ASEE's 123rd Annual • Conference & Exposition • New Orleans, LA • June 26-29, 2016

New Orleans JAZZED about Engineering Education

Paper ID #15322

First Generation Students Identification with and Feelings of Belongingness in Engineering

Hank Boone, University of Nevada, Reno

Hank Boone is a Graduate Research Assistant and Masters Student at the University of Nevada, Reno. His research focuses on First Generation engineering college students' engineering identity, belongingness, and how they perceive their college experience.He is also on a National Science Foundation project looking at non-normative engineering students and how they may have differing paths to success. His education includes a B.S. in Mechanical Engineering from University of Nevada, Reno.

Dr. Adam Kirn, University of Nevada, Reno

Adam Kirn is an Assistant Professor of Engineering Education at University of Nevada, Reno. His research focuses on the interactions between engineering cultures, student motivation, and their learning experiences. His projects involve the study of student perceptions, beliefs and attitudes towards becoming engineers, their problem solving processes, and cultural fit. His education includes a B.S. in Biomedical Engineering from Rose-Hulman Institute of Technology, a M.S. in Bioengineering and Ph.D. in Engineering and Science Education from Clemson University.

First Generation Students Identification with and Feelings of Belongingness in Engineering

Abstract:

This research paper investigates how engineering students overcome difficulties in engineering through development of an engineering identity, belongingness and social capital with a focus on first generation students (FGS). FGS research often draws comparisons to continuing generation students (CGS) and depicts FGS as weaker students and having difficulty reaching graduation. Difficulties include limited study skills, difficulty meeting admission requirements, personal responsibility of tuition, need for employment, and familial relationships. Research demonstrates FGS "struggle", but little literature examines FGS success persisting to degree attainment. Social capital was chosen as it is a prevalent factor of FGS success while identity and belongingness may relate to students' levels of social capital.

FGS is defined as an individual whose parents have not attained a four year bachelor's degree. Upper division students were selected as these students have persisted past traditional engineering barriers and may have developed identity and feelings of belongingness. A required communications class for engineers at a western land grant institution was surveyed using 106 Likert-type, matrix, and modified dichotomous items to understand the student's social capital, experience, identity, and belongingness (n=202, 96% response rate). Analysis showed that being a FGS predicted higher belongingness to engineering major and class. It was also found that FGS had similar engineering identity, motivations toward engineering, experiences in engineering, and social capital provided by their social networks when compared to CGS students. FGS had a more positive opinion on experiences tied to the engineering classroom because they thought their professors gave them encouragement to think creatively, did not go through material too fast, and were happy with their class size when compared to CGS students. FGS did not have as many resources provided by their family/guardian but this could contribute to their differing views of their engineering experience.

Introduction

First generation college students can be defined by different definitions while two have been used extensively in higher education research: having neither parent attended college or neither parent having attained a baccalaureate degree[1]. For this paper, the definition will be neither parent having attained a baccalaureate degree because it broadens the population by allowing us to explore a range of views and experiences of first generation students. It is also the US Department of Education standard definition[2]. First generation research has traditionally made direct comparisons between first generation students (FGS) and continuing generation students (CGS) through examination of academic test scores[3], decreased attainment of degree/persisting in college[2], and increased dropout rates[4]. The traditional presentation of research results presents FGS as disadvantaged or less than their CGS counterparts, and often ignores how FGS succeed in educational environments.

The broad purpose of our work seeks to shift the focus of FGS acting in a deficit model to one of understanding experiences of the FGS and how this unique set of experiences can help transform engineering education into an environment that recruits, retains, and develops diverse talent to solve a broad range of engineering problems[5]. This work links with previous work sharing the perspective of removing the deficit model for FGS. Non-deficit model research found a higher percentage of FGS than CGS pursue college to get a better job, and to make more money[6]; FGS place more importance on giving back to their family financially and bringing honor to their family[7] and FGS take fewer risks in college[8], are more afraid of failure[9], and are more likely to choose majors with high earning potential[8]. When examining FGS in the context of engineering, work has shown FGS often choose against majoring in engineering because of not having engineering prerequisites[10]. FGS that choose to major in engineering show more career interest than the CGS[11]. FGS students in engineering also have statistically different social capital characteristics and accessed resources compared to CGS showing that FGS students are successful, but use different resources to gain entry and persist in engineering[12]. We seek to continue advancement in the understanding of the experiences of FG engineering students, through examination of engineering students who have made it beyond traditional exit points in engineering, and into upper division courses. This understanding will be developed through addressing the following research questions (RQ):

RQ 1) What experiences, affective domain traits, and social capital resources explain engineering students' development of engineering role identity and feelings of belongingness?

RQ 2) In what ways are these experiences unique for first generation engineering students when compared to continuing generation peers?

This increased understanding will be further utilized by the research team in subsequent qualitative phases of the research project by exploring grounds for causation and the developmental role of any significant factors play in development of the constructs of interest.

Theoretical Frameworks

Social Identity Theory

Social identity, a theory that is operationalized to understand organizational behavior, explains how one defines themselves according to categorization into group affiliations[13]. The definition of social identity connects how one sees their own identity and their group affiliation. At times, one's salient or personal identity helps or hinders their group affiliation or how much they *belong* to their group[14]. If one sees themselves as *different* from the group then they will want to dissociate themselves from the group affiliation. In our case, those that feel they do not fit into engineering may choose to shift away from engineering. An identity mismatch does not always cause dissociation from engineering but is more a measure of one's "fit"[14]. FGS students may see their salient identity as separate from engineering, but they choose to associate (major in) engineering and thus take on engineering's group affiliation. Social identity serves as the overlying structure guiding our work. This theory serves to potentially bridge the gap between engineering identity and belongingness to engineering. Additionally, the role of social capital falls into this theory as it serves to moderate entrance into the engineering group and the development of feelings of belongingness in engineering. Identity, belongingness, and social capital will be used to measure the students' engineering social identity for this study. Explicit framing of how we are operationalizing each of these constructs is outlined below.

