Exploring the Career Thinking of Native American Engineering Students (Research)

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Exploring the Career Thinking of Native American Engineering Students

Abstract

Recent reports indicate that there are less than 1900 (0.6%) Native American undergraduate and graduate engineering students nationwide (Yoder, 2016). Although Native Americans are underrepresented in the field of engineering, there is very little research that explores the contributing factors. The purpose of our exploratory research is to identify the barriers, supports, and personal strengths that Native American engineering students identify as being influential in developing their career interests and aspirations in engineering. Informed by research in Social Cognitive Career Theory (SCCT; Lent, Brown, & Hackett, 1994, 2000), we conducted an online survey to assess the motivational variables that guide the career thinking and advancement of students preparing to enter the field of engineering. Instrumentation included Mapping Vocational Challenges (Lapan & Turner, 2000, 2009, 2014), Perceptions of Barriers (McWhirter, 1997), the Structured Career Development Inventory (Lapan & Turner, 2006; Turner et al., 2006), the Career-Related Parent Support Scale (Turner, Alliman-Brissett, Lapan, Udipi, & Ergun, 2003), and the Assessment of Campus Climate for Underrepresented Groups (Rankin, 2001), which were used to measure interests, goals, personal strengths and internal and external barriers and supports.

Participants (*N*=23) consisted of graduate (≈25%) and undergraduate (≈75%) Native American engineering students. Their survey responses indicated that students were highly interested in, and had strong self-efficacy for, outcome expectations for, and persistence for pursuing their engineering careers. Their most challenging barriers were financial (e.g., having expenses that are greater than income, and having to work while going to school just to make ends meet) and academic barriers (e.g., not sufficiently prepared academically to study engineering). Perceptions of not fitting in and a lack of career information were also identified as moderately challenging barriers. Students endorsed a number of personal strengths, with the strongest being confidence in their own communication and collaboration skills, as well as commitment to their academic and career preparation. The most notable external support to their engineering career development was their parents' encouragement to make good grades and to go to a school where they could prepare for a STEM career. Students overall found that their engineering program climates (i.e., interactions with students, faculty, staff, and program expectations of how individuals treat each other) were cooperative, friendly, equitable, and respectful. Study results are interpreted in light of SCCT and recommendations for future research and practice in engineering education are provided.

Introduction

Recent reports indicate that there are less than 1900 (0.6%) Native American undergraduate and graduate engineering students nationwide [1]. Native Americans are underrepresented in the field of engineering; moreover, there is very little research that explores the contributing factors to Native American student success in engineering specifically. To begin to fill this gap, we conducted an exploratory research study aimed at identifying the magnitude of self-identified barriers, supports, and personal strengths of Native American engineering students that are influential in the development of their career interests and aspirations in engineering. We

employed Social Cognitive Career Theory (SCCT) [2,3] to guide our choice of variables that might influence Native American students' development of their career interests and aspirations in engineering.

Literature Review

SCCT is a highly researched theoretical framework that has been increasingly used by vocational psychologists [4] and other educational researchers [e.g. 5] to identify factors contribute to the underrepresentation of women and racial minorities in STEM fields [2,3]. SCCT proposes that individuals develop interests in specific careers for which they feel competent (efficacious) and for which they expect to achieve the outcomes they desire (positive outcome expectations) [2]. The ***Social-Cognitive Variables*** of career interests, along with self-efficacy and outcome expectations, predict career choice goals. Efficacy, outcome expectations and goals predict choice actions (such as persistence) (See Figure 1).

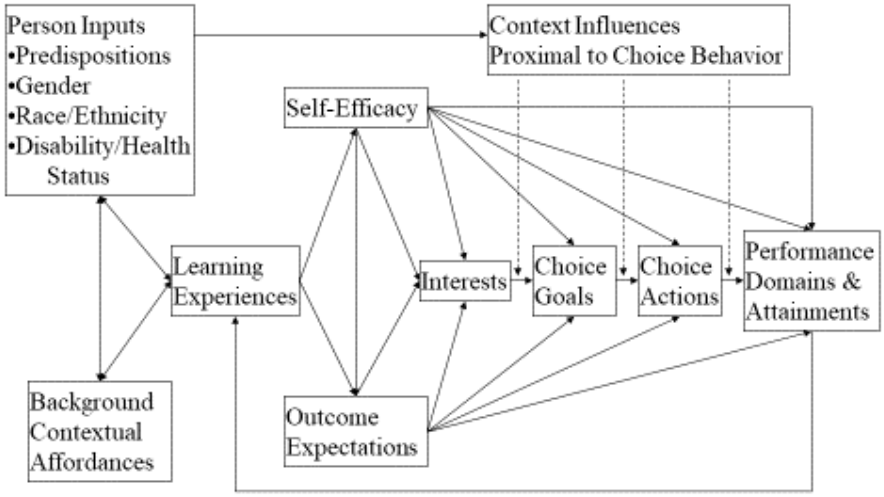

Figure 1. A Model of Social Cognitive Career Theory (adapted from Lent, Brown, & Hackett, 1994, 2000)

