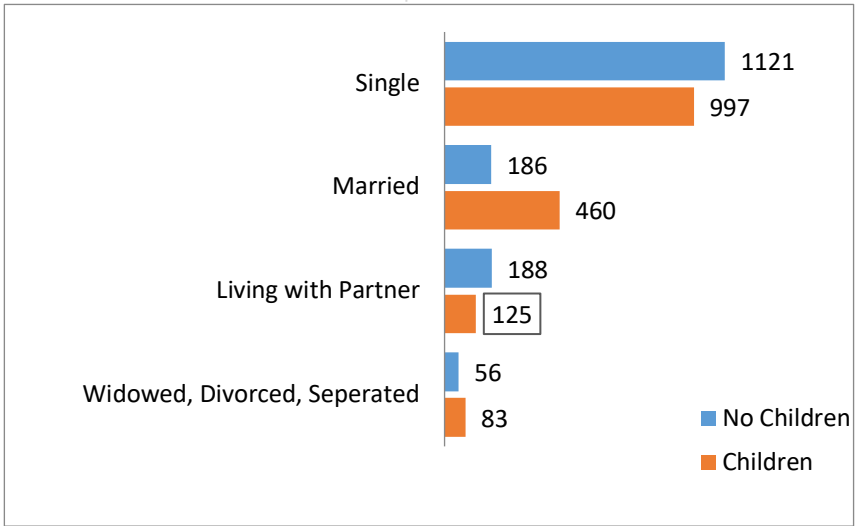
Findings

Demographic Background

The majority of students in the study were full-time students -- 63% of students were full-time while 37% enrolled part-time. In addition, the majority of students were aged 35 years or younger. When looking at gender, 79% of students are men, 20% are women, and 1% identify as non-gender conforming. Race/ethnicity broke down in the following way in the sample:



Overall, the sample is quite a diverse group of students. In addition, 52% of students report being parents, and the majority of parents in the sample are also single. In fact, the number of single students who report having children or not are similar in this sample. Alongside balancing school with family responsibility, the majority of students also work.



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MANUSCRIPT IN PROGRESS

Educational Background and Future Aspirations of Technician Students in Two-Year Programs: Emerging Findings from PathTech LIFE

Lakshmi Jayaram, Ph.D. and Will Tyson, Ph.D.

University of South Florida

A few decades ago, community colleges were conceptualized in the academic literature as a place where students go to "cool-out," or in other words, a place for [failing] high school students to become permanently marginalized from the mainstream of social and economic life (Clark, 1960, 1980). Community college education was not found to be a stepping stone towards a four-year college nor as an opportunity for a terminal degree that provided relevant credentials for jobs in the contemporary economy (Rosenbaum 2007, Goldrick-Rab 2010, Schudde & Goldrick-Rab 2014, Shaw & Goldrick-Rab 2003). The indictment of community colleges increased as traditional metrics of enrollment, retention, and completion rates indicated community colleges failed to pave pathways to meaningful educational or occupational trajectories (Schuetz 2008, McClenney 2007, Hossler et al 2009, Bailey et al 2004, Derby & Smith 2004, Wild & Ebbers 2002, Goldrick-Rab 2006). Several studies have also pointed to the particularly challenging experiences and circumstances of racial-ethnic minority students, first generation college students, and non-traditional students who are over-represented in community colleges (Flynn 2015, Goldrick-Rab & Sorensen 2010). Recent research in the "college for all" era (Rosenbaum 2001) and post-industrial economy dependent on skilled technical workers reveals how community colleges facilitate re-skilling through flexible programs that align closely with the needs of today's economy (American Association of Community Colleges 2011, Goldrick-Rab 2013, Rosenbaum et al 2013). Older students who may have been stigmatized in their secondary schools and sent to community colleges to "cool out," now report transformative experiences in their post-secondary schooling experiences (Tyson & Jayaram 2014, Goldrick-Rab & Kinsey 2013, Rosenbaum et al 2016).

Today's community college students are a diverse and complex student population. According to the National Center for Education Statistics (2014) and The American Association of Community Colleges (2014) as of the 2012–2013 academic year there were 12.8 million students enrolled in community colleges across the United States. Seventy-one percent of community college students are over 22 years old, and according to NCES projections the number of students over the age of 25 will continue to increase during the next five years (AACC 2014). Two-thirds of all community college students attend part-time—many due to other responsibilities including childcare and work responsibilities, and most students are working in addition to their studies. Cook and King (2007) and Orozco and Cauthen (2009) noted that students' work schedules, and particularly those working more than 20 hours a week, make it less likely that these students will be able to finish their course work (Mullin 2012a). Other factors that interfere with community college student retention and achievement include delaying enrollment, supporting dependents, and not having a high school diploma (Mullin 2012b). Community college students experience a variety of socioeconomic and cultural factors that complicate their college experience, and two-year institutions serve a particularly key role in preparing under-represented, under-prepared, and less affluent students for the workforce, many of whom aspire to transfer to four-year universities and earn bachelor's degrees or beyond (Bensimon & Santiago, 2013).

Community colleges are increasingly offering programs and degree options within Science, Technology, Engineering, and Mathematics (STEM) fields. Georgetown University's Center on Education and the Workforce estimates that 92 percent of STEM workers need postsecondary education and 35 percent of STEM job openings require a certificate or associate degree. According to the National Academies, nearly half of Americans with bachelor's degrees in science and engineering attended community colleges at some point, and almost a third of those with master's degrees did so as well. Yet degree completion rates in STEM programs at community colleges remains low.

The low rates of degree completion may be due to increased number of students either transferring to four-year colleges, seeking certification rather than degrees, or just completing specific coursework to improve job prospects/advancement. According to the U.S. Department of Education, from 2000 to 2014, the number of sub-baccalaureate certificates awarded by two-and-four-year colleges increased 150 percent, compared with a 59-percent increase in associate degrees and a 47-percent increase in bachelor's degrees during the same period. Certificates, or "stackable" credentials, can create educational pathways for "non-traditional" students and provide on- and off-ramps for students who may need to stop to care for family members or to earn money (Mangan 2015). In today's world, formal education in STEM fields is often ongoing, with several starts and stops. Young people are often working and attending school at the same time or cycling between the two to keep pace with necessary credentials (Carnevale, Smith, & Strohl, 2010). While the term "stop-out" refers to non-continuous enrollment patterns in comparison to "drop-outs" where the departure from school is permanent, for non-traditional students with complex lives outside of school, it is difficult to determine whether departure from schooling is temporary or permanent, causing questions about many of the statistics describing community college enrollment patterns. The stop out/drop out dichotomy may be too simplistic to capture today's community college enrollment experience and "cycling" may be a better term to conceptualize the way educational pathways overlap and intersect with other life course transitions related to family, work, and community.

Traditionally, five classic milestones marked the transition to adulthood: completing education, entering the labor force, becoming financially independent, getting married, and becoming a parent, in that order, timing, and sequence (Mortimer and Aronson, 2000; Shanahan, 2000). The phenomena of "cycling" between school and work creates fluidity between completing one's education and becoming financially independent through a full-time career. In addition, many young adults stay financially dependent on their families of origin, and family researchers have empirically shown the changing

nature of families in today's society that comprise diverse kinship arrangements without set ordering, timing, and sequencing of partnering and parenthood. In short, many of the traditional markers that culturally conveyed movement into adulthood simply do not hold the same universal meaning in contemporary society anymore.

