# WIP: Exploring an Engineering Faculty's Intention Toward Inclusive Teaching

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## Background and framework

In this work-in-progress paper, we present a study design for exploring strategies to involve engineering faculty in inclusive teaching practices, which are practices that integrate informal mentoring strategies into everyday communication with students in efforts to improve their interest, capacity, and belongingness in engineering. As part of a larger NSF-funded study on the interactions of engineering professional formation with diversity and inclusion, we will use semi-structured interviews to investigate an electrical and computer engineering (ECE) faculty's intention to implement inclusive teaching practices, using Fishbein and Ajzen's reasoned action model to define intention [1]. The interviews will be focused around an inclusive teaching "tip sheet" that was recently distributed to the ECE faculty. These interviews will allow us to characterize factors that influence the development of such an intention within the context of an engineering department, in order to make recommendations for administration.

Among efforts to improve diversity and inclusion in STEM, faculty mentoring has been identified as an effective strategy for supporting the success of underrepresented students [2]. However, student-faculty interactions that occur outside of formal mentoring relationships can also affect how included students feel at their school. Informal mentoring can occur in regular everyday interactions faculty have with students in class and during office hours, and can encourage the persistence of underrepresented students through targeting students' interest, capacity, and belongingness in STEM [3]. Positive student-faculty interactions in regular classroom settings have been associated with students' problem solving skills [4], self-efficacy [5], and academic confidence [6]. On the other hand, a lack of effort on the part of faculty to interact positively with students may harm academic confidence [5]. These examples indicate that involving engineering professors in inclusive practices as part of their everyday teaching roles is a promising strategy for fostering inclusivity in engineering schools. Inclusive teaching practices involve being "accessible to students in ways that generate positive and welcoming interactions" [5]. However, to take full advantage of this opportunity for improving inclusion requires having a majority of engineering professors adopt inclusive behaviors.

The reasoned action model states that an intention to perform any behavior is formed by three factors: attitude (evaluation of the outcomes), perceived norm (social pressure or support), and perceived behavioral control (self-efficacy) [1]. A widely applicable and well-tested model, the effectiveness of the reasoned action approach to predict intention and behavior has been confirmed in quantitative studies for many different behaviors and populations, such as high school students completing a school year [7], college students' drinking and driving [8], and women attending breast cancer screenings [9]. Besides this model's predictive ability, it can also be used as a framework to change behavior by addressing the underlying beliefs and background factors that influence attitudes, perceived norms, and perceived behavioral controls. The function of how background factors (which could include, for example, information, personal experience or values) influence the three primary factors for intention is context-specific [1], and is the focus of this study.

As part of our larger NSF-funded study, we interviewed ECE faculty three years ago about the general topics of engineering culture, diversity, and inclusion to gain an initial sense of where professors stood concerning these topics. In a previous study [10], we applied the reasoned action model as a framework for a thematic analysis of those transcripts. The thematic analysis explored the faculty's intention to make change for diversity and inclusion, meaning an intention to take any of a broad category of actions toward increased diversity and inclusion in the department. The analysis revealed that two of the three factors for intention, namely, perceived norm and perceived behavioral control, represented obstacles to faculty participation in change efforts; diversity and inclusion efforts were not seen as a norm in the department, and many faculty did not believe they could have much influence on diversity and inclusion. Based on our findings, we created an inclusive teaching "tip sