Quantitative Method for Assessing the Adaptability of Engineering Instructors

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Abstract

This empirical research brief entails an examination of an instrument that measures a person's adaptability. Having such an instrument would enable instructional change to be explored through an adaptability lens. Despite the advancements in research and technologies, calls for instructional change in engineering education instruction still persist. Changes in teaching are needed to align with best practices, keep up with national needs, and respond to unpredictable changes in ways of life. Adaptability is defined as a measure of an individual's capability to successfully adjust to changes in the environment. Adaptability of individuals in varying professions has been studied more broadly; adaptability of engineering instructors is an under explored area of research. The purpose of this study was to use survey responses to describe the overall individual adaptability of engineering instructors. Findings from this study will help inform future research about instructor change in terms of adaptability and can inform faculty development activities. Engineering instructors at an R1, midwestern university in the United States of America were surveyed in Fall 2021 and Fall 2023 using a 35-item Likert scaled Individual ADAPTability Measure (I-ADAPT-M) instrument. Descriptive statistics about participants' overall adaptability are presented for the 80 participants. Insights from this research brief suggest that individual adaptability assessment could be valuable in studying instructional change and planning faculty development. This research brief is part of a forthcoming journal article involving exploratory factor analysis of the sub dimensions that makeup overall adaptability.

Background

Changes in teaching are needed to align with best practices, keep up with national needs, and respond to unpredictable changes in ways of life, such as disruptions to educational systems. Some stakeholders of engineering education have consistently expressed the need for engineering education to align with the level of sophistication and unpredictability that industries deal with when solving societal problems [1], [2], [3]. A similar sentiment has been echoed by industry representatives and government agencies who have gone a step further and articulated the changes needed in engineering education to meet the needs of professional practice [4]. ABET [5] has also made changes to the student outcomes, further reflecting the need for change in engineering education. However, engineering instructors have been slow to change their practices in teaching and learning [1], [2].

Change among engineering instructors has been studied using multiple lenses. A dominant way for studying change has focused on characterizing the behaviors that occur (or do not occur) when the environment changes [6], [7], [8]. Two common lenses that have been used to examine engineering instructors' change behaviors include the Diffusion of Innovation (DoI) model [9] and Adaptive Change Model (ACM) [10]. While these lenses have provided valuable insight into the change behaviors of engineering instructor [6], [8], using other lenses that view change from a different perspective could prove useful. Different lenses could help by providing a more holistic view of change in engineering education while building upon existing knowledge.

Adaptability is a theory of change which is complementary to existing research and provides new insights about supporting the change process of engineering instructors. Adaptability has been described as the "ability, skill, disposition, willingness, and/or motivation to change or fit different tasks, social, and environmental features" [11, p. 13]. A person's individual adaptability therefore determines how successful they are at adjusting to change. Unlike the DoI and ACM's focus on behavior, adaptability suggests that individuals will respond to change based on differences in their personality. Individual adaptability therefore offers a complementary lens for studying change in engineering education from the perspective of a personality trait of the instructor.

Purpose

The purpose of this study was to use survey scores to describe the overall individual adaptability of engineering instructors. Findings from this study will help inform future research about instructor change in terms of adaptability. Understanding the adaptability of engineering instructors can also inform recommendations for faculty development activities that are more personalized to the personality traits of individual instructors.

Theory of Adaptability

Adaptability is the measure of an individual's capability to successfully adjust to changes in the environment [11], [12]. In a typical workplace environment, individuals respond to change by demonstrating varying strengths in different dimensions of adaptability which are linked to their job types [11], [12], [13]. Individual adaptability therefore is seen as a personality trait that is expressed depending on the context [11]. Individual adaptability has been proposed to be a stable trait and the theory of Individual ADAPTability (I-ADAPT) was developed based on this premise [11]. Individual adaptability is believed to be a function of enduring knowledge, skills, abilities and other characteristics (KSAOs) that an individual possesses.

The I-ADAPT-M instrument has been used and adapted by researchers to study adaptability among different populations of interest. These include project managers [14], materials handlers [15], executive MBA students, and workers in telecommunications, financial services, digital advertising and media [16]. Other researchers have provided evidence of validity of the I-ADAPT-M instrument. For example, Hamtiaux et al. [17] gathered data to provide evidence for the validity of the first- and second-order structure of I-ADAPT survey and provided evidence based on relationship with other variables by comparing results from the Career Adapt-Ability Scale (CAAS) to the I-ADAPT-M. However, none of the prior research has examined individual adaptability in the context of teaching in engineering education. Therefore, there exists a gap in understanding the individual adaptability of engineering instructors which can inform change practices and the tailoring of change efforts to individuals.

