WIP: Survey Validation to Enable Investigating Community Cultural Wealth in Engineering Students' First Year Experiences (FYE)

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Adetoun Yeaman is an Assistant Teaching Professor in the First Year Engineering Program at Northeastern University. Her research interests include empathy, design education, ethics education and community engagement in engineering. She currently teaches Cornerstone of Engineering, a first-year two-semester course series that integrates computer programming, computer aided design, ethics and the engineering design process within a project based learning environment. She was previously an engineering education postdoctoral fellow at Wake Forest University supporting curriculum development around ethics/character education.

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Dr. Xiaojing Yuan is a full professor at the University of Houston in the Engineering Technology Department of the Cullen College of Engineering. As the founding director of the Intelligent Sensor Grid and Informatics (ISGRIN) research lab, she has delivered numerous presentations and published over 90 technical articles. Her research interests lie at the intersection of sustainable technology and resilient systems, with a focus on creating AI-powered automation systems that ensure the sustainability and resilience of existing and new infrastructure, including energy, transportation, water and wastewater management, and buildings. I am also developing a modeling and simulation platform that provides what-if analysis using quantifiable sustainable life-cycle metrics as part of the performance evaluation when designing such automation systems. Another of her current research interest is STEM higher education, particularly in the engineering and technology areas. All data clearly show the fast-approaching cliff we all face, where's the "silver bullet?" What individual faculty can do – with no time and ever-increasing tasks, functions, and paperwork! Can AI-powered assistants solve our problem – or at least assist us along the way to find a better solution?

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Introduction

First-year curricula typically include a variety of foundational concepts and skills and in many cases, students have the opportunity to work in teams in a project/inquiry-based learning environment. The first year is also a unique time in students' lives when they are navigating what it means to be in a university environment - to live and work more independently, which challenges growth in areas such as socialization, study habits, and time management. It is no surprise that successful first year experience (FYE) programs also include a mixture of co-curricular activities ranging from academic support to community building, and personal development initiatives to facilitate students' professional and personal growth [1].

The purpose of this Work in Progress study is to validate a survey that will be used to investigate the effects of social and navigational capital of first-year engineering students on three important aspects of the entrepreneurial mindset (EM). This is done for two reasons: 1) construct validity and contextualization to engineering education - specifically first-year engineering experiences and 2) expansion to engineering students beyond the United States. Data was validated using correlational analyses and reliability estimates from Cronbach's alpha calculations. Results gained from the study will support the design and development of a full survey to be deployed across multiple institutions beginning in the Fall of 2024.

Entrepreneurial Mindset (EM). Three specific components outlined in the KEEN entrepreneurial mindset (EM) framework of Curiosity, Connections, and Value Creation, i.e., the 3Cs of EM, are important qualities of engineering professionals [2]. Furthermore, longitudinal assessments which identify increases in the EM have closely tied the 3Cs with student success pre and post-graduation. While incoming engineering students bring their own experiences, they are also reliant on other factors in their FYE to further enhance their knowledge and expertise toward becoming engineering professionals. To quantitatively assess students' EM, various assessment strategies and instruments have been developed, including the Engineering Student Entrepreneurial Mindset Assessment (ESEMA) [3], a self-reporting survey instrument with validated questionnaires. Starting with the 3Cs, the ESEMA breaks down EM into six distinct themes, parallel to the outcomes developed by London et al. [4]: Altruism, Empathy, Help Seeking, Ideation, Interest, and Open Mindedness.

Community Cultural Wealth (CCW). Developed by Yosso [5], community cultural wealth (CCW) is defined as "an array of knowledge, skills, abilities, and contacts possessed and utilized by Communities of Color to survive and resist macro and micro-forms of oppression." Most of the studies on CCW [6-9] have relied on qualitative methods geared towards understanding the experiences of students of color. For example, while aspirational, familial, social, and navigational capital provided the most support to Latino students' college experiences, Samuelson and Litzler [6] showed engineering students tend to utilize two (*aspirational* and *navigational*) assets more frequently. Hiramori, et al. [10] explored the possibility of quantitatively measuring the constructs of CCW. In our line of inquiry, assuming all of our first

year engineering students have enough *aspirational* assets, we seek to uncover how, if at all, do the social and navigational assets contribute to their professional growth based on the 3Cs of EM.

