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Recognizing Engineering Students' Funds of Knowledge: Creating and Validating Survey Measures

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Abstract

This research base paper examines students who are the first in their families to attend college. Our research seeks to understand the role students' funds of knowledge makes in first-generation college students' undergraduate experience. Funds of knowledge are the set of formal/informal knowledge and skills that students learn through family, friends, and communities outside of academic institutions. This paper reports funds of knowledge themes relevant to first-generation college students in engineering and the process of gathering validity evidence to support the funds of knowledge themes.

Using ethnographic and interview data, six themes emerged: connecting experiences, community networks, tinkering knowledge, perspective taking, reading people, and mediational skills. Pilot data collected at two institutions were used to run exploratory factor analysis to verify the underlying theoretical structures among the themes.

Results of the exploratory factor analysis found that almost all items reliably loaded onto their respective constructs. The funds of knowledge identified in this study are not an exhaustive account, nevertheless uncovering these hidden assets can support first-generation college students to see their experiences as equally valuable knowledge in engineering. We are currently in an ongoing process of collecting a second dataset to perform a confirmatory factor analysis, i.e., the next phase of the validation process for survey instrument development.

Introduction

This research paper takes an asset-based approach towards uncovering the funds of knowledge of students who are the first in their families to attend college. Former efforts to support first-generation college students have often taken a deficiency perspective, viewing their backgrounds as things to be overcome or "fixed." Our research joins efforts to take an asset-based approach that treats first-generation college students' backgrounds as sources of strength and knowledge. Research from anthropology and education suggests that including students' background and experiences inside of the classroom can enhance student learning and interest [1]–[3].

First-Generation College Students

Students who are the first in their families to attend college have been defined in several ways. For example, studies from Pascarella et al. [4] considered these students as coming from a family were both parents only have a high school education, while Chen [5], Pike and Kuh [6], and Terenzini et al [7] include a measure of low-income in their definition. In a more recent report, by the National Center for Educational Statistics [8], first-generation college students were characterized as students' whose parents did not have postsecondary educational experience. Another study stated, "first-generation college students include students whose parents may have some college, postsecondary certificate(s), or associate's degree, but not a bachelor's degree" and this definition closely aligns with the definition set forth by the Federal TRiO program (i.e., outreach and student service programs created to serve students from disadvantaged backgrounds) [9, p. 8]. There are inconsistencies and numerous ways in defining first-generation college students, so much so that Whitley et al. [10] found at least six different definitions. However, regardless of how first-generation college student status is defined, empirical research has found that even after controlling for socioeconomic status, age, sex, race/ethnicity, and institution type, the "first-generation status appears to be a disadvantage throughout postsecondary education" when predicting degree attainment [11, p. 26].

In our study, we define first-generation college students as students who are the first in their families to attend college and coming from a household where neither parent has obtained a bachelor's degree [9], [12], [13]. This includes low-income students and non-low-income students. Conversely, in this study, we define continuing-generation college students as students who come from a household with at least one parent having earned a bachelor's degree [9], [14]. While literature in higher education has theorized the first-generation college student population as lacking in academic preparation [12], [15], inadequate familial support [16], or troubled by institutional and personal barriers [17], one constant message has been clear: broadly, the educational system perpetuates conditions that do not support first-generation college students. Therefore, rather than perpetuating a deficit narrative of first-generation college students, we report on our ongoing efforts to document their funds of knowledge and investigate potential links between this knowledge and their engineering trajectory.

Brief Overview

The paper is organized as follows. First, we provide a brief overview of the theoretical framework—funds of knowledge. Our goal was to understand the types of constructs that can be developed, using pre-existing ethnographic and interview data from engineering students, and then validated through quantitative methods. We describe the process of validating the funds of knowledge themes using the systematic steps outlined by Pett, Lackey, and Sullivan [18]. Finally, we conclude by outlining future steps in our research, chiefly, collecting a second dataset to perform a confirmatory factor analysis (the next step in the validation process).

Theoretical Framework

The themes we developed were heavily informed by our understanding of the theoretical framework of funds of knowledge. Funds of knowledge are the "historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being" [19, p. 133]. The funds of knowledge framework provides a counter-hegemonic response to pervasive forms of cultural deficit thinking by using an asset-based perspective to recognize knowledge that is often ignored. This approach provides an important intervention into how educators think about marginalized students (i.e., low-income, first-generation college students, racial/ethnic minorities, etc.). The funds of knowledge framework rejects the notion that students' households can be reduced to being economically poor and poor in terms of quality of experiences [19]. Through a funds of knowledge lens, experiences are treated as sources of knowledge and a familyies knowledge, social networks, and resourcefulness is emphasized as assets from which students can learn [20].

The funds of knowledge framework comes from a blend of anthropological and educational perspectives, outlining the broad contours of these traditions provides additional clarity. Educational trends view poor and minoritized students' *culture* as the cause of their educational mishap, understanding culture as a "holistic configuration of traits and values that shaped members into viewing the world in a particular way" [20, p. 34], [21]. In contrast, understanding students' funds of knowledge requires moving away from traditional anthropological notions of culture as "shared norms that shape individuals' behavior … [or] … discovering standardized rules of behavior" to those that take a processual approach that focuses on the everyday lived experiences of students [20, p. 40]. More specifically, a processual approach focuses on the processes of daily activities, experiences of students and their lived practices at home, and interactions with community. "These daily activities are a manifestation of particular historically accumulated 'funds of knowledge'" [22, p. 237].

We take the funds of knowledge framework, which was originally intended to offer a way for primary and secondary teachers to research their students' communities in order to recognize culturally relevant pedagogical practices and focus on students seeking post-secondary education. An earlier systematic review of the funds of knowledge literature, synthesizing how the framework was being utilized in the secondary and post-secondary space, found few research studies on students in post-secondary spaces utilizing the framework to connect engineering concepts to their lived experiences [23]. Perhaps the methodological approach of visiting students' home and/or communities, as was the case for primary and secondary educators, is difficult to attain at the post-secondary level. Therefore, we sought a different approach towards respecting students lived experiences, that is, using their own words as a way to capture their experiences.

Research Goals

The purpose of this study was to develop a scale to capture aspects of students' funds of knowledge. Our goal was to understand the types of constructs that can be developed, using engineering students' ethnographic and interview data, and then undertake a validation process through quantitative methods.

Methods

Data for this study came from two sources: qualitative and quantitative datasets.

To create the themes, we drew from two sets of qualitative data from prior research studies [24], [25]. The first research study collected ethnographic and interview data from students who identified as low-income, first-generation, or both. The research investigated the students' school and work experiences to identify the funds of knowledge that were the most relevant to their engineering work. More information about the process of collecting this ethnographic data and student demographic information can be found in prior published work [24], [25]. The second interview data was collected from second-semester, first-year engineering students both first-generation and continuing-generation college students. More information about the method of data collection and demographic information of these participants can be found in prior published work [26], [27]. Both sets of qualitative data were used to develop six major themes, for which we then created multiple survey questions.

The validation process for the survey instrument requires pilot testing, therefore quantitative data was collected at two universities in the US south and mountain regions, $n = 187$. This quantitative dataset served to validate the six major themes and their respective survey questions. This dataset was comprised of first-year engineering students to fourth-year or higher, of which 32 were first-generation college students, 154 were continuing-generation college students, and 1 student not reporting parental level of education.

Results

Process of developing a Funds of Knowledge survey instrument

The process of developing an instrument to capture aspects of students' funds of knowledge was guided by Pett, Lackey, and Sullivan's [18] four systematic steps: 1) item generation, 2) determining a format for measurement, 3) pilot testing the instrument, and 4) administering the final instrument. In this paper, we briefly discuss steps the 1-3. We do not discuss step 4 as we are in the process of collecting data to complete this step.

