

Developing a Survey for Engineering Faculty Knowledge and Interest in Diversity, Equity, Inclusion Topics

Stephen Secules

*School of Universal Computing,
Construction, and Engineering
Education*

Florida International University

Miami, US

ssecules@fiu.edu

orcid.org/0000-0002-3149-2306

Sung Eun Park

*School of Universal Computing,
Construction, and Engineering
Education*

Florida International University

Miami, US

supark@fiu.edu

orcid.org/0000-0003-4227-6446

Cassandra McCall

*Engineering Education
Department*

Utah State University

Logan, US

cassandra.mccall@usu.edu

orcid.org/0000-0002-0240-432X

Maimuan Begum Kali

*School of Universal Computing,
Construction, and Engineering
Education*

Florida International University

Miami, US

mkali007@fiu.edu

orcid.org/0000-0003-1770-7363

Abstract—This work-in-progress research paper presents progress towards the creation of a survey instrument for assessing engineering faculty knowledge and understandings of DEI. We initiated survey development by conducting a small qualitative pilot interview study with faculty to discuss the roles of DEI in their classroom contexts. Participant discussions were used to derive example topics and statements that could indicate the level of faculty expertise on DEI. We present initial topics and statements as our draft pilot survey instrument and intend to apply it during recruitment for large-scale qualitative studies focused on DEI, with the goal of finding participants who are open to DEI perspectives and practices but not yet applying them in their own classroom contexts. We conclude with additional theoretical issues for future exploration, steps for survey validation and further development, and implications.

Keywords—Survey, Faculty development, Faculty attitudes, Diversity, Inclusion, Equity, Learning Progression

I. INTRODUCTION

Researchers have demonstrated persistent issues with diversity, equity, and inclusion (DEI) in engineering education. Due to their direct contact with students, faculty are key stakeholders in creating inclusive or marginalizing educational cultures that are shaped by chosen pedagogical approaches, course policies, and student interactions. As a result, significant effort has been focused on developing training programs and support structures to educate faculty on DEI topics. While prior DEI studies have documented the marginalizing experiences of students and highlighted best practices for inclusion (e.g., [1-4]), extant workshops and training sessions tend to approach DEI from an institutionalized perspective – a perspective that is focused on educating faculty on DEI terminology and related policies. However, institutional change literature has shown that simply disseminating best practices does not produce sustainable shifts in faculty views and engineering classroom practices; formalized training and workshops yield similarly limited outcomes. Concepts and practices introduced during a workshop are often not implemented once the workshop ends, especially if a faculty member's underlying beliefs are inconsistent with those informing it (e.g., [5,6], regarding non-

DEI pedagogical beliefs). Therefore, it is crucial for research and faculty development efforts to center individual growth and change as integral aspects of enhancing faculty's DEI knowledge and promoting faculty adoption of inclusive classroom practices.

In order to evaluate the effectiveness of programmatic and research-based change efforts, we must develop measures of faculty learning progressions regarding DEI. Current DEI surveys in engineering education emphasize topics such as the inclusion of faculty (i.e., measuring university climate) as well as student sense of belonging, identity, motivation, self-efficacy, etc. (i.e., measuring student inclusion e.g., [7-10]). At the same time, faculty development workshops that focus on DEI often distribute surveys to assess specific outcomes of these events as well as their immediate impacts on faculty perceptions of what was gained during the workshop. This form of measure is useful in that it allows faculty developers to identify and improve participant outcomes from attending such events but it does not examine long term impacts on faculty adoption or adaptation of discussed concepts and practices. These surveys are also typically simple evaluations, rather than validated surveys aimed to differentiate faculty learning progressions on specific constructs. Thus, there is a need for more in-depth surveys that test faculty conceptions of, knowledge of, and interest in DEI topics that can be used to create and evaluate faculty-centered interventions that promote sustained cultural change.

A. Purpose

In this work-in-progress paper, we present an initial survey design that will be used in a broader effort to engage faculty and document their growth around learning edges related to DEI (proposals under review). Initially, we plan to use this survey to assist with recruitment of faculty for qualitative DEI and cultural change studies. At the same time, we anticipate this design may be used by the broader research community to evaluate interventions that center faculty knowledge gains related to DEI and the adoption of strategies for promoting DEI in their classrooms.

II. LITERATURE REVIEW

We surveyed engineering education as well as the broader education literature for existing quantitative measures related to diversity, equity, and inclusion. During this search, we identified items typically included in these surveys and how they have been employed across contexts. Next, we discuss a number of those instruments that have provided insights into the development of our own instrument.