Engineering Role Identity

Identity as defined in this study refers to one's role identity or how one see themselves in certain aspects of their life[15]. A person may have many role identities (e.g. engineer, researcher, team leader) that overlap or are distinctly separate identities. Role identity is unique to each individual but certain characteristics may be shared by group members who are part of a larger community. Engineering role identity is therefore unique and self-defined by each engineer. This framework is used in our study to understand if there are unifying and differing role identities amongst FGS and CGS. Engineering role identity has been defined by three characteristics: how one perceives their performance/competence towards engineering, how one perceives their interest in engineering, and how they perceive they are recognized as an engineer[16]. Findings using this conceptualization of role identity have shown that FGS have higher outcome expectations for their career[11] and were also validated and used to form a structural equation model to understand engineering choice of major[17]. Explicitly considering the engineering identity development of upper division FGS allows us to understand how these conceptualization translate up from freshman populations and how conceptualizations of identity may differ for upper level students.

Belongingness in Engineering

Belongingness for this study is defined by a student's sense of belonging. Sense of belonging is defined by an individual's self-measure of "fit" within a higher education institution's social and academic systems[18]. Findings using this framework have shown that students with an increased sense of belonging in a learning community have decreased attrition rates[18]. Understanding belonging to engineering could help retain students who have the aptitude and interest in engineering (i.e. have an engineering role identity) but who would leave because they do not feel connected to an engineering community. A longitudinal study measuring the sense of belonging of engineering students over four years has shown that engineering students have an increase in sense of belonging for their engineering major between their last two years compared to their first two years[19]. This finding bolsters our population selection of junior and senior students where there is a higher chance that students will feel like they belong in engineering compared to freshmen or sophomore students. A sense of belongingness, just like role identity, is participant dependent, meaning that a sense of belongingness for a FGS could be different from a CGS based on their experiences and views of engineering. Determining how junior or senior FGS have developed or not developed feelings of belongingness for engineering continues to help us better understand the experiences of FGS.

Social Capital

Belongingness and identity show how well one fits into engineering, but we also want to understand how one gains entrance into engineering and engineering communities. Social capital answers this question. "To possess social capital, a person must be related to others, and it is those others, not himself, who are the actual source of his or her advantage [when gaining entry into a group]."(pg. 7) [20]. A person who has engineering social capital then has people in their social group that can help them become an engineer. One attains entry into engineering through institutional agents (i.e. professors, teachers, and parents). Social capital, like engineering and belongingness, is unique to the individual because each person has differing institutional agents and relationships with their institutional agents. FGS and CGS students may be offered different levels of social capital, but both can be successful. Martin, Miller, and Simmons work showed that FGS were successful but accessed certain engineering programs differently[12]. Their work presented FGS students' decision to enter, persist, and graduate in engineering and was a big proponent in formation of research questions and survey instruments. A study comparing first-generation white males to non-first generation white males showed that first generation white males that had high future aspirations accessed institutional agents more frequently[21]. Data from Miller, Martin, and Orr showed FGS in engineering "more often reported both smaller, distant networks and networks which provided significantly lower resource access compared to their peers who came from a home with at least one parent having completed a four-year college degree. Thus, FGS may be another group that is at-risk of not having the necessary social capital that can successfully link them to engineering" (pg. 86) [22]. Miller, Martin, and Orr's work shows the importance of social capital for FGS to persist in engineering. Their work was rooted in social capital that was linked to sociology. Lin conceptualized social capital as "resources embedded in a social structure; accessibility to such social resources by individuals; and use or mobilization of such social resources by individuals in purposive actions."(pg. 35)[23]. For the analysis of this study accessibility will be used to measure the institutional agents support to gain entry and persist in the "closed group"[24] of engineering.

Future Time Perspective and Connections to Identity

Given the outlined role of the future in FGS development of social capital[21]; the role that future oriented goal setting plays in the development of student identities[25]; and influence of student future time perspectives can have on actions related toward engineering tasks [26,27] we have expanded our frameworks to include explicit consideration of student motivation, specifically their future time perspectives. Future time perspective, as utilized in this work is defined by the work of Hilpert et al.[26] and Benson, Kirn, & Morkos[28]. This operationalization of the future time perspective framework is comprised of 4 factors: perceived instrumentality of present tasks, connectedness to future, value of one's future in relation to the present, and perception of one's future. Perceived instrumentality is how one sees the usefulness of certain tasks (i.e. homework, projects, internship) toward their future goals. Connectedness to future is how one sees their future goals connected to their present actions. Value measures the importance of either the present or the future in relation to each other. Lastly, perception of future measures the closeness or the amount of time one thinks about the future. Previous work in engineering has found that students' motivation toward short-and long-term goals affects students approaches and actions taken toward problem solving in engineering[29]. The influence of student future time perspectives on task-based actions serves to connect identity and motivation. To develop a role identity one must take on the performative aspects of the role or position they wish to attain, in this case engineer. Student motivations leading to a shift in performative action serves to shift how students develop an engineering identity and how they perceive their fit or belongingness in the engineering community.

Methods

Instrument

A 106 item survey was created to assess FGS feelings of belongingness (6 items[19]), engineering identity (15 items[16]), motivations toward a future in engineering (18 items[26,29]), social capital[30] and experiences[31] by adapting previous established items.

Detailed descriptions of survey items may be found in the works cited. In brief, belongingness items measured students' perceptions of belongingness in an engineering class (items=3, 7 point Likert-Type) and engineering as a major (items=3, 7 point Likert-Type). Both aspects of belongingness were measured by asking students how much they feel like they belong, how comfortable they are in engineering, and how well they fit into engineering. Engineering role identity was assessed through items related to engineering performance/competence (items=5, 7 point Likert-type), recognition as an engineer (items=7, 7 point Likert-type), and interest in engineering (items=3, 7 point Likert-type). An in-depth discussion of the identity measures is provided by Godwin[32]. Future time perspective items examined students' perceptions of how much they value the future (value, items=5, 7 point Likert-type), how students perceive their future career (perceptions of the future, items=3, 7 point Likert-type), connections made between the present and the future (connectedness, items=5, 7 point Likert-type), and how students' viewed present tasks as beneficial (perceived instrumentality, items=4, 7 point Likert-type).

Social capital was measured through the use of Martin's Name and Resource Generator (NRG) developed as part of NSF grant (0950710). This section asked questions about people that assist with obtaining entry into engineering (institutional agents), and who provided access to resources that aid in student success in engineering. Resources include: assisting with college admissions, fostering skill and interest towards engineering, fostering engineering career development, and support structures to increase persistence in engineering. Institutional agents who aided in accessing resources include: Parent or guardian, other family member, family friend, peer (friend, classmate, peer mentor), middle/high school teacher or counselor, community or technical college personnel, college/university personnel (admissions personnel, program directors), college/university professor, and employer or coworker. Students were asked to think about these names and resources at two time points: before entering college and as of today.

Experience items measured experiences students had with academic resources (items=4, modified 6 point Likert-type), interactions with professors (items=11, 5 point Likert-type) and students (items=6, 5 point Likert-type) in engineering, and experiences being stereotyped that were linked to one's generational college status, race/ethnicity, gender, and disability (modified dichotomous). The modified Likert type items had an NA value at the top end of the answer block and the modified dichotomous type items had a "Don't know" option. The NA value was added so students had an option to answer if they never had an interaction with a certain academic resource. The "Don't know" option was added to the stereotype section if students may not have been cognizant of their stereotyping.

Survey Administration and Participants

Surveys were administered in person during the third week of the fall semester at the end of a class meeting of an upper level required technical communications class (ECOM) at a western public land-grant institution. Surveys were administered over the span of a week and responses were collected in class after participants finished the paper survey. The population consisted of engineering majors who have taken at least two years of engineering courses. The class is dependent on a four year plan and has prerequisites that restrict students from taking the course until their third year of engineering. A total of 202 survey responses (96% response rate) were turned in from the participants. A 96% response rate was obtained for this survey administration due in part to the instructor's mandatory attendance policy. All students were given the option to not complete the survey.

Analysis

Of the 202 survey responses, 78 FGS (39% of total survey) were identified using the U.S Department of Education definition (neither parent/guardian having a baccalaureate degree) while 130 CGS were identified. The data was analyzed using the R statistical and computing software[33]. Surveys with incomplete belongingness, identity, and experience responses were not used for data analysis (remaining of combined FGS and CGS, n=162, FGS=64, CGS=98).

Data Cleaning

An Accessibility Measure of Resources (AMR) was created for each social capital response option (before college and as of today) by summing the number of resources each institutional agent afforded a participant access to. Figure 1 displays a portion of the social capital items, where rows represent the resources while columns represent institutional agents. Participant responses were summed for each column.

Before or during the time you were initially considering engineering as a college major, did you know anyone who… (Please check all that apply)

	Parent or guardian	Other family member	Family friend	Peer
Provided you with college admissions information	O	O	O	O
Took you to their place of engineering work	O	O	O	O

Figure 1: Social Capital sample question sample used to demonstrate the data format for AMR calculations.

Further data manipulation was collected for demographic questions that asked participants if their Parent/Guardian was born in the U.S. Missingness for this question were recoded as a "3" to represent "NA". Yes responses were coded as a "1" and no coded as a "2".

Parent/Guardian education items were simplified to a dichotomous CGS or FGS using the aforementioned definition of first generation. Survey items used for the participants to report Parent/Guardian highest level of education were less than high school, high school diploma/GED, some college or associate/trade degree, bachelor's degree, master's degree or higher, and don't know. If the student reported one parent received a bachelor's degree then that participant was marked as a CGS. Missingness for one parent/guardian's level of education was labeled as FGS if the other parent had less than a bachelor's degree because the interpretation was the student came from a single parent/guardian household or the influence of the 2nd parent on the student was low. Values of don't know were also thought to be interpreted as less than a value of a bachelor's degree because it is assumed the student would know if a parent went to college.

Exploratory Factor Analysis

*E*xploratory factor analysis (Promax rotation, 0.4 cutoff) was conducted using the entire population of those surveyed. Questions were subdivided by their respective theoretical construct: identity, belongingness, and motivation. Exploratory factor analysis was done to ensure the frameworks factored as expected when items are tested with a new population. Exploratory factor analysis was also run for the experience items, but items did not factor together but answered separate questions for each item.

Generalized Linear Models

Generalized linear models were then created using backwards deletion with the average factor scores, demographics, and AMR of institutional agents. Items measuring experiences was not used to create the linear models. A significance level of alpha=0.05 was used for this work. Outcome variables of interest include belongingness to course and major and engineering identity factors (recognition, performance/competence, and interest). Setting the alpha value to a more restrictive 0.01, would limit exploration of factors that may play a central role in FGS experiences that have had minimal exploration in developed survey instruments.

T-tests

T-tests were conducted on survey constructs comparing the FGS to CGS on belongingness, identity, future time perspective factors, AMR scores, and experiences with classmates, professors, and advisors.

Results

According to literature, engineering identity should have three distinct factors (recognition, interest, and performance/competence) sense of belongingness should have two distinct factors (belongingness to major, belongingness to class), and motivation should have four factors (value, connectedness, perception of future, and instrumentality). All questions have previously been validated but have not been tested with the population being studied.

Exploratory Factor Analysis

The table on following page shows the factors that appeared from the EFA. Each framework was analyzed using a separate EFA. For a full list of factor loadings with factor scores, refer to the appendix. Identity has been excluded at the original author’s request.

Table 1: EFA factors

Factor	Theoretical Framework	Example question
Belongingness to class	Belongingness	I feel that I am part of my engineering class
Belongingness to major	Belongingness	I feel I belong in engineering
Performance/ Competence	Role Identity	I understand concepts I have studied in engineering
Recognition	Role Identity	My instructors see me as an engineer
Interest	Role Identity	I find fulfillment in doing engineering
Value	Future Time Perspective	Long range goals are more important than short range goals
Connectedness	Future Time Perspective	Engineering is the most rewarding future career I can imagine for myself.
Perception of Future	Future Time Perspective	I don't like to plan for the future
Instrumentality	Future Time Perspective	What I learn in my engineering course will be important for my future occupational success.

Factor loadings matched previous work and literature, and the factor names were picked based on the previous work. The factor analysis for experience items was inconclusive therefore all experience items were treated as individual measures. Please refer to the appendix for factor reliability. The items that loaded together under specific factors were then averaged together. Any factor found in Table 1 is therefore an average value among several items.

Significant predictors for belongingness factors

Once factor averages, missingness of data, and measure of sum of resources from institutional agents were found, a general linear model was derived using backward deletion until all predictors were significant (α=0.05). The following table represents the significant predictors that model belongingness to class.

Table 2: Significant predictors (at 0.05) of Belongingness to class model

	Estimate	Std. Error	Significance Level
(Intercept)	2.82	0.96	**
AMR of university professor before college	0.10	0.04	**
AMR of college/university personnel before college	-0.11	0.04	*
AMR of peer before college	-0.07	0.03	*
AMR of other family member as of today	0.10	0.03	***
Perception of Future	0.34	0.07	***
Having a race or ethnicity not listed above	-1.32	0.65	*
1st Parent/Guardian is Male	0.42	0.15	***
Being a First gen student	0.34	0.15	*
R^2= 0.33, p-value=2.467e-10			
Legend: * = <0.05, **= <0.01, ***= <0.001			

The entire model is significant and explains 33% of the variance in the students' belongingness to class scores. Significant positive predictors to belongingness to class are AMR of university professor before college, AMR of other family member as of today, Perception of Future, 1st Parent/Guardian is Male, and being a first generation student. The AMR of university professor before college shows that those students that have support from a university professor in fostering interest and the exposure to paths into engineering have a higher belongingness to class once they have reached their upper division courses. AMR of "other family member" as of today shows that constant support from family improves belongingness to class which has been linked to retention to graduation. A positive perception of future means that a student thinks of the future in the present. Therefore, having a developed plan for the future correlates to an increase in belongingness to class. The survey allowed the participants to identify their parents as parent 1 and parent 2. Having a 1st Parent/Guardian as male also allows students to belong more to their class. When inputting data, a trend emerged that if the participant was male then they would put their Parent/Guardian 1 as male also. With this trend, one can say that being a male increases the participants' belongingness to class. Although this may be a possible explanation for the data, if being a male was a predictor for the model, then it would have appeared through backward deletion. Parent/Guardian 1 listed as male requires further exploration of the literature and qualitative analysis with our participants to determine what role, if any, this actually plays in students' feelings of belongingness. Being a first generation student was also a positive predictor for belongingness to class. This finding means that FGS on average have more belongingness than CGS.

Significant negative predictors to belongingness to class are AMR of college/university personnel before college, AMR of peer before college, and having a race or ethnicity not listed above. The survey defined college/university personnel as an admissions personnel or program directors. So having many resources provided from an admissions personnel or program director before college decreased the likelihood of student's feeling like they belonged to class. Students may have received information that was used to give them interest in engineering but the information provided may not have been describing the engineering class but engineering as a major. This may also relate to students' views on ECOM, seeing that many students perceive ECOM as a requirement to graduate but not as an asset toward their future career. Students also feel like ECOM is not engineering because it is more of an English course than a traditional math heavy engineering course. An increased AMR of peer before college decreases belongingness to class. The AMR before college is related to interest and support towards the engineering field and a negative relationship may mean that the students do not have this friend by their side to go through engineering with them. Further, this may lead to students having a lack of the same or similar peers from before college, feeling out of place now that they are in college, and having difficulty finding new groups to associate themselves. The students then have a lack of belongingness to major because they are searching for peers that existed before college but may not exist in the engineering discipline. Lastly, having another race or ethnicity not listed is a negative predictor in belongingness to class. Those that did not identify with a race or ethnicity (n=2) for this population, identified as "pink" and "human". Interpretation of this result is difficult due to the small population and questions related to the quality of responses given from participants. Students who do not fall within traditional race/ethnicity categories may in fact have difficulty feeling like they belong in their courses, but the results of this work are not conducive to explore this discussion further.

The following table represents the significant predictors that model belongingness to major after backwards deletion at the 0.05 significance level.

Table 3: Significant predictors (at 0.05) of Belongingness to major model

	Estimate	Std. Error	Significance Level
(Intercept)	2.40	0.59	***
AMR of family friend before college	-0.04	0.02	*
AMR of parent or guardian as of today	0.05	0.02	**
Perception of Future	0.41	0.06	***
Perceived Instrumentality	0.21	0.07	**
First Parent/Guardian is male	0.28	0.12	*
Being a First generation student	0.29	0.13	*
R^2=0.41, p-value=5.34e-16			
Legend: * = <0.05, **= <0.01, ***= <0.001			

The entire model is significant and explains 41% of the variance in the students' belongingness to major scores. Significant positive predictors for belongingness to major are AMR of parent or guardian as of today, perception of future, perceived instrumentality, first parent/guardian is male, and being a first generation student. Having AMR from a parent or guardian as of today gives the student a sense of belongingness to the engineering major. The parent or guardian is assisting the student to further their career through financial aid, providing encouragement, writing letter of recommendations, and maybe even taking the student to their engineering workplace. These are examples of AMR but not the full list of possible resources. Perception of future gives a student a positive belongingness to major. The positive relationship shows that engineering students are thinking about their future as an engineer and this in turn causes them to feel like they belong in engineering. Having a high perceived instrumentality score (seeing a usefulness for tasks) shows an increase in belongingness to major. To understand the relation, one must know how tasks are defined. The questions that factored for instrumentality related to the student's engineering course, therefore tasks refer to seeing their engineering course (ECOM) as relevant to their future (being an engineer). Having a 1st Parent/Guardian as male, as stated for belongingness to class, requires further exploration. Being a first generation student was also a positive predictor for belongingness to major. This finding means that FGS on average have more belongingness than CGS.

Significant negative predictors for belongingness to major is AMR of family friend before college. So, if a family friend supplies resources to help get into engineering, the student has a lower belongingness score.

Significant predictors for engineering identity factors

The following table represents the significant predictors that models Recognition after backwards deletion at the 0.05 significance level.

Table 4: Significant predictors (at 0.05) of Recognition model

	Estimate	Std. Error	Significance Level
(Intercept)	2.17	0.77	**
AMR of employer or coworker as of today	0.07	0.02	**
AMR of college/university personnel before college	-0.07	0.03	*
Perception of Future	0.39	0.05	***
College expense provided by financial aid	0.13	0.05	*
College expense provided by parent, guardian, or family	0.18	0.05	***
R^2=0.34, p-value=8.65e-13			
Legend: * = <0.05, **= <0.01, ***= <0.001			

The entire model is significant and explains 34% of the variance in the students' Recognition scores. Positive predictors for recognition are perception of future, college expense provided by financial aid, college expenses provided by parent, guardian, or family, and AMR of employer or coworker as of today. A positive perception of future relates to a positive recognition as an engineer. Juniors and seniors who are planning for the future in their career feel like that are recognized more by professors, family, and engineering peers. College expenses provided by financial aid or provided by a familial member show an increase in recognition as an engineer. The students receiving financial aid qualify for it by: a) a grant or scholarship through grades or b) need based. In both cases, the student may be concerned to lose this money and know that if one does poor in a class, then they lose their financial aid. The same may be true in some familial sources of financial aid. The family may have a minimum GPA and/or a certain amount of years they give the student to graduate or the student loses financial aid. The last positive predictor of recognition was AMR of coworker or employer as of today. The resources asked on the survey were engineering specific so these coworkers and employers are engineering coworkers and employers. Engineering students traditionally start internships in their junior or senior year and they are becoming recognized in not only the academic realm but a small portion of industry too.

Negative predictors for recognition is AMR of college/university personnel before college. An admission personnel may have assisted students before college but this may lead to a student feeling a lack of recognition once they do not receive the same attention in their major.

The following table represents the significant predictors that models Interest after backwards deletion at the 0.05 significance level.

Table 5: Significant predictors (at 0.05) of Interest model

	Estimate	Std. Error	Significance Level
(Intercept)	1.43	0.33	***
Perception of Future	0.52	0.05	***
Perceived Instrumentality	0.15	0.06	*
College expense provided by oneself	0.09	0.04	*
Parent/Guardian 1 Born in U.S.	-0.26	0.11	*
R^2=0.55, p-value<2.2e-16			
Legend: * = <0.05, **= <0.01, ***= <0.001			

The entire model is significant and explains 55% of the variance in the students' Interest scores. Positive predictors of interest are perception of future, instrumentality, and college expense provided by oneself. A high perception of future, if one thinks about their future often, leads to a higher reason to be interested in engineering. High instrumentality, where students perceive their engineering course as very useful for their future, predicts an increase in interest. When students can connect their engineering classes to their future career, they show an interest in engineering. The engineering students are seeing themselves as future engineers and that's why instrumentality and interest are positively linked. When oneself pays for college, it positively predicts interest in engineering. College is an expensive endeavor and if a student is paying their own way they want to make sure they are attending classes and getting the most for their money.

Negative predictor of interest is Parent/Guardian 1 born in U.S. The finding may show that Americans going to college from at least one American born in the U.S. are less interested in engineering than those with a parent born outside the U.S. Since the nation is in an economic upturn, U.S. engineering students may see engineering as more of a job than a career.

The following table represents the significant predictors that models Performance/Competence after backwards deletion at the 0.05 significance level.

Table 6: Significant predictors (at 0.05) of Performance/Competence model

	Estimate	Std. Error	Significance Level
(Intercept)	6.58	0.78	***
AMR of college/university personnel before college	-0.07	0.03	*
Perception of Future	0.19	0.06	**
Connectedness	-0.15	0.06	*
Being a Female	-0.35	0.15	*
College expense provided by parent(s), guardian(s), or family	-0.13	0.05	**
College expense provided by oneself	-0.18	0.06	**
R^2=0.23, p-value=3.91e-07			
Legend: * = <0.05, **= <0.01, ***= <0.001			

The entire model is significant and explains 23% of students' Performance/Competence scores. A positive predictor for performance/competence is perception of future. This shows that if a student thinks about their future (as an engineer) often they will feel they are competent at engineering. Negative predictors for performance/competence are AMR of college/university personnel before college, connectedness, being a female, college expense provided by parent(s), guardian(s), or family, and college expense provided by oneself. The AMR of college/university personnel before college can deter the student's perceived performance/competence in the engineering discipline. Having a high connectedness seems to predict low performance/competence. Connectedness is how one identifies with engineering as their future career. The students that see themselves as engineers later may be having a difficult time with their coursework. Being a female was also a negative predictor of performance/competence. The question for sexual orientation allowed students to identify themselves in several boxes and each value can be thought of as either a specific sexual orientation or not that sexual orientation. So being a female compared to not being a female (male, transgender, agender, cisgender, genderqueer, or a gender not listed) is a negative significant predictor for performance/competence. College expense provided by oneself, or provided by parent(s), guardian(s), or family is also a negative predictor of performance/competence. Students who do poorly in classes lose financial aid and then must find a new way to pay for college by themselves or through their family. Another possible explanation for this relationship is the students may have a smaller stake in their education and see high performance/competence in their studies as less important.

T test comparison of CGS and FGS

The following table represents the survey items that showed a significant difference between FGS and CGS.

Table 7: FGS and CGS survey items that are statistically different

Item	FGS Mean	CGS Mean	Effect size (Cohens d)	Significance value
Are you satisfied with the size of the classes?	4.56	4.10	0.468	**
Do your professors encourage you to think creatively?	5.00	4.64	0.390	*
Do your professors move through the course material too quickly?	2.77	3.06	0.396	*
AMR of parent or guardian before college	23.98	27.74	0.808	***
AMR of parent or guardian as of today	18.33	20.27	0.606	***
Belongingness to Major	6.34	6.01	0.341	*
Legend: * = <0.05, **= <0.01, ***= <0.001				

FGS show a higher value than the CGS for satisfaction of class size, have a higher score for professor encouraging them to think creatively, and have a lower score when asked about professor's speeding through course material. The three comparisons when combined shows that FGS see their college experience in a positive light. FGS students have less AMR from parent or guardian before college and as of today when compared to FGS. These trends show that FGS' parent or guardian do not foster social capital as much as CGS parents do in this population. As was apparent in the glm models, a first generation student has more belongingness to major than CGS.

Interestingly, all motivation and identity factors are not significantly different between FGS and CGS students. Both CGS and FGS students are motivated toward engineering similarly and show the same average engineering identity. All but one institutional agent showed a significant difference. Both CGS and FGS are then being supported by their agents in similar ways. Many of the experience questions were also similar for the two groups meaning that FGS and CGS experiences are not significantly different.

Discussion

Belongingness

Most surprisingly, FGS in this study have a higher sense of belongingness in both their major and class than CGS. One study found that more FGS who chose to major in engineering their freshmen year persisted to earning a degree in engineering more than those CGS who started in engineering[34]. The CGS may have felt like they did not belong in their class and decided to matriculate out of engineering to other disciplines. The findings may also be linked to the location and demographics of the institution. The western land grant institution studied has a higher than normal percentage of FGS enrolled in college. The FGS may feel that they belong because there is a good representation of their fellow first generation peers. The findings may not transfer to other institutions that have a lower population of FGS. Using an equity lens on this finding, FGS will need more belonging to have success in college. Programs such as TRiO and Upward Bound have been used since the mid twentieth century to assist FGS to enter college and graduate with a degree from a four year institution. The programs focus on advising and tutoring help with coursework[35]. These programs give FGS an equal footing with their CGS counterparts. A further limitation was that FGS may have been a part of the TRiO program or may not have.

A university professor's influence increases students' persistence and belongingness to class. Freeman & Jensen found that a professor's warmth and openness to students affected freshmen students' motivations and also stated that informal meetings with students significantly add to the students sense of belongingness to class[36]. We suggest that a meeting before college should be more informal than any meeting when there is a power dynamic for the student-professor relationship, which will allow students to become more comfortable with their professors. Additionally, other family members and a parent or guardian were other agents that increased both belongingness to major and class. Metheney & McWhirter found that familial support for college increased the student's perceived social status, even for students (typically FGS) with low Social Economic Status (SES)[37]. Since college is a higher social status institution, family help fosters belongingness for all students, both CGS and FGS.

AMR scores that are negative predictors for belongingness may be explained by the majority of incoming students feeling unprepared for engineering once they get to college[38]. These students, although they have high aptitude toward math and science, do not realize their aptitude is based on high school rigor. Students then enter college level engineering classes with a false sense of confidence based on past experiences. The students' confidence towards math and science has also been nurtured by support from high school peers and admission personnel for the college, which have shown to both be negative AMR predictors for belongingness to class based on the results. This work shows that the students' perceptions of engineering belongingness from high school to junior and senior year of engineering decreases over time and may be explained by the unexpected rigor.

Shifting from past perceptions to conceptualizations of the future, motivation factors that were significant in the positive prediction of belongingness were perception of future and perceived instrumentality. The positive relationship was independent of parental education. The perception of future may be perpetuated by the regimented scheduling of the undergraduate career. There are innumerable prerequisites the students must think about and plan for to get through their undergraduate degree. Once sophomore year is done, students tend to start considering internships that will make them marketable for their future engineering career. The planning mentality has trained engineers to focus on their future often and pick ways of furthering their careers. Perceived instrumentality (how one sees a current task relevant to their future goals) can be thought of as a measure of fit. If a student does not feel something is relevant to their future, then they will disregard the task and look for another task to pursue to achieve their future goals. For the traditional math heavy educational path of engineering, a student would perceive an English class as not relevant to their math intensive career goals.

Identity

Connectedness was a negative predictor of performance/competence which coincides with how much one wants to be an engineer in the future. This may mean that all students, regardless of test scores or ability, want to be an engineer. The rigor and culture of engineering causes students to perceive struggle as a necessary step to their degree which leads these individuals to perceive they are not just getting their degree, but earning it.

Money was also found to be a negative and positive predictor of identity on multiple factors. Research has mirrored this study's predictive model significance of money because money affects low, middle, and high income families the same: the cost of college affects all income groups' persistence of college[39]. Paying for college by oneself is both a positive predictor of interest and a negative predictor of performance/competence. Students who pay their own college expenses may then be interested in having a future in engineering because they have a job to pay their own way to attain their degree and do not want to waste their time and money in an uninteresting major. Those that pay their own college expense may still be developing engineering skills and have low performance/competence possibly because they have a job instead of dedicating more homework time to understand engineering concepts. Having low performance/competence is not directly linked with attrition, because students who have to work at engineering are prone to learning the material for themselves and are more familiar with setbacks and overcoming these roadblocks. Students that only have high performance/competence, although traditionally thought to persist in engineering, have been shown to leave engineering when a setback is encountered because it is the first setback since they have been a high achiever their whole life and have not had to work that hard[40]. A duality of a positive and negative predictor also appears for college expense provided by family. These engineering students feel recognized as an engineer because their family is supporting them with their future endeavors as an engineer but have a lower performance/competence because they are not self-reliant through financial aid or a job or internship. Lastly, college expenses provided by financial aid allows for increased recognition as an engineer because the college provides grants and scholarships to engineering students who are doing well in their classes.

Being a female showed a decrease in performance/competence. One may think that aptitude is lower for females and this is a direct example of their decreased skills in math and science, but this is not the case. Performance/competence is one's self perception of how well one can do on things and at times the grade one receives and the grade one thinks they can earn differs tremendously. The performance/competence can be better explained by confidence and doubt. The females in this study may be showing lower levels of performance/confidence because females are at times held to a different standard compared to their male peers. Looking at gender bias, the females in engineering felt that they were given help and resources because they were a female and receiving help over males thus led to self-doubt[41]. McLouglin goes on to say females then began to think the school let in too many females, they felt they were treated like they were incapable of being self-reliant, and now wish to be treated the same as their male peers[41].

The last predictor dependent on demographics was having their parent born in the U.S shows a negative interest in engineering when compared to those that have their parent/guardian 1 born outside the U.S. Comparing the two groups, both groups of students may be motivated to pursue engineering for different reasons. Those that have parents born outside the U.S. may see engineering as a lifelong passion that they enjoy and came to the U.S. to pursue engineering in college. The students born in the U.S. may have other interest outside of engineering that decreases their interest in engineering or only see engineering as one of several possible future careers.

One factor that was significant in the positive prediction of all identity factors was perception of future. Perception of future was also significant for belongingness. Perception of future has been shown to be significant for engineering students' conceptualization of goals and is now showing a connection toward both role identity and belongingness to engineering for all students, regardless of parental education.

AMR from an employer or coworker was a positive predictor of being recognized as an engineer. This furthers the general trend to pursue an internship so one can be successful in engineering.

FGS and CGS comparisons

Our findings show FGS and CGS have a similar view of their college experience, are motivated towards engineering in a similar way, see themselves as both competent engineers, and have access to a similar amount of resources from their social networks. The findings do not hold with the deficit model, but further work showing that FGS and CGS students can both be successful for different reasons. Although most values were similar, FGS had an increased belongingness to major, a differing view on the engineering classroom, and less resources provided by their parents to be successful in engineering. All differing aspects could be a matter of perspective for those that are CGS and FGS. FGS have seen less of the college experience and have been exposed to less college level ideas from their family ties. Further, FGS' parents/guardians may have not known what to provide for their children so they have decreased resources to provide for their children compared to CGS' parents/guardians. Therefore, FGS students may think all college level ideas as innovative while CGS, learning many college level ideas from their CGS parents, think of the same concepts as novel. FGS are more satisfied with the class size, believe their professors encourage them to think creatively more frequently, and also go over material at a slower pace. FGS may be more accepting of the engineering degree program and that may be a connection to why they are statistically more likely to belong to the engineering major.