1) Item Generation

First, we used a deductive approach technique to generate themes and survey items. A deductive approach requires an understanding of the theoretical definition of funds of knowledge, prior literature, and interview data from first-generation college students in engineering [28]. The seminal work of González et al. [20] prompted us to consider a processual approach to students' culture, which oriented us to consider students' everyday lived experiences. Specifically, a processual approach "to culture question[s] the shared, bounded, timeless nature of culture" [22, p. 237]. Adopting this view of culture helped validate the experiences of a wide range of first-generation college students, encompassing multiple racial/ethnic identities, class, and language preference. While we know that first-generation college students are more likely to be Latino/a and/or African American [8], [12], [29], and socioeconomic status varies among this population, it was important to consider culture not as a bounded system commensurate with bounded social groups, but as a "*process* of everyday life, in the form of daily activities" [22, p. 237].

We used ethnographic and interview data of engineering students, collected during two separate research projects, to generate broad themes. Using our two qualitative datasets, we were able to generate six themes that captured aspects of students' funds of knowledge. The six themes we generated were: connecting experiences, tinkering knowledge, perspective taking, reading people, mediational skills, and community networks. We acknowledge that these themes are not an exhaustive list but provide a strong starting point for being able to quantitatively capture students' funds of knowledge. Because of space limitations, this paper will only discuss the process we undertook to generate one theme: connecting experiences. Table 1, however, provides definitions of each of the six themes we constructed. In the subsection that follows, we provide one example on how we used prior literature and student interview data to create the theme connecting experiences and its respective survey items.

Table 1. Hypothesized Funds of Knowledge Themes with Definitions

Funds of Knowledge Themes	Definition
Connecting Experiences	Students' ability to draw from hobbies or home environment activities to scaffold what they are currently learning in engineering.
Tinkering Knowledge:	Consists of two subthemes, knowledge from home and knowledge from work
From home	-Tinkering knowledge from home relates to activities (i.e., repairing, assembling, or building) that students have engaged with in their home environment.
From work	-Tinkering knowledge from work pertains to activities (i.e., fixing, assembling, or building) that students have engaged with in a work-related environment, both paid and un-paid.
Perspective Taking	A cognitive capacity to examine a situation or examine another person's experience.
Reading People	Using non-verbal cues (i.e., body language and emotional state) to understand others or situation.
Mediational Skills	Students' ability to help others 'sort things out' in unfamiliar situations or circumstances
Community Networks:	Encompasses four subthemes, i.e., students' family members, networks at work, neighborhood friends, and university friends. General advice, resources (material or non-material), and support that members of students' community provide to aid them in their engineering coursework.
Coworkers	-Coworkers provided advice, resources (i.e., material or non-material), and/or support to aid in their engineering coursework.
Neighborhood Friends	-Neighborhood friends provided advice, resources (i.e., material or non-material), and/or support to aid in their engineering coursework.
Family Members	-Family members provided advice, resources (i.e., material or non-material), and/or support to aid in their engineering coursework.
College Friends	-Friends made while in college provided advice, resources (i.e., material or non-material), and/or support to aid in their engineering coursework.

Generating the theme "Connecting Experiences"

At the core of the funds of knowledge framework is the idea that students enter college with lived experiences that have led to knowledge gains [20]. Everyday experiences are conceivable sites for learning engineering. In the science education space, the Committee on Learning Science in Informal Environments [30] affirmed that learning experiences "include a broad array of settings, such as family discussions at home, visits to museums, nature centers, or other designed settings, and everyday activities like gardening, as well as recreational activities like hiking and fishing, and participation in clubs" (p. 1). In engineering, it is common for some students to obtain experiences with engineering by playing with Legos [31], [32] and/or participating in summer camps [33], [34]; through these activities, students learn about engineering and become interested in the field. The activities students engage in outside of the classroom (e.g., hobbies, museums, etc.) directly affects their learning inside the classroom and "reduces the achievement gap between young people from low-income and high-income families" [35, p. 2].

In our interview data of twelve first-year engineering students, three cited having experienced Project Lead the Way (PLW) in high school, eight cited playing with Legos as children, and four students did not cite either one of these experiences. The different experiences of first-generation compared to continuing-generation college students were further captured by interview questions that asked students to think back to experiences/activities they engaged in as children or adolescence and determine if they now see them as engineering related experiences. By asking students to reflect on the pre-college activities that fostered their interest in engineering, we were able to understand the cultural and historical practices that brought them to seek an engineering degree. With this theme, we sought not to capture every micro experience students have had in their life, rather obtain a general understanding of the connections between their lived experiences and their current engineering coursework. We targeted two different types of environments, home and hobbies, which could include activities at home our outside of students' home. While several students highlighted PLW and/or playing with Legos, as their main exposure to learning and becoming interested in engineering, one student, Naomi, identified working with her father at home as her source of interest in engineering:

> … Working with my dad ... I remember I built a dog house ... I took a saw and I started cutting things out and he stopped me. He's like, "No, you need to have a plan. What are you making this house for, which dog? Where are you going to put it?" I had to think of all of the things besides just building a dog house.

Naomi may not have been aware at the time, but her father was guiding her through the engineering design process. When probed further of whether she saw this experience relating to her current engineering courses, Naomi stated,

> Yeah. In [first-year engineering class] we had to do all those iterations … they're like, "brainstorm a little bit..." They [first-year engineering instructors] … emphasized how important it was to have steps and follow through and do them all well to get to a final end result, instead of barreling through and completing something at the end.

Naomi clearly had engineering-related experiences at home, through her father, even though he did not have a formal engineering degree and her experiences did not mirror those traditionally thought of as engineering (i.e., Lego robotics or engineering courses/summer camps). Another student, Anika, when asked to look back on experiences growing up that may have connected to engineering, stated, "I haven't had any engineering experiences, ever. It's just mostly been math-y stuff, not engineering related. I didn't even play with Legos or anything." Her hobbies mostly centered around art, as she explained, "I've painted since I was five, I like drawing everything.

Then I was taking a drawing class outside of school and then in school, all the time. High school was when I first started selling [art] stuff. I've always been into it."

When asked if she saw connections between her interest in art and her disciplinary interest in computer engineering, she replied, "Not in computer engineering. Maybe … construction or some other forms of engineering, just not computer. I haven't found it yet." When further probed about whether she thought it was important to make a connection to her art interest and engineering, Anika replied, "I think so. I think it's definitely a benefit to me that I can do art because a lot of engineers aren't really artistic, and so I guess that makes me stand out, which maybe I can help connect to different things that people don't think of." Similar to Naomi, Anika did not have traditionally defined engineering experiences nevertheless she remained optimistic about making connections with her passion for art and engineering.

Lastly, we present the case of Ashely, another student who did not indicate having traditionally defined engineering experiences as most of her peers in the dataset. When asked of activities or experiences growing up she saw relevant to engineering, Ashely replied,

> "Yeah, definitely my hoarding of information kind of personality ... The question *why* was kind of my best friend … I also did like to ... I wouldn't say like tinker around with things but make something better or do something and improve it."

Ashely didn't describe her activities or experiences as tinkering, but she did say she would find a more efficient way to "rake the leaves in the fall," different ways to "build a pillow fort," different ways of cooking. While these activities may not fall under the umbrella of typical engineering-related experiences, for Ashely, they did offer connections to her interest in pursuing engineering.

The cases of Naomi, Anika, and Ashely highlight what different engineering related activities can look like for underrepresented students, such as these students, who were women, racially/ethnically diverse from each other, and one participant was also a first-generation college student. Likewise, these narratives may also point to another issue; that is, traditional engineering-related activities may be more common for male students and students with family members who are engineers. To move beyond students' experiences with Legos or PLW and honor the diverse home experiences and hobbies students have had, which they viewed as relevant to their engineering interest, our survey questions instructed students to think about hobbies and experiences at home. On top of these two types of experiences, it was important to understand if students were leveraging these experiences in their engineering-related coursework. The survey items, "I see connections between experiences at home and what I am learning in my engineering courses" and "I draw on my previous experiences at home when little instruction is given on how to solve an engineering task," were inspired by Naomi's connection with her experience of designing and building a dog house with her dad and her design focused first-year engineering course.