Some surveys tended to focus on faculty perspectives of DEI as well as their knowledge and use of practices for enhancing inclusion in their classrooms. For example, Matters et al. [11] investigated the level of STEM faculty's awareness and knowledge about inclusive teaching practice within the community college context. The survey instrument was developed to gather information including pedagogical approaches, instructional techniques, and barriers to the adoption of inclusive teaching practices. The survey consisted of beliefs about teaching and learning (5 constructs with 19 items), instructional practices (9 constructs with 26 items), and environmental factors (2 constructs with 6 items) using a Likert type scale.

Other researchers utilized surveys to evaluate the outcomes and effects of workshops on participant perspectives and approaches to DEI. For example, Harrison-Bernard et al. [12] developed a pre- and post-survey that included ten self-reported questions distributed before and after a workshop to measure faculty and staff knowledge and awareness of diversity and unconscious bias in the biomedical field. Responses ranged from 1 (*strongly disagree*) to 5 (*strongly agree*) to prompts that related to these topics such as, "I always know what to say when interacting with people from different cultures." Similarly, Rooney et al. [13] evaluated the effects of their workshop on engineering faculty's self-efficacy toward culturally responsive teaching and inclusive teaching strategies. They modified the Culturally Responsive Classroom Management Self-Efficacy Scale (CRCMSE) developed by Siwatu et al. [14], which consists of 35 items. Respondents were asked to rate their confidence in performing CRCM tasks ranging from 0 (*no confidence at all*) to 100 (*completely confident*). Its internal reliability was excellent (Cronbach's $\alpha = .97$). With factor analysis, underlying factor structure of CRCMSE was one-factor structure which explained 52.88% of the variance.

At the programmatic level, Parker et al. [15] examined the effects of an equity-focused professional development program for STEM faculty in community colleges. The program includes a week-long workshop, monthly professional learning meetings, presentation, resources for carrying out a change in the classroom. Their survey consisted of nine constructs using a 4-point Likert type scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). The nine constructs were: 1) beliefs regarding the success of all students in STEM disciplines, 2) beliefs regarding the success of all students in STEM classes, 3) knowledge about strategies for encouraging all students, 4) understanding the ways classroom environments encourage or discourage student persistence, 5) ability to create an equitable classroom environment, 6) knowledge of methods that decrease microinequities in the classroom, 7) knowledge of methods that evaluate classroom interventions, 8) confidence in identifying

and addressing microinequities in the classroom, and 9) comfort with evaluating classroom interventions.

Spanierman et al. [16] developed a validated, multidimensional Multicultural Teaching Competency Scale (MTCS) for pre- and in-service K-12 teachers. The MTCS consists of 16 items measured using a 6-point Likert type scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*) to assess multicultural teaching skills (10 items) and multicultural teaching knowledge (6 items). The construct validity of the two factor structure showed a good fit through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). In addition, the concurrent evidence for criterion-related evidence of validity of the MTCS was examined using the Teacher Multicultural Attitude Survey (TMAS) [17], the Color-blind Racial Attitudes Scale (CoBRAS) [18] and the Social Dominance Orientation Scale (SDO) [19].

Through this review, we found surveys that centered inclusive teaching, multicultural teaching competency, or DEI knowledge gains as a means to examine the effects of DEI professional development workshops with faculty. The psychometric properties of surveys were often missed or not discussed in resulting publications, while studies whose purpose was survey development presented psychometric information as a component of the survey development process, including tests for validity and reliability [14,16]. Psychometric properties are important for improving the accuracy of the measurement and evaluation of observed variables. Therefore, conducting and explicating psychometric analysis procedures should be done not only when using existing instruments, but also when developing new ones. Since there are few instruments with published psychometric properties related to faculty knowledge and awareness of DEI, the development of survey instrument with psychometric properties is needed. Notably, surveys used to examine the difference between pre- and post-workshops or interventions were usually limited to overall impressions and unidimensional conceptions of what was gained during the event. Therefore, a multidimensional conceptualization (e.g., knowledge of student diversity, awareness of values, inclusive and multicultural teaching, etc.) needs to be considered to understand faculty's in-depth knowledge, awareness, and multifaceted perspectives of DEI instead of a single dimension.

III. SURVEY DESIGN AND DEVELOPMENT

To establish a survey protocol, we took a qualitative exploratory cognitive interview approach [20]. We draw from our pilot qualitative interviews in the following ways: 1) we examine the ways faculty understood our questions and terminology and their level of comfort with discussion topics to formulate a survey that will be understandable by and comfortable for them to complete, and 2) we examine the variety of statements faculty made freely and through their own reasoning rather than official policy or guidance, to help identify statements that could differentiate (discriminate) between faculty perspectives.