Conclusions

This study created predictive models for belongingness and identity for junior and senior level engineering students at a four year western land grant institution. FGS and CGS students did not have any significantly distinct experiences in college but FGS students had a more open view of the classroom experience. FGS students also seemed to have a higher belongingness to major and class when compared to CGS students. Motivation and social capital pieces also were shown to predict both identity and belongingness. All institutional agents gave the same amount of resources to both FGS and CGS except for parent/guardian as of today and before college. Although FGS students had a lower support from their parent/guardian, there was no indication that they were less motivated, had lower identification to engineering, or had differing experiences in their college degree. CGS and FGS have traditionally been compared by test scores, attrition rates, and connecting to college. This study furthers research showing that CGS and FGS are different because of their past and current experiences, are just as capable as CGS, and FGS' higher persistence in engineering may be explained by understanding their feelings of belongingness.

Future Work

Currently, the AMR totals all resources and can only show a benefit from an institutional agent. Future analysis will be done in order to see what resources are significant predictors for identity and belongingness. FGS status will also be used as an interaction variable to see if there is a specific variable that is significant for only FGS. Results of this work will also be used to guide further qualitative work to better understand the importance of these factors in the development of feelings of belongingness and engineering identity.

Bibliography

1. Ward L, Siegel M, Davenport Z. *First Generation College Students: Understanding and Improving the Experience from Recruitment to Commencement*. 1st ed. Jossey-Bass; 2012.
2. Nunez A, Cuccaro-Alamin S. *First-Generation Students: Undergraduates Whose Parents Never Enrolled in Postsecondary Education Descriptive Analysis Reports*.; 1998.
3. Tym C, McMillion R, Barone S, Webster J. *First-Generation College Students: A Literature Review*.; 2004. http://inpathways.net/first_generation_college_students.pdf.
4. Thayer P. Retention of Students from First Generation and Low Income Backgrounds. *J Couns Oppor Educ*. 2000:9. http://www.csun.edu/afye/documents/Thayer-2000-first-gen-retention-lit-review.pdf.
5. The National Academies of Sciences Engineering Medicine. 14 Grand Challenges for Engineering in the 21st Century. *NAE Gd Challenges Eng*. 2016. http://www.engineeringchallenges.org/challenges.aspx. Accessed February 2, 2016.
6. Saenz VB, Hurtado S, Barrera D, Wolf D, Yeung F. *First in My Family: A Profile of First-Generation College Students at Four-Year Instituitions Since 1971*.; 2007.
7. Van T. Bui K. First-Generation College Students at a Four-Year University: Background Characteristics, Resaons For Pursuing Higher Education, And First-Year Experiences. *Coll Stud J*. 2002;36(1):3-12.
8. Montmarquette C, Cannings K, Mahseredjian S. How do young people choose college majors? *Econ Educ Rev*. 2002;21(6):543-556. doi:10.1016/S0272-7757(01)00054-1.
9. Stuart EM. The Relation of Fear of Failure, Procrastination and Self-Efficacy to Academic Success in College for First and Non First-Generation Students in a Private Non-Selective Institution. 2013.
10. Chen X, Carroll DC. *First-Generation Students in Postsecondary Education A Look at Their College Transcripts Postsecondary Education Descriptive Analysis Report*.; 2005.
11. Verdín D, Godwin A. First in the Family: A Comparison of First-Generation and Non-First-Generation Engineering College Students. In: *2015 IEEE Frontiers in Education Conference*.; 2015:1-8.
12. Martin JP, Miller MK, Simmons DR. Exploring the theoretical social capital "deficit" of first generation college students: Implications for engineering education. *Int J Eng Educ*. 2014;30(4):822-836. http://www.scopus.com/inward/record.url?eid=2-s2.0-84906318325&partnerID=tZOtx3y1.
13. Ashforth BE, Mael F. Social Identity Theory and the Organization. *Acad Manag Rev*. 1989;14(1):20-39.
14. Rogers P, Lea M. Social presence in distributed group environments: The role of social identity. *Behav Inf Technol*. 2005;24(2):151-158. doi:10.1080/01449290410001723472.
15. Jackson RL. *Encyclopedia of Identity*. Los Angeles: SAGE Publications, Inc.; 2010. http://web.b.ebscohost.com.unr.idm.oclc.org/ehost/detail/detail?sid=7749d4af-c1a2-4d07-8bf5-340b1b3a7779%40sessionmgr198&vid=0&hid=107&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#AN=474345&db=e025xna.