Additionally, when considering Anika's passion with art and Ashely's various hobbies of continually questioning why things appear the way they do and finding efficiency in everyday tasks (e.g., cooking, raking leaves), survey items centering on hobbies seemed appropriate for this theme. Therefore, two survey items specifically focused on hobbies were created, i.e., "I draw on my previous experiences from my hobbies when little instruction is given on how to solve an engineering task" and "I see connections between my hobbies and what I am learning in my engineering coursework (e.g., design projects, homework, exams, presentations)." We acknowledge that students could still consider Legos or PWL as hobbies and/or home experiences. Our goal was not to exclude the traditional ways of doing engineering for students; rather our goal was to broaden the narrative of what counts as engineering-related pre-college experiences.

We used a similar process of generating the remaining five themes (i.e., tinkering knowledge, perspective taking, reading people, mediational skills and community networks) and creating survey items that capture the themes. Ethnographic data was used to generate the remaining five themes; however, this process will not be elaborated in this conference proceeding. Continuing with Pett et al.'s [18] systematic steps for developing a survey instrument, the next subsections provide a brief overview on the process of formatting the funds of knowledge scale following results from the exploratory factor analysis.

2) Determining Format for Measurement

When deciding how to organize the survey items, Pett et al., [18] outline considerations that provide efficiency and effectiveness when collecting data. First, we considered the instrument format style and selected a seven-point anchored scale. While there is no universally agreed-upon standard for the number of points on a rating scale, one study did affirm that rating scales beyond 7- points do not increase reliability [36]. True to the Likert-scale format, we provided students a prompt for which they were required to rate their level of agreement [36]. For the theme *Connecting Experiences* we asked students "To what extent do you agree or disagree with the following statements," using a 7-point scale of 0 = "strongly disagree," 6 = "strongly agree." Qualtrics Software was used as our method of data collection.

3) Pilot Testing the Instrument: Exploratory Factor Analysis of Funds of Knowledge Themes

Once themes and survey items were generated and the appropriate instrument format was selected, the instrument was pilot tested at two institutions. The institutions were chosen based on convenience sampling. While there is no universally agreed upon sample size for pilot testing survey instruments, Tabachnick and Fidell [37] and Gorsuch [38] suggest a sample size ranging from 100-200. Our pilot survey consisted of 207 student responses; however, 20 students were removed from the dataset due to inattentiveness, leaving a total of $n = 187$. To ensure attentiveness to the survey questions, attention check questions were placed throughout the survey. Students were prompted to "Please select number 2," using a Likert scale of 0 through 6. All analyses were performed using R statistical software version 3.5.1 [39]. The exploratory factor analysis was performed using the *fa* function in the psych package version 1.8.12 [40].

Following the attention check, we examined question data for univariate skewness and kurtosis. Skewness ranged from -1.13 to 0.69 and kurtosis ranged from -1.31 to 1.58; both ranges indicated acceptable univariate normality (i.e., skewness absolute value of less than 2.0 and kurtosis absolute value of less than 7.0; [41], [42]). The adequacy of each variable and the relationship between each variable were assessed using Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. KMO = 0.820 and Bartlett's test yield significance at (χ^2 (1225) = 7553.26, $p < 0.001$), both measure suggested the dataset was appropriate for factor analysis [43], [44]. The factor extraction method used in the exploratory factor analysis was ordinary least squares (OLS). A recent study found that OSL yields "factor loading matrices that exhibited less bias and error" than maximum likelihood and principal axis methods [45, p. 189]. This method of extraction is appropriate as the data were within the acceptable range of skewness and kurtosis. Scree plots were used to visualize the number of factors that should be retained for each theme. Oblique rotation was used due to the correlational nature of the variables as it "provides a more accurate and realistic representation of how constructs are likely to be related" [46, p. 282]. That is, the correlation matrix determined that all variables, in their own themes; were significantly correlated with each other.

Items that cross loaded (loadings of > 0.32) onto two or more factors were removed, factor loadings that were not above 0.32 were also excluded [37], and items with communality below a 0.40 threshold were also removed [47]. Variables that violated one or more of the considerations mentioned above were removed from the analysis. All Heywood cases were excluded from the analysis. Exploratory factor analysis was re-run until a factor solution with adequate factor loadings and communalities was reached. Results of the factor structure, for each latent variable, can be found in Tables 2 at the end of this paper. Cross loadings that were 0.10 and greater are displayed in Table 2; however, no factor loading was above the recommended 0.32 cutoff value.