Social capital is focused on the support provided by various networks of relationships the student leverages during their degree [10]. *Navigational* capital relates to the student's ability to learn and maneuver through social and academic situations on campus. Both forms of assets provide support for students beyond the typical academic achievements normally emphasized in university settings.

Methods

Participants. This study included responses from 16 students at Ashesi University, a small (student population ~1,500) private university located just outside of Accra, the capital of Ghana. Considered a premier institution locally, the university draws a traditional student population, but uniquely draws students from over 30 African countries, with more than a quarter being international to Ghana. Responses were divided evenly amongst those who identified as males and those who identified as females (7 each), with one individual who identified as non-binary and one who did not respond to the question. The majority of participants were under 21 (13 or 87%), two were 21, and one did not respond.

Instrument. The survey used in this study is based on a previously validated survey [3]. Additionally, the survey contains questions on two constructs of CCW (social and navigational capital), which originated from the quantitative survey by [10]. The resulting survey consisted of 44 items across 8 constructs as well as three demographic questions. Further validation of this initial survey was necessary for two important reasons: 1) construct validity and contextualization to engineering education - specifically first-year engineering experiences and 2) expansion to engineering students beyond the United States [11].

Validation Procedures. The focus of this WIP study is on construct validation and reduction of items within the initial instrument. Due to the low number of responses available from the instrument, inter item correlations were deemed the most appropriate method of item reduction and validation [12]. Pearson's correlational analyses were conducted between each item in the factor, with correlated items ($p < 0.05$) removed. Items were removed until alpha-if-deleted values dropped below the standard acceptable value of 0.70 [13]. After item removal, Cronbach's alpha values were calculated for each construct.

Results

Pearson's correlation analyses revealed highly correlated items ($p < 0.05$) for each of four constructs: 1) CCW navigational capital, 2) CCW social capital, 3) EM ideation, and 4) EM open-mindedness. Additionally, all but one of the constructs (EM open-mindedness) had higher

alpha-if-deleted values with highly correlated items removed (Table 1). Two constructs: EM altruism and EM interest both contained high starting alpha values and contained no correlated items. Finally, two remaining constructs: EM empathy and EM help seeking revealed extremely low initial alpha values with no correlated items. Within these two constructs, removal of items did not result in higher alpha values. The final version of the survey contains 31 items validated across 6 constructs. Once the additional consent (1 item), filtering (1 item), and demographic questions (4 items) were added as well, the survey contained a total of 36 questions.

Table 1. Constructs within the survey as well as the number of items and alpha values before and after validation procedures

Construct	**Initial Items**	**Final Items**	**Reduction**	**Initial α**	**Final α**
CCW Navigational Capital	8	5	3	0.73	0.82
CCW Social Capital	9	5	4	0.67*	0.75
EM Altruism	3	3	0	0.85	No changes
EM Empathy	2	0	2	0.28*	Removed
EM Help Seeking	2	0	2	0.61*	Removed
EM Ideation	9	8	1	0.90	0.92
EM Interest	3	3	0	0.85	No changes
EM Open Minded	8	7	1	0.84	0.84
Total	***44***	***31***	***13***		

Discussion and Future Directions

This initial validation study provided some helpful insights for the larger study. The ESEMA survey was originally validated through a focus group of undergraduate students in the United States from various engineering disciplines and ethnic backgrounds. Since we are going to conduct a comparative study including an institution abroad, additional validation was important to ensure the quality of the study. The participants were all students in a first year engineering course and were also from a racially homogeneous yet ethnically diverse background outside of the U.S. Interestingly, the validation results showed that removal of items were unnecessary and the same survey can still produce quality results for a non-U.S site. The findings not only validated the survey instrument we developed based on the validated surveys of EM (ESEMA) and CCW, but also revealed a connection between the two constructs of CCW (social and navigational) and 3Cs of EM in first-year engineering students' experiences. Further investigation involving various engineering programs within and outside the United States will support the design and development of interventions of FYE curricula, co-curricula, and beyond.

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