The value of SCCT in describing the engineering career development of underrepresented groups is that it allows for the examination of population specific contextual affordances (i.e., barriers and supports, and opportunities to develop personal strengths and skills) and person factors (e.g., statuses, such as gender or ethnicity) that are hypothesized to together predict sources of self-efficacy and outcome expectations information. SCCT provides researchers with the flexibility to specify and examine those factors that could be unique to cultural and ethnic groups [2,3]. Thus, SCCT is a particularly useful theory to guide engineering career development investigations among Native American engineering students [6].

In a recent review of the literature, Fouad and Santana [4] found that SCCT is predictive for pre-college, undergraduate, and graduate college students from underrepresented groups. Additionally, when examining contextual affordances, investigators have found that parent support is a particularly salient predictor of self-efficacy beliefs and outcome expectations among multi-ethnic students, including samples of Native American students [7,8]. Moreover, strong empirically-based support has been found for using an SCCT model with young people from underrepresented racial-ethnic minority groups within the STEM domain [e.g., 9, 10] and engineering studnts [11]. More information is needed, however, about how Native American young people process environmental (contextual) variables and supports, and how they assess their own personal characteristics and skills when considering preparing for and persisting in engineering.

In terms of persistence and retention in graduate education, Fouad and Santana [4] reviewed the breadth of research on racial/ethnic differences in engineering career pathways [e.g. 12]. They concluded that racial minority students often face an unwelcoming climate and experience a sense of not belonging. Other researchers have found that institutional supports and a positive interpersonal environment predicted learning and engagement [13]. Moreover, researchers have found that campus climate is related to goals among Native American, African American, and Latino/a undergraduate students in biological sciences and engineering [9]. This research suggests that variations in campus climate (i.e. the positivity or negativity of how Native American students perceive these climates) may be related to engineering persistence.

Taken together, the literature suggests that SCCT is a viable model to study the career development of Native American students and engineering students. There is some evidence that personal and contextual barriers and supports are predictive in expected ways. Nevertheless, this research is in its nascent stages, and a more comprehensive understanding of these variables would move the research in this area forward. SCCT may provide a useful framework through which we can investigate Native American students' engineering career development; however, there is less evidence about the contextual and person factors that interact with and predict the social-cognitive variables of efficacy, outcome expectations, interests, goals, and choice actions among these young people.

Purpose of the Study

The purpose of this exploratory research was to identify the barriers, supports, and personal strengths that Native American engineering students identify as being influential in developing their career interests and aspirations in engineering. Our research questions was: 1) What is the magnitude of the specific personal and contextual barriers and supports that Native American engineering students face as they prepare for their engineering careers? Informed by research on Social Cognitive Career Theory (SCCT) [2,3], we conducted an on-line survey to assess the motivational variables that guide the career thinking and advancement of students preparing to enter the field of engineering.

Method

Participants. Study participants (*N*=23) included graduate (≈25%) and undergraduate (≈75%) Native American engineering students. Their mean age = 25.87 (SD = 6.98); 65% were male, 30% were female; and 4% identified as other. Participants were enrolled in degree programs for the fields of electrical, and chemical, mechanical, aerospace, biomedical, civil, environmental industrial, software engineering.

Procedures. Participants were recruited from American Indian Science and Engineering Society (AISES) national and regional conferences, and undergraduate and graduate engineering programs in Minnesota, Oklahoma, and surrounding regions. Participants completed an online survey comprised of five self-report instruments: Mapping Vocational Challenges [14], Perceptions of Barriers [15], the Structured Career Development Inventory [16,17], the Career-Related Parent Support Scale [18], and the Assessment of Campus Climate for Underrepresented Groups [19], The survey was powered by a university licensed copy of Qualtrics. Participants received a $15.00 gift certificate for completing the survey. All recruitment and research strategies were approved by appropriate institutional review boards prior to research initiation.

***Instrumentation*.** The on-line survey included modification of validated instruments from SCCT research that measure interests, goals, personal strengths and internal and external barriers and supports. Details on each instrument and the modifications here.

The *Mapping Vocational Challenges – Engineering Version* (MVC-E) [14] was used to measure Engineering Interests, Engineering Efficacy, and Expected Outcomes (either positive or negative) for pursuing an Engineering Career. This revised version was modeled after prior versions of Mapping Vocational Challenges (MVC), which was designed to measure interests, efficacy, outcome expectations, and parent support across both a range of occupations and for specific types of occupations [e.g., 8]. Good validity and reliability has been demonstrated among Native American young people [e.g., 8. 20].

In the original MVC, students were asked to rate items on a 3-point Likert scale; however, to increase variability and scale reliability, and to more accurately capture participants' perceptions, this rating scale was expanded to 5 points. Students were asked to rate these two items, "1) Please rate your interest in studying engineering (to prepare for an engineering career)", and "2) Please rate your efficacy (confidence) for studying engineering", using this scale: 5 = very high, 4 = high, 3 = neither high nor low, 2 = low, 1 = very low. Students were asked to rate this item, "3) Please rate the outcomes you expect by studying engineering (to prepare for an engineering career)", using this scale: 5 = very good, 4 = good, 3 = neither good nor not good, 2 = not good, 1 = really not good".

The *Perceptions of Barriers Scale* **(**POB**)** [15] is a 28-item scale that is used to measure a range of both personal and contextual barriers to students' academic and career development [15, 21]. Sample items that identify these barriers are: "I am not talented enough", and "The training I want is not available". For this current study, three additional items were included that were specific to the academic training of engineering students. Sample items from this addition were:

"I was not sufficiently prepared academically", and "I was not sufficiently prepared in engineering theory or content".

Participants were asked to rate each barrier for how likely it would be that it would keep them from preparing for/pursuing a career in engineering/engineering faculty. The rating scale was a Likert Scale of 1 to 4, with 4 being rated as "most likely" and 1 being rated as "least likely". Construct validity for the POB has been ascertained in multi-ethnic samples of high school and college students [20, 21, 22, 23, 24].

In recognition of the multi-faceted nature of barriers, and to encourage measurement parsimony, we followed the statistical analysis strategy of prior researchers for the POB (and its parallel measure, the Perceptions of Educational Barriers Scale) by examining career barriers by domains [21, 23, 25]. In these prior studies, domains were determined via principal components (PCA) and confirmatory factor analysis; however, given the limited sample size comprising this current exploratory study, we used the domains ascertained in the Turner et al. (in preparation) study [, which were derived from a PCA of data from 100 Native American college students. Barrier domains included: 1) financial barriers, 2) academic barriers, 3) perceptions of not fitting in, 4) lack of career information, 5) not, talented, motivated or interested enough, 6) balancing work and family, and 7) lack of parent/peer support. The items comprising each of these factors were scaled, and the subscales were used as variables in this study. Cronbach's α for these subscales = .66 to .89. Given the brevity of the scales, we also calculated reliability estimates using the Spearman-Brown Prophecy Formula (x2). These estimates = .80 to .94.

The *Structured Career Development Inventory* [16] measures students' personal strengths and skills. The 58-item Structured Career Development Inventory (SCDI) was developed to measure the strengths, skills, and outcomes identified in the Integrative Contextual Model of Career Development [16, 26]. For this study, only the 29 items measuring social, academic, career exploration, and goal setting skills were analyzed, as only these items bore directly on our research question.

Items were scored on a 5-point Likert-type scale (1= Strongly Disagree to 5 = Strongly Agree), with higher scores indicating a greater extent to which strengths and skills were developed. Sample items for the SCDI skills scales are: "I am committed to reaching my future educational and career goals" (Proactivity), and "I have participated in career exploration activities" (Career Exploration Skills).

The SCDI has been used in studies of adolescent, college student, and post-high school young adult career development [e.g., 27, 28, 29], including studies of the career development of Native American young people. Career exploration, as measured by the SCDI, has been positively related to interests and efficacy among Native American young people [30].

The *Career-Related Parent Support Scale* [31] is a 27-item instrument that was used to measure students' self-reports of their parents' support in the four areas of self-efficacy information (Instrumental Assistance (IA), Career-Related Role Modeling (CM), Emotional Support (ES), and Verbal Encouragement (VE)) identified by Bandura [32]. IA is the tangible help provided by parents in planning and preparing for their young people's careers. CM is adolescents'

perceptions of their parents' career-related modeling behavior. ES is adolescents' perceptions of their parents' attention to the affect they experience about educational and career development issues. VE is adolescents' perceptions of their parents' encouragement of their pursuit of educational and career goals. Each of the CRPSS scales is scored on a 5-point Likert scale (1 = Strongly Disagree, 3 = Neither Agree or Disagree, 5 = Strongly Agree), with higher scores indicating more agreement. Sample items are: "My parents teach me things that I will someday be able to use at my job" (IA), and "My parents have shown me where they work" (CM). Parent's career-related role-modeling has been significantly related to career planning and exploration self-efficacy, knowledge of self and others self-efficacy, educational and vocational development self-efficacy, career decision-making self-efficacy and career decision-making outcome expectations [31].