A. Qualitative Exploration of Faculty Perspective on Equity in Their Classrooms

We began exploring the ways faculty think about equity and inclusion in their own classrooms by conducting pilot interviews

with engineering faculty members. To date, we have interviewed two engineering faculty members regarding equity in their classrooms with the intent to continue this pilot phase and expand our understanding of faculty conceptions of equity and inclusion. We recruited colleagues who we anticipated were “interested novices” regarding equity and inclusion topics, in order to help better understand which statements they made and which patterns of thinking they held that would indicate their level of expertise. Our impression was that these individuals were interested in promoting DEI as engineering faculty, but did not hold particular expertise or conduct research in this area. The following questions represent the pilot interview protocol:

1. So first, tell me about your typical teaching load and roles.
2. What are some things you find challenging about your role teaching students [class or subject matter]?
3. What are items you are focused on now for improving your teaching of [class or subject matter]?
4. What are your personal values regarding diversity, equity, and inclusion?
5. How do you personally identify regarding race and gender? Are there any other salient identities you would like to share?
6. Do you think your identity impacts how you teach [subject matter] or interact with students? If so, how?

The interview protocol questions were designed to first help a faculty member talk freely about their teaching role and whatever specific challenges or improvements they perceive regarding their teaching. Next, the questions interrogate specific values regarding diversity equity, and inclusion, personal identities (positionality [21]), and the ways they see that positionality interacting with or influencing their teaching. The following dimensions of expertise on equity emerged from the pilot interviews:

TABLE I.

Category	Novice - Expert Range	Example statement
Agency	No control versus specific actionable control	I have no control of diversity in my classroom
Motivation/ Reason for action	Others’ rules versus self or system needs	I have taken a lot of teaching workshops
Empathy	Lack of concern versus high concern	I worry about my students during Covid, on teams
Awareness	Lack of knowledge of students (identities, backgrounds, knowledge) versus high knowledge	I know about students’ diverse backgrounds
Framing of Diversity Challenge	Diversity of thought / interest versus inequity, demographics	I would prefer to focus on diversity of interest
Comfort with self-reflection + diversity talk	Uncomfortable versus comfortable	I would prefer not to talk about it

We anticipate that these dimensions are a starting place that we will continue to adapt and revise relative to additional qualitative and quantitative pilots, as further discussed in the Discussion section.

One promising result of the qualitative pilot is the presence of statements faculty member(s) made freely and honestly that represent a digression beyond official diversity policy or training advice. We think that one of the biggest challenges with creating a survey to distinguish an equity/inclusion learning progression is the fact that many statements will sound like the ‘right answer’. In the pilot interview examples in Table I, the faculty members clearly valued diversity and inclusion but made several statements that indicated a novice approach. For instance, one faculty member stated “I have no control over diversity in my classroom,” however we think a DEI expert would qualify this statement more with the multiple ways a faculty *does* have control over diversity, including program admissions, recruitment and advertising for a course, inclusion impacting persistence and thus diversity in a subsequent course, etc. Thus, we can begin to distinguish that “Agree/Disagree: *I value diversity and inclusion*” may be a less helpful survey question than “Agree/Disagree: *I have no control over diversity in my classroom*” because it has more “discrimination” to differentiate among participants. We can continue to investigate the discrimination value of some survey questions over others.

Other qualitative approaches to faculty learning on equity and inclusion may be useful to draw on. Some of these frameworks that conceptualize equity in situ in the classroom may help expand the external validity of these instructor perspective indicators by tying classroom outcomes and student perspectives more directly to instructor intentions. These approaches include frameworks that focus on teacher perspectives on race or gender, such as ideology [22], teacher noticing [23] and discourse [24]. There are also several critical qualitative approaches that assess equity in classrooms [25] or student discourse [26]. Intersectionality [27] is also a useful way to conceive of the ways that multiple systems of oppression overlap in higher education [28] and engineering education [29]. We will continue to incorporate these qualitative insights and theoretical approaches into the continued development of survey measures.

B. Pilot Survey Protocol

The following questions (Table II) represent our work-in-progress pilot survey protocol. Faculty would be asked to indicate the level of agreement that they maintain with a particular statement on a 1-7 Likert type scale: 1-Strongly Disagree; 2-Disagree; 3-Somewhat Disagree; 4-Neutral; 5-Somewhat Agree; 6-Agree; 7-Strongly Agree.

IV. DISCUSSION

A. Theoretical Challenges with Survey Measures

Our approach conceives of a learning progression for DEI topics, and our survey draws on our qualitative data and literature in order to identify where people are on that learning progression. Overall, we think we have made initial progress in the process of writing this paper. Still, during our interviews, we noticed some aspects of the relative learning/ growth areas and the strengths of our participants that are hard to distill into a simple survey measure or succinctly describe in a single statement. For instance, we noticed that one participant was particularly sensitive to DEI topics, afraid of getting the terminology wrong, and resistant to opening up about their own

TABLE II.