16. Godwin A, Potvin G, Hazari Z. The Development of Critical Engineering Agency, Identity, and the Impact on Engineering Career Choices. In: *ASEE 2013 Annual Conference & Exposition*.; 2013:1-14. http://www.asee.org/public/conferences/20/papers/6290/view.
17. Godwin A, Potvin G, Hazari Z, Lock R. Understanding engineering identity through structural equation modeling. In: *2013 IEEE Frontiers in Education Conference (FIE)*.; 2013:50-56.
18. Hoffman M, Richmond J, Morrow J, Salomone K. Investigating "Sense of Belonging" in First-Year College Students. *J Coll Student Retent Res Theory Pract*. 2002;4(3):227-256. doi:10.2190/DRYC-CXQ9-JQ8V-HT4V.
19. Smith TF, Wilson D, Carlson D, Plett M, Bates R, Veilleux N. Investigation of Belonging for Engineering and Science Undergraduates By Year in School. In: *American Society for Engineering Education Annual Conference*.; 2012:1-11.
20. Portes A. Social Capital: Its Origins and Applications in Modern Sociology. *Annu Rev Sociol*. 1998;24(1):1-24. doi:10.1146/annurev.soc.24.1.1.
21. Moschetti, Roxanne, Hudley C. Measuring Social Capital among First-Generation and Non-First-Generation, Working-Class, White Males. *J Coll Admiss*. 2008;198:25-30. doi:10.1353/rhe.0.0147.
22. Miller MK, Martin J, Orr MK. Toward Determining Changes in Engineering-Related Social Capital : Resource Composition as Students Make Decisions About College. *J Educ Train*. 2014;1(2):72-91. doi:10.5296/jet.v1i2.5158.
23. Lin N. Building a Network Theory of Social Capital. *Connections*. 1999;22(1):28-51. doi:10.1108/14691930410550381.
24. Ohland MWM, Sheppard SD, Lichtenstein G, Eris O, Chachra D, Layton R a. Persistence, emgagement, and migration in engineering programs. *J Eng Educ*. 2008;97(3):259-278. doi:10.1002/j.2168-9830.2008.tb00978.x.
25. Oyserman D, Destin M. Identity-Based motivation: Implications for intervention. *Couns Psychol*. 2010;38(7):1001-1043. doi:10.1177/0011000010374775.
26. Hilpert JC, Husman J, Stump GS, Kim W, Chung WT, Duggan MA. Examining students' future time perspective: Pathways to knowledge building. *Jpn Psychol Res*. 2012;54(3):229-240. doi:10.1111/j.1468-5884.2012.00525.x.
27. Kirn A, Faber C, Benson L. Engineering Students Perception of the Future: Implications for Student Performance. *Under Rev*. 2014.
28. Benson L, Kirn A, Morkos B. CAREER: Student Motivation and Learning in Engineering. In: *ASEE Annual Conference*.; 2013.
29. Kirn A, Benson L. Quantitative assessment of student motivation to characterize differences between engineering majors. *Front Educ Conf 2013 IEEE*. 2013:69-74.
30. Trenor JM. Influence of Social Capital on Under-Represented Engineering Students' Academic and Career Decisions. In: *2011 American Society for Engineering Education Annual Conference*.; 2011:1-3.
31. Brainard S. PEERS Campus Climate Survey 2013. *Univ Washingt*. 2012. http://www.engr.washington.edu/peers/dissemination/survey.html. Accessed August 1, 2014.
32. Godwin A. The Development of a Measure of Engineering Identity. In: *ASEE 2016: American Society for Engineering Education Annual Conference & Exposition*. New Orleans, LA; 2016:15.
33. R Core Team. R: A Language and Environment for Statistical Computing. *R Found Stat Comput*. 2015. https://www.r-project.org.
34. Engle J, Tinto V. *Moving beyond Access: College Success for Low-Income, First-Generation Students*.; 2008.
35. U.S Department of Education. *A Profile of the Student Support Services Program: 1997-98 and 1998-99, with Select Data from 1999-2000*. Washington, D.C; 2004. http://www2.ed.gov/programs/triostudsupp/index.html.
36. Freeman TM, Anderman LH, Jensen JM. Sense of Belonging in College Freshmen at the Classroom and Campus Levels. *J Exp Educ*. 2007;75(3):203-220. doi:10.3200/JEXE.75.3.203-220.
37. Metheny J, McWhirter EH. Contributions of social status and family support to college students' career decision self-efficacy and outcome expectations. *J Career Assess*. 2013;21(3):378-394. doi:10.1177/1069072712475164.
38. Harris Interactive. *STEM Perceptions : Student & Parent Study: Parents and Students Weigh in on How to Inspire the Next Generation of Doctors, Scientists, Sofware Developers and Engineers*.; 2011. http://www.microsoft.com/presspass/presskits/citizenship/docs/STEMPerceptionsReport.pdf.
39. Paulsen M, St. John E. Social Class and College Costs: Examining the Financial Nexus Between College

Choice and Persistence. *J Higher Educ*. 2002;73(2):189-236.
40. Myer M, Marx S. Engineering Dropouts : A Qualitative Examination of Why Undergraduates Leave Engineering. *J Eng Educ*. 2014;103(4):525-548.
41. McLoughlin L a. Spotlighting: Emergent Gender Bias in Undergraduate Engineering Education. *J Eng Educ*. 2005;94(4):373-381. doi:10.1002/j.2168-9830.2005.tb00865.x.

Acknowledgements

I would like to acknowledge Dr. Julie Martin at Clemson University for her help and permission to implement the Martin's Name and Resource Generator (NRG) in my project. I would also like to thank her for her guidance in revising my research questions.

I would also like to acknowledge Dr. Alison Godwin at Purdue University for permission to use her engineering identity survey questions she created for her dissertation and subsequent projects. I would also like to thank her for directing me to specific identity literature and explaining some of the more complex concepts of her research.

Lastly, I would like to thank Dr. Suzanne Brainard (recently retired/University of Washington), Dr. Elizabeth Litzler(University of Washington, and the The University of Washington Center for Workforce Development for their permission to use survey questions taken from their PEERS Campus Climate Survey 2013. The survey was adapted and revised from an earlier project called PACE. Project to Assess Climate in Engineering (PACE) survey questions were developed by the Center for Workforce Development at the University of Washington through grants funded by the Alfred P. Sloan Foundation. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the funding sources.

The work in this paper was supported through funding by the National Science Foundation (award numbers EEC-1428523 and EEC-1428689). Any opinions, findings, and conclusions or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Appendix

Table 8: Belongingness factor scores (0.4 cutoff)

	Belong to class	Belong to major
I feel comfortable in engineering		0.451156
I feel I belong in engineering		0.75648
I enjoy being in engineering		0.971255
I feel comfortable in my engineering class	0.454204	
I feel supported in my engineering class	0.893204	
I feel that I am part of my engineering class	0.894118	

Table 9: Future Time Perspective Factor Loadings (0.4 cutoff)

	POF	V	C	PI
I will use the information I learn in my engineering course in other classes I will take in the future				0.46
Engineering is the most rewarding future career I can imagine for myself.			0.78	
My interest in an engineering major outweighs any disadvantages I can think of			0.79	
I want to be an engineer			0.84	
I will use the information I learn in this engineering course in the future				0.89
What I learn in my engineering course will be important for my future occupational success.				0.71
I do not connect my future career to what I am learning in this course				0.41
It is better to be considered a success at the end of one's life than to be considered a success today		0.58		
The most important thing in life is how one feels in the long run		0.68		
It is more important to save for the future than to buy what one wants today		0.54		
Long range goals are more important than short range goals		0.67		
What happens in the long run is more important than how one feels right now		0.88		
I don't think much about the future	0.74			
I don't like to plan for the future	0.62			
It's not really important to have future goals for where one wants to be in five to ten years	0.70			
One shouldn't think too much about the future	0.77			

Planning for the future is a waste of time	0.76			
Legend: POF = Perception of Future V = Value C = Connectedness PI = Perceived Instrumentality				

Table 10: Cronbach alpha reliability measure of constructs

Construct	# of items	Standardized α
Belongingness to class	3	0.86
Belongingness to major	3	0.82
Recognition	7	0.80
Performance/Competence	5	0.82
Interest	3	0.87
Perception of Future	3	0.86
Value	5	0.81
Connectedness	5	0.84
Instrumentality	4	0.73
Experience	33	0.82