Research Question (RQ)

The research question answered in this research brief is: Using the I-ADAPT instrument, what are the adaptability scores of engineering instructors at a large midwestern R1 university in the United States of America?

Methods

Setting and Participants

The study was conducted at an R1, midwestern university in the United States of America, with a focus on instructors from engineering. Participation was voluntary. All instructors who were actively teaching engineering were invited to participate. Adjuncts and other part-time positions were excluded to ensure that participants were in full-time positions and there was a common incentive structure. Therefore, only data from instructors in tenured, tenure-track, and professor of practice (teaching-track) positions were included in the final data set.

Data collection

Data were collected from participants using Qualtrics at two different periods of time – Fall 2021 and Fall 2023. A second round of data collection occurred in Fall 2023 to recruit additional participants and increase the sample size. A link to the survey was emailed to all instructors. A total of 160-175 engineering instructors were invited to participate each time. After the application of the inclusion criteria, 72 responses were received in Fall 2021 and 40 responses were received in Fall 2023. Out of the 40 responses received in Fall 2023, 8 were from new participants who did not respond to the earlier survey (Fall 2021). The new submissions in Fall 2023 were combined with the Fall 2021 submissions. Combining data from two time points was based on the premise that adaptability is a stable trait [11]. In total, 80 unique participants completed the survey. These 80 observations were used for descriptive analysis and to answer the research question.

Data were collected using the Individual ADAPTability Measure (I-ADAPT-M) instrument [11]. The instrument was made up of 55 items of which 35 items were included in the survey. The 35 items were selected due to their alignment with the context of teaching. Items not included related to a physical environment such as the ability to lift 50 pounds. For each question, participants were asked to respond using a 5-point scale ranging from strongly disagree (1) to strongly agree (5).

Validity evidence of the I-ADAPT instrument was collected using the contemporary validity framework [18]. The validity evidence collected included internal structure, response process, and consequences. Factor analysis was conducted for internal structure and results for a 1-factor model were calculated (Cronbach's $\alpha = 0.93$). Response process evidence was collected via think-aloud interviews with a subset of the participants. In terms of consequences, no perceived consequences – positive or negative – were anticipated as the participants' responses were not shared with anyone outside of the research team.

Data Analysis

Data were first cleaned and prepared for analysis by reverse coding any of the negatively framed questions. An overall adaptability score was then calculated by averaging the score from each of the items for each participant across the 35 items. This score was then used for descriptive analysis to answer the research question. Descriptive statistics were used to characterize the distribution of the calculated overall adaptability of all 80 participants who submitted complete responses to the survey in 2021 or 2023.

Results

The descriptive statistics of the overall adaptability scores of the participants are shown in Table 1 and the distribution of the participants' scores are presented in Figure 1. The average scores for the 80 participants ranged from 2.91 to 4.71 (1 to 5 possible). The mean (3.86) and median (3.87) were close to equal, as shown in Table 1, and indicates symmetry in the distribution of the scores of participants in the study. The descriptive statistics (Table 1) indicated that 25% of participants had scores above 4.15 while 50% of the instructors had scores between 3.60 and 4.15. The most frequent score range for engineering instructors was between 3.9 and 4.0 (n = 22) (Figure 1).

Table 1: Description of engineering instructor by individual adaptability

	Min.	1st Quartile	Median	Mean	3rd Quartile	Max.
Overall Adaptability	2.91	3.60	3.87	3.86	4.15	4.71