Glen Elder's work (1974, 1981, 1990) on the life course is especially foundational for studying educational and occupational pathways as nested within macrosopic social change and microscopic life experiences, and conveys the importance of examining students' educational experiences in the context of developmental, social, and historical age to represent their position in the life course, the structure of their lives, and the historical context of their cohort. Education research adopts life course theory to show how educational pathways and trajectories intersect with the life course as well as macro-level social and economic factors and micro-level family and social circumstances (Elder 1974, Elder 1981, Eisenberg & Goldrick-Rab 2016, Settersten et al 2010). The realities of a high-tech post-industrial economy perhaps hold the greatest macro-level implications for two-year programs in STEM fields through creating a need for STEM educational instruction and credentials. On the micro-level, status attainment theory conceptualizes educational and occupational pathways as a reflection of both achieved and ascribed characteristics. Early status attainment models relied heavily on predicting one's mobility across the life course as well as the next generation's possibility for mobility on generation one's social origins. In this model, father's education and occupation strongly predicted not only how far he would go in his life, but how far his child would as well, leading to a rather deterministic representation of society where social mobility was limited. In contrast, contemporary status attainment models instead favor emphasis on achieved characteristics such grades, test scores, educational expectations, and parental involvement. In other words, social origins may not be wholly predictive of social destinations, and a major factor in disrupting a thesis of social reproduction is the transformative role of schooling. As more opportunities arise for young people to become educated, skilled, and

credentialed, theoretically speaking, we would anticipate greater social mobility, less poverty, and overall improved societal stability and well-being.

One important note relates to under-represented groups in both STEM-related educational programs and workplaces. High-tech jobs represent avenues for stable and secure jobs with potential for growth and promotion – the "good" jobs in our economy. Even though community colleges play a pivotal role in our national agenda of providing access as well as broadening participation of under-represented students with advanced technology degrees and careers, the empirical literature on the role of community colleges in expanding opportunities in the technology and manufacturing workforce is limited (Wang, 2013). In particular, scholars have noted challenges experienced by women, minorities, and individuals with disabilities in post-secondary STEM education programs. Weber (2011) noted the necessity for role models for female students while Gorman et al. (2010) echoed the need for women professionals to mentor female students. O'Riley (1996) stated the need for new narratives to be told which would indicate the diversity of the students. The collective story told to students and potential students is limited by racism and sexism, as well as not reflecting some experiences of rural workers. Townsend (2009) also asserted that community colleges needed to provide a supportive climate for minorities and women students. This included the importance of changing discourse about women and minorities and the representation of minority and women faculty who are paid equitably. Success in STEM will increase "racial and ethnic equality," according to Beede et al. (2011). STEM community college programs also offer promising avenues for students with disabilities to reach their potential within more student focused environments (Rule et al., 2011; Garrison-Wade and Lehman, 2009). Groups such as women, under-represented minorities, non-traditional students, veterans, and students with disabilities may face unique challenges that influence their STEM educational and employment trajectories.

In sum three bodies of literature inform this study of technician students in two-year programs: life course theory, the transition to adulthood, and status attainment models. *Life course theory* provides a framework for analyzing individual's lives within social, cultural, and historical contexts. This theoretical approach places a focus on life histories and how early events and experiences have an impact on later choices and decisions. Another framework that informs this analysis relates to the long *transition to adulthood* that often characterizes cohorts of young people today. In short, the transition to adulthood is no longer a linear and simple progression from adolescence with clearly defined markers. It is instead an often long and complicated process. At the heart of these changes is the need for a skilled workforce causing educational credentialing to become a centerpiece of accomplishing adult status in society today. *Status attainment theory* aims to conceptualize the way our ultimate educational and occupational pathways reflect both achieved and ascribed characteristics, and attributes ultimate career placement to both social origins as well as educational achievement.

Research Objectives

This analysis has the following research objectives:

- What kind of educational backgrounds do technician students in two-year programs have?
- What kind of variation in educational backgrounds exist by age, gender, race/ethnicity, first-generation status, and parenthood?
- Does educational background influence future educational aspirations? Are there sociodemographic differences?