A modified version of the *Assessment of Campus Climate for Underrepresented Groups* [19] measures contextual barriers and supports related to program and campus climate. The instrument, that assesses variations in campus climate, is scored on a 5-point Likert Scale, with lesser scores indicating a more negative perceived climate, and greater scores indicating a more positive perceived climate. For this study, 7 aspects of campus climate tapped by this instrument were measured by one item each, and each item was treated as a variable. We did this to examine the magnitude of various aspects of the climate that were most salient to Native American engineering students rather than obtaining an overall score representing the perceived negativity or positivity in the climate.

Results

The results of the participant surveys are assembled in Tables 1 and 2. Native American engineering students strongly agreed that they were interested in, had efficacy for, had positive outcome expectations for, and were likely to complete their engineering degrees, with mean scores across theses 4 variables ranging from Mean = 4.14 to 4.91 (SD ranging from .43 to .86), scored on a 5-point Likert Scale (5 to 1).

Their most challenging *barriers* were financial (e.g., having expenses that are greater than income, and having to work while going to school just to make ends meet) (Mean = 2.31, SD = .96), and academic barriers (e.g., not sufficiently prepared academically to study engineering) (Mean = 2.18, SD = .86). Perceptions of not fitting in (Mean = 1.98, SD = .76), and a lack of career information (Mean = 1.91, SD = .70) were identified as moderately challenging barriers (as scored on a 4-point Likert Scale (4 to 1)).

The students endorsed a number of *personal strengths and skills*, with the strongest being confidence in their own communication and collaboration skills (Mean = 4.33, SD = .45), as well as commitment to their academic and career preparation (Mean = 4.11, SD = .61), with Personal strengths and skills scored on a 5-point Likert Scale (5 to 1)).

The most notable *external support* to their engineering career development was their parents' encouragement to make good grades and to go to a school where they could prepare for a STEM career (i.e., Parents' Emotional Support, Mean = 4.29, SD = .88), with Parent Support scored on a 5-point Likert Scale (5 to 1).

Finally, students overall endorsed *positive aspects of their program environments*, meaning that these Native American engineering students perceived that the interactions with others and the expectations for how people treat each other were positive. Students found their programs to be more cooperative than uncooperative (Mean = 3.86, SD = .77), more friendly than hostile (Mean = 3.79, SD = .81), more equitable than discriminatory (Mean = 3.79, SD = .80), and more respectful than disrespectful (Mean = 3.71, SD = .83), as scored on a 5-point Likert Scale (5 to 1). Only the variables with the greatest magnitudes were reported in this section. Means and SD of variables not discussed here are available in Tables 1 and 2.

Table 1. Social Cognitive Variables, Personal Strengths and Skills, and Contextual Supports (Parents), Descriptive Statistics		
	X	SD
Social-Cognitive Variables		
Engineering Interests	4.43	.85
Engineering Efficacy	4.14	.86
Engineering Outcome Expectations	4.79	.43
Likelihood of Completing Your Engineering Degree	4.91	.30
Personal Strengths and Skills		
Social (i.e., communication & collaboration) Skills	4.33	.45
Academic Skills	4.11	.61
Career Exploration Skills	4.06	.58
Goal-Setting Skills	3.83	.63
Contextual Supports – Parents		
Parent Support – Emotional Support	4.29	.88
Parents' Encouragement to Make Good Grades	4.50	.76
Parents' Encouragement to Go to Engineering Program	4.07	.99
Parent Support – Verbal Encouragement	4.20	.75
Parent Support – Career Role Modeling	3.92	.99
Parent Support – Instrumental Assistance	3.61	.85
Contextual Supports -- Climate		
Cooperative to Uncooperative Climate	3.86	.77
Friendly to Hostile	3.79	.81
Equitable to Discriminatory	3.79	.80
Respectful to Disrespectful	3.71	.83
Concerned to Indifferent	3.64	.74
Comfortable to Uncomfortable Climate	3.64	.75
Enjoyable to Dismal	3.57	1.02