Topic	Definition	Example Protocol Items
Agency	How much control faculty feel they have over DEI issues	I have no control over the diversity of students in my classroom. It is not my job to focus on diversity and inclusion.
Empathy	How much faculty actively empathize with their students	I worry about my students' experiences when they do not share them with me.
Knowledge of students	How much knowledge faculty have of their students	I know about the backgrounds my students bring to my class. I know about the demographic identities of my students. I know about the specific needs of students.
Values	Values and motivations for DEI work	I have specific personal values for diversity, equity, and inclusion. I only think about diversity, equity, and inclusion because it is required or recommended by my employer.
Comfort	How comfortable faculty are with DEI topics	I am comfortable talking about my own and others' demographic identities (race, gender, sexual orientation, etc.).
Focus	Focus on diversity of interest or equity / inclusion of demographics	People focus too much on the diversity of demographics like race and gender. Rather than different demographic groups, it would be better to talk about diversity of thought or interest.
Positionality impact	How faculty see impact of their own identity in teaching	My demographic identity (race, gender, sexual orientation, etc.) does not impact my teaching. Who I am impacts how I interact with students.
Identity blindness / awareness / action	Narratives of identity blindness	In an ideal classroom, identity (race, gender, sexual orientation, etc.) does not come into play.

classroom. This can be understandable in the context of the high stakes and broader public and political conversation we have around DEI topics in the US, but it is also a limitation when trying to engage and think more deeply on these topics. It is difficult to learn about the topics that we are afraid to discuss. In contrast, we noticed another participant easily engaged in the terminology and discussions of DEI but positioned this as a field of expertise for others. This was connoted by references to literature bases and workshops that others hold, but that do not create much consequence for the faculty member. These seem to be two particular ways to be an “interested novice” faculty regarding DEI, yet they are hard to distill into survey questions that reflect both possibilities and additional variations.

Another example of a challenging theoretical topic to probe is around “identity blindness”, which we drew from the literature [24] and resonated with the interview findings. In one of the interviews, a question about “*how identity impacts your teaching?*” was met with a quick “*I hope it doesn't*” response, which we interpreted to mean the faculty member prioritizes and idealizes an identity-blind classroom. We think this statement

indicated a novice conception of equity in the classroom, however, we found it difficult to phrase this as a sole measure out of context. The statement “*I treat all students equally*” or “*I hope race does not impact the experience of my class*” may sound like neutral positive statements that most would agree with, and may not clearly differentiate between identity-blind and identity-conscious or identity-active conceptions of the classroom.

B. Next Steps for Survey Validation

The survey items presented in this paper were created based on the qualitative literature review and findings from pilot interviews, and we recognize that significant work still needs to be conducted before any inferences can be made from it. To specify concepts clearly, the refinement of survey items is necessary. For example, negative wording or absolutes (e.g., always, all, ever, etc.) should be avoided. Some definitions, particularly those related to DEI topics, might be vague or unclear to respondents. Therefore, it would be helpful to present exact definitions regarding the terminology so that every respondent interprets and understands it the same way. These survey development procedures will also be checked with a pilot focus group and with the extant work of scholars whose research area is DEI to obtain content validity of the final instrument.

Moreover, the survey questions will be validated by examining psychometric properties from the data collected by the pilot survey. The psychometric properties including item discrimination and step difficulties will be examined using Item Response Theory (IRT) Model [30, 31]. The internal structure as validity evidence will be examined with Exploratory Factor Analysis (EFA). Internal consistency will be checked using Cronbach's α .

C. Implications

The purpose of this work-in-progress paper is to help make progress towards a more robust approach for assessing equity in engineering classroom practices and in faculty learning on the topic. The current measures for DEI views tend to deal entirely with faculty perceptions and affirmations of DEI values; they do not provide a nuanced set of dimensions of DEI that can be triangulated with classroom data and assessed longitudinally over time to track faculty learning. Our primary plan for the survey is to use it to help recruit relative “interested novices” for the topic of DEI, as these will be ideal candidates to help create change in classroom equity through our future research. Through investigating and publishing this survey, we are making progress towards a validated instrument that may be used by other researchers, faculty developers, and universities hoping to promote and understand faculty learning on DEI.

D. Topics for Discussion

We are hoping for feedback from the FIE conference attendees on a number of topics. First, we invite feedback on the measures we have developed. If additional dimensions of understanding DEI have shown up in the literature, we would be happy to include these as part of the measure. Second, we invite feedback about our process. While we have some experience constructing similar surveys, we are eager to hear input from those who have more experience and/or those who may understand the survey questions as potential participants. Third,

we would like to understand if and how our survey development is useful to the broader community beyond our own purposes in study recruitment. Gaining clarity about this eventual usage will help us tailor the survey instrument so that it has wider eventual usage beyond our specific usage. Finally, we would like to engage a discussion about the opportunities and limitations regarding engaging faculty on DEI in their classrooms. We think the processes that shift engineering classroom practice towards equity and inclusion are understudied and we would like to engage a wider dialogue about how collaborate to support more work in this area.

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