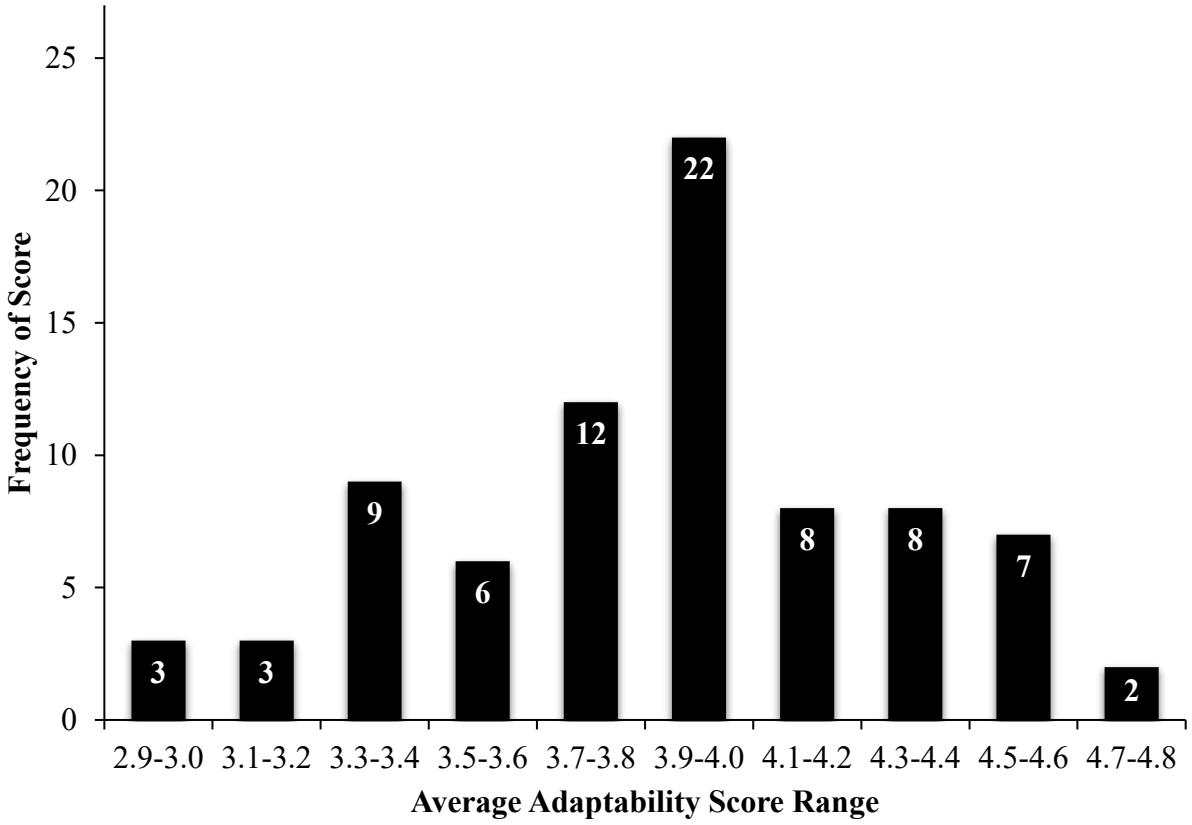

Figure 1: Frequency of individual adaptability scores based on ranges for engineering instructors (n=80)

Discussion

Based on the findings, almost all the participants' average overall adaptability score was at or above three (neutral (3), agree (4), and strongly agree (5)) indicating that participants perceived themselves as having some level of overall adaptability, on average, and capability to adjust to changes in the environment [11]. Participants having a perception of the ability to change relative to teaching is encouraging in terms of implementing change efforts. A more nuanced understanding of the dimensions that make up the overall adaptability scores will be examined in the full journal publication. A more nuanced understanding is important to identifying specific knowledge, skills and abilities (KSAs) that engineering instructors possess relative to change. Knowing an individual's adaptability score can help inform teaching and learning centers about the needs of the instructors that they are working with. By examining the individual dimensions of adaptability of engineering instructors, comparisons to other job types can be made as well.

Limitations & Future Work

This study was conducted at a typical R1 university in the United States of America, and it is anticipated that similar results would be found among engineering instructors at other R1 universities as expectations around teaching are likely similar. The forthcoming manuscript will focus on understanding each dimension of engineering instructors' adaptability to help guide individualized faculty development efforts. Future work could also compare the scores of engineering instructors with other job types.

Conclusion

This study has added to the body of knowledge by demonstrating the use of the theory of adaptability as a lens to view change in engineering education. The I-ADAPT-M instrument showed evidence of validity in the context of teaching and was able to document a range of adaptability scores of engineering instructors. The findings from this study are also valuable to researchers and engineering educators as a new way of understanding change in university settings. A journal manuscript is forthcoming that explores the dimensions of individual adaptability of engineering instructors. The outcomes from this research will be valuable to educators, faculty developers, and institutions in understanding the KSAs of engineering instructors at a more nuanced level to help inform change efforts that are tailored to the individual adaptability profiles of the instructors. Additionally, the theory of adaptability provides a new lens to study change which is complementary to existing studies of change in engineering instruction.

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