Data & Methods

The data for this study comes from the PathTech LIFE dataset. PathTech LIFE is a survey study that is part of a trilogy of projects funded by the National Science Foundation (NSF) Advanced Technological Education (ATE) Targeted Research in Technician Education. PathTech is a partnership between University of South Florida, Florida Advanced Technological Education Center (FLATE) at Hillsborough Community College and national ATE Center Partners. We administered a national survey to 3,216 community college students in advanced technology programs across 96 two-year colleges. PathTech LIFE seeks to understand how learning, interests, family, and employment (LIFE) experiences of two-year college students impact their decisions to enroll, return for further coursework, and/or pursue a certificate or degree. Overall, the sample shows that technician students are a diverse group, and includes about 20% women, 30% racial-ethnic minorities, 10% reporting disabilities, 5% LGBT students, and an age range of 18 to 65+. Technician students are also "non-traditional" in higher education settings by way of their life experiences, with the majority simultaneously juggling school, work, and parenthood.

We used a survey research design to respond to our three research questions. We used descriptive statistics to describe the sociodemographic backgrounds of respondents. We used multilevel modeling to respond to research question three.

We used purposive sampling to target two-year college students in advanced technologies programs across the nation (Ary, Jacobs, Razavieh, & Sorensen, 2006). We sent recruitment flyers and emails to members of the expert panel; then, these individuals forwarded the information to administrators at affiliated programs. There were a total of 3,216 respondents representing 95 two-year colleges across the nation in the following advanced technologies programs: engineering technology, energy and environmental technology, micro and nanotechnology, and advanced manufacturing.

We constructed an online questionnaire (using Qualitrics). To establish content validity, we compiled an expert panel, with two administrators each, from seven two-year college AS/AAS degree programs in advanced technologies. The expert panel included Principal Investigators from national advanced technologies centers representing advanced manufacturing, engineering technologies, micro and nano technologies, and energy and environmental technologies. These individuals reviewed the instrument and provided feedback following a three stage iterative process known as the Delphi technique. In addition, we distributed the questionnaire in a pilot study as well as conducted a think-aloud with six advanced technologies students to provide feedback on the items of the instrument. The questionnaire was designed to capture the socio-demographic profile, life stages, life transitions, and motivating factors of students in advanced technologies programs at two-year colleges. Other sections of the questionnaire included open-ended questions in an attempt to capture information on students' life stages and transitions, demographic items (i.e., age, gender, race/ethnicity, socioeconomic (SES) factors, academic discipline within advanced technologies, employment status, marital status, number of dependents, prior academic background), and career and educational aspirations.

Findings

Our first question is, "What kind of educational backgrounds do technician students in two-year programs have?" The table of descriptive statistics on the next page shows that 58% of students were enrolling in a technician program for the first time, 17% had previously enrolled in a community college program, 8% had earned an associate's degree, 10% had enrolled in a four-year college program, and 7% had earned a bachelor's degree. Taken together, this shows that 42% of students in the sample seem to be cycling between educational programs over time.

In response to our second question, "What kind of variation in educational backgrounds exist by age, gender, race/ethnicity, first-generation status, and parenthood?" we see some interesting patterns. For example, of the 10% who had previously been enrolled in a four-year program, half the students were between the ages of 18-26. In examining parents' educational backgrounds, the majority of students' parents had not completed HS, had a HS diploma or GED, or some college. Less than half of the students in the sample had a parent who was degreed, and potentially the first generation to complete a higher education program. When looking parenthood, we see that the majority of the sample identifies as a parent and as single. Finally, the majority of the sample is also employed, either part-time or full-time, alongside completing their studies. Taken together, we see that the majority of students in the sample are first-generation students cycling between school, work, and family.

		Never enrolled	Enrolled in CC	Earned Assoc degree	Enrolled in 4 Year	Earned Bach degree	Total
	N	1860	546	256	325	229	3216
FutureHighestDeg	None	11%	12%	12%	10%	22%	12%
(does not include current degree)	Associates	29%	33%	21%	21%	27%	28%
	Bachelors	33%	36%	42%	43%	15%	34%
	Masters	20%	13%	17%	21%	30%	19%
	PhD	7%	5%	9%	5%	6%	6%
AspirHighestDeg	None	11%	12%	0%	10%	0%	10%
(includes current degree)	Associates	29%	33%	33%	21%	0%	27%
	Bachelors	33%	36%	42%	43%	64%	38%
	Masters	20%	13%	17%	21%	30%	19%
	PhD	7%	5%	9%	5%	6%	6%
Age Quintiles	18-19	35%	7%	3%	3%	2%	22%
	20-21	23%	12%	7%	14%	2%	17%
	22-26	17%	24%	25%	33%	21%	21%
	27-33	12%	27%	27%	26%	36%	19%
	34+	13%	30%	38%	24%	40%	21%
Gender	Male	81%	81%	75%	78%	72%	80%
	Female	18%	18%	24%	21%	28%	20%
	Non-gender conforming	1%	1%	1%	1%	0%	1%
Race/Ethnicity	White	66%	71%	62%	74%	71%	68%
	Hispanic/Latino	18%	15%	16%	13%	9%	16%
	Black/African American	10%	12%	11%	8%	6%	10%
	Asian	10%	7%	11%	7%	13%	9%
	Native American or American Indian	3%	4%	3%	2%	3%	3%
	Middle Eastern or North African	2%	1%	3%	2%	2%	2%
	Native Hawaiian or Pacific Islander	3%	1%	4%	2%	1%	3%
	Something else, please specify	3%	4%	2%	4%	2%	3%
Disability	Yes	9%	11%	14%	16%	6%	10%
	No	88%	83%	80%	79%	90%	85%
	Prefer not to say	3%	7%	5%	5%	5%	4%
Mother's educational attainment	Less than high school	10%	10%	12%	4%	6%	10%
	High school or GED	29%	31%	30%	24%	24%	29%
	Some college	17%	20%	16%	16%	10%	17%
	Associate's degree/certificate	13%	12%	14%	14%	13%	13%
	Bachelor's degree	17%	13%	15%	23%	27%	18%
	Master's degree	7%	8%	8%	13%	14%	8%
	Professional degree (e.g., JD or MD)	1%	1%	0%	2%	3%	1%
	Doctoral degree	1%	1%	1%	1%	2%	1%
	Don't know	5%	3%	4%	3%	2%	4%
Father's educational attainment	Less than high school	13%	10%	14%	6%	8%	11%
	High school or GED	29%	34%	35%	21%	22%	29%
	Some college	15%	17%	13%	17%	11%	15%
	Associate's degree/certificate	11%	8%	12%	10%	13%	10%
	Bachelor's degree	16%	14%	13%	26%	26%	17%
	Master's degree	6%	8%	4%	10%	11%	7%
	Professional degree (e.g., JD or MD)	2%	1%	1%	2%	4%	2%
	Doctoral degree	1%	1%	1%	3%	3%	1%
	Don't know	8%	6%	7%	6%	2%	7%
Family Status	Parent	56%	51%	50%	42%	33%	52%
	Single	74%	54%	48%	64%	50%	66%
	Widowed	0%	0%	1%	0%	0%	0%
	Divorced	2%	5%	4%	2%	4%	3%
	Separated	1%	1%	2%	1%	1%	1%
	Living with a partner	9%	11%	9%	12%	10%	10%
	Married	14%	28%	37%	20%	34%	20%
Employment	Not currently employed, not actively looking	12%	12%	11%	12%	11%	12%
	Not currently employed, actively looking	15%	11%	8%	11%	12%	13%
	In the military	0%	1%	0%	0%	0%	0%
	Employed seasonally	4%	3%	2%	4%	3%	4%
	Employed part-time in job unrelated to studies	30%	21%	22%	24%	20%	26%
	Employed part-time in job related to studies	12%	11%	9%	12%	11%	12%
	Employed full-time in job unrelated to studies	12%	15%	18%	17%	21%	14%
	Employed full-time in job related to studies	15%	25%	29%	20%	21%	19%

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