Table 2. Barriers to Engineering Career Development Descriptive Statistics

Most Challenging	X	SD	Moderately Challenging	X	SD	Least Challenging	X	SD
Financial Barriers	2.31	.96	Not Fitting In	1.98	.76	Talent/Motivation/Interest	1.83	.75
Not enough money	2.43	.99	I don't fit into my program	2.00	.68	Not interested	1.86	.86
Expenses greater than income	2.29	.99	Not able to get the job I want	2.00	.88	Lack of talent	1.86	.99
Must work to make ends meet	2.21	.89	No mentorship	1.93	.73	Lack of motivation	1.79	.58
Academic Barriers	2.18	.86	Lack of Career Information	1.91	.70	Balancing Work and Family	1.67	.82
Not prepared academically	2.29	.83	About balancing work/family	2.00	.66	Have a family	1.86	.77
Not enough engineering theory	2.14	.66	About engineering	1.93	.83	Being married	1.71	.83
Not confident Enough	2.29	.99	About focusing my career path	1.86	.66	Pressure from Boy/Girlfriend	1.43	.85
Not smart Enough	2.00	.96	About skills needed for my job	1.86	.66			
						Lack of Parent/Peer Support	1.55	.56
						Lack of peer support	1.79	.89
						Others don't think I can do it	1.64	.63
						Lack of parent support	1.18	.41

Discussion

The purpose of this exploratory research was to identify the barriers, supports, and personal strengths that Native American engineering students identify as being influential in developing their career interests and aspirations in engineering. Our research question was: What is the magnitude of the specific personal and contextual barriers and supports that Native American engineering students face as they prepare for their engineering careers?

Native American engineering students reported their most challenging barriers were financial (e.g., having expenses that are greater than income, and having to work while going to school just to make ends meet) and academic barriers (e.g., not sufficiently prepared academically to study engineering). Perceptions of not fitting in and a lack of career information were also identified as moderately challenging barriers. Students endorsed a number of personal strengths, with the strongest being confidence in their own communication and collaboration skills, as well as commitment to their academic and career preparation. The most notable external support to their engineering career development was their parents' encouragement to make good grades and to go to a school where they could prepare for a STEM career. Students overall found that their engineering program climates (i.e., interactions with students, faculty, and staff, and program expectations of how individuals treat each other), were cooperative, friendly, equitable, and respectful.

The results are consistent with research supporting parent support as salient predictor of self-efficacy beliefs and outcome expectations among multi-ethnic students, including samples of Native American students [7,8]. Additionally, the results offer some insight into the environmental (contextual) variables and supports faced by Native American students that might improve STEM education experiences for Native American engineering students. For example, parent support seems to be a key factor of support for undergraduate students, whereas financial concerns seem to be a resonating barrier. Pre-college engineering education interventions for parents and students could be an important component for future success.

The findings also inform an understanding of how Native American engineering students are assessing their own personal characteristics and skills when considering preparing for and persisting in engineering. Native American students reported high commitment to their degree programs and positive campus climate, but noted barriers to academic preparation and career information. This suggests a strong need for extra-curricular skills development or opportunities to raise awareness about scholarships, internships, and career pathways.

Study Limitations and Suggestions for Future Research

This exploratory study is limited due to small sample size, which limits generalizability of findings. Moreover, our study is limited in that we did not conduct inferential statistical analysis. Nevertheless, the findings suggest that SCCT might offer a useful framework to examine the career thinking of Native American engineering students and provide a foundation for variable choice for future studies. A large, multi-site, longitudinal investigation would help validate the SCCT for Native Americans, as well as for the engineering domain specifically [4].

Research in URMs college entry, retention, and persistence continues to move toward more integrated models with emphasis on intersectionality, context, and environmental factors [e.g., 33]. For example, research on culturally responsive programming for Native American pre-college students is widespread [33-37]. Less research focuses on the role of cultural backgrounds in undergraduate and graduate experiences. One study of college students in STEM fields similarly found that Native American students were likely to endorse communal goals tied to their tribal identities that may encourage feelings of belonging uncertainty in STEM [38]. A recent literature review of Native American graduate students in STEM fields found that although they are engaged in a number of career interventions, traditional academic mentoring should incorporate indigenous values and kinship structures [39]. Notably, much more research is needed to integrate and understand the influence of cultural experience to socio-cognitive constructs of career thinking [41-43].

Conclusion

SCCT may offer a framework to examine changes in career thinking overtime and explore in more detail the role of educational intervention on NAAN student self-efficacy and expected career outcomes. The study described here looked specifically at the context of Native American undergraduate career thinking in the engineering discipline. Overall, our finding suggest that SCCT might offer a useful framework to examine career thinking of Native American engineering students. The unique contribution of this study is that it provides a roadmap of salient variables that can be tested in future research among Native American engineering students, and that can be employed when considering educational interventions for current students.

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