Discussion

The results of the exploratory factor analysis provides the first layer in the validation process supporting our hypothesized latent constructs of (1) connecting experiences; (2) tinkering knowledge: work; tinkering knowledge: home; (3) perspective taking; (4) reading people; (5) mediational skills; (6) community networks: coworkers, community networks: neighborhoods, and community networks: family members. Overall, the survey items demonstrated high factor loadings and were within an acceptable range of communalities except for items in the latent construct of community networks: neighborhood friends, which, we, therefore, removed from the analysis. Likewise, the item "Q1i = Family member(s) have given me emotional support that helped me continue my engineering coursework," from the hypothesized latent construct of community networks: family members, was removed due to low communality; therefore, only two items remained in this construct. Additionally, two items from the hypothesized latent construct connecting experiences, "Q2b =I see connections between experiences at home and what I am learning in my engineering courses" and "Q2e = I draw on my previous experiences at home when little instruction is given on how to solve an engineering task," had cross loadings of 0.32 and 0.30, respectively. Tabachnick and Fidell [37] suggest removing cross loadings above 0.32, meaning that our items are within the borders of the acceptable limits. Given the results of this exploratory factor analysis there are two possible directions to take in the next phase of the validation process: 1) remove the hypothesized latent construct of community networks: family members and observe how the removal of this construct impacts items Q2b and Q2e or 2) run a second exploratory factor analysis using split half-sampling technique with the larger dataset that is currently being collected to see if the items behave different with a larger dataset. Both courses of action are intended to move the process of validating the survey instrument to its next phase, i.e., confirmatory factor analysis.

We are currently administering the final instrument to engineering students at five participating institutions across the United States and four Mathematics, Engineering, and Science Achievement (MESA) Engineering Programs. MESA Engineering Programs admit students who are the first in their families to attend a four-year university and/or are low-income making it an ideal place to maximize our sample of first-generation college students. After completing the final data collection process, we will conduct a confirmatory factor analysis to test the factor structure for each latent constructs and finalize our decision of dropping the hypothesized latent construct of community networks: family members.

Conclusion

Through our research, we developed six funds of knowledge themes based on the experiences of first-generation college students in engineering. We then translated those themes into survey questions and validated them using exploratory factor analysis. The next step in our research is to continue deploying the survey at a broader scale, specifically five universities and four Mathematics, Engineering, and Science Achievement (MESA) Engineering Programs that focus on first gen students. This will allow us to reach broader conclusions about first-generation college students' funds of knowledge and their connections with engineering. We are particularly interested in conducting an intersectional analysis of the survey data to determine which funds of knowledge are most relevant to first-generation college students based on demographic characteristics, such as race/ethnicity, socioeconomic class, and gender, and other descriptors, i.e., transfer student status, language spoken at home, and career expectations to name a few.

Understanding the funds of knowledge of first-generation college students in engineering has the potential to benefit both these students and their continuing generation peers. First, these can serve as inspiration for culturally-relevant pedagogy that would enhance first gen student learning and interest in engineering. We echo the sentiments of Wilson-Lopez et al.'s [2] ethnographic study of Latino/a adolescent students in that "students' funds of knowledge should be the starting point for engineering education" [p. 14]. Second, funds of knowledge can help guide the people who support and mentor first-generation college students—from student service staff to professors—to identify opportunities to help these students excel.

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Table 2 Exploratory Factor Analysis using Pilot Dataset Collected in Fall 2018

	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**h2**
Q1a=Friend(s) from my neighborhood have given me **advice** that helped me in my engineering coursework (e.g. design projects, homework, exams, presentations).							**0.96**			0.84
Q1b=Friend(s) from my neighborhood have given me **resources** that helped me in my engineering coursework.							**0.91**			0.76
Q1c=Friends(s) from my neighborhood have given me **emotional support** that helped me continue my engineering coursework.						0.10	**0.50**	0.11		0.37
Q2a =I see connections between my **hobbies** and what I am learning in my engineering coursework (e.g. design projects, homework, exams, presentations).			-0.12		0.11	**0.81**				0.64
Q2b =I see connections between experiences at **home** and what I am learning in my engineering courses.			0.12			**0.60**		-0.10	0.32	0.59
Q2d = I draw on my previous experiences from my **hobbies** when little instruction is given on how to solve an engineering task.			-0.10			**0.95**			-0.16	0.80
Q2e = I draw on my previous experiences at **home** when little instruction is given on how to solve an engineering task.						**0.54**	-0.14		0.30	0.58
Q3b = At home, I learned to use tools to build things.				-0.12	**0.77**	0.11				0.72
Q3d = At home, I worked with machines and appliances (considered broadly, e.g., gym equipment, sewing machines, lawn mower, bikes, etc.).				0.10	**0.77**					0.59
Q3e = I learned to fix things around the house (considered broadly, e.g., plumbing, furniture, electrical wiring, etc.).					**0.85**					0.80

Q3g = At home, I learned to assemble and disassemble things.			-0.10		**0.78**	0.13			-0.10	0.80
Q4a = At work, I learned to work with tools	**0.91**									0.82
Q4b = At work, I learned to use tools to build things.	**0.89**									0.87
Q4d = At work, I worked with machines (e.g., car jack, sewing machine, lawn mower, etc.)	**0.93**									0.85
Q4e = At work, I learned to fix things.	**0.99**					-0.10				0.89
Q4f = At work, I learned to assemble and disassemble things.	**0.93**									0.88
Q5a = I am open to listen to the point of view of others.		-0.13		**0.98**						0.79
Q5b = I consider other people's point of view in discussions.		-0.10		**0.87**			-0.11			0.68
Q5c =I like to ask people questions about their experiences.		0.22		**0.42**		0.15				0.42
Q5e = I like to view both sides of an issue.				**0.74**						0.59
Q5f = It is easy for me to see other people's point of view.				**0.72**			0.11	-0.11		0.62
Q6a = I can pick up other people's emotional cues.			**0.85**		0.10	-0.11				0.73
Q6b = I am good at decoding other people's body language.		0.12	**0.87**			-0.10				0.81
Q6c = I am good at reading people.			**0.97**	-0.10						0.79
Q6d = I can identify other people's motivations without having to ask them directly.			**0.72**						0.11	0.58
Q6e = I can identify other people's concerns without having to ask them directly.			**0.61**	0.12		0.19		-0.14	-0.15	0.61
Q7b = Help someone else adjust to an unfamiliar place.		**0.94**			0.14	-0.19			0.12	0.73
Q7c = Help someone else adjust to unfamiliar social situations.		**0.92**	0.10		0.11	-0.19				0.80
Q7d = Help different groups of people better understand each other better.		**0.74**			-0.14	0.10				0.65

Q7e = Bring people together in the same space who usually would not spend time with each other.		**0.66**				0.12				0.54
Q7f = Help different individuals on a team better understand each other better.		**0.80**				0.11			-0.10	0.68
Q1j =Coworker(s) or mentors have given me **advice** that helped me with my engineering coursework.								**0.94**	0.11	0.89
Q1k =Coworker(s) or mentors have given me **resources** that helped me with my engineering coursework.								**0.84**	0.10	0.74
Q1l =Coworker(s) or mentors have given me **emotional support** that helped me continue my engineering coursework.								**0.61**		0.49
Q1g = Family member(s) have given me advice that helped me with my engineering coursework.									**0.66**	0.47
Q1h = Family member(s) have given me resources that helped me with my engineering coursework.		0.10	-0.10		-0.11				**0.64**	0.48
SS Loadings	4.44	3.50	3.42	3.04	2.66	2.50	2.11	2.10	1.22	
Proportion Var	0.12	0.10	0.10	0.09	0.07	0.07	0.06	0.06	0.03	
Cumulative Var	0.13	0.22	0.31	0.40	0.47	0.53	0.60	0.66	0.69	

Note. h2 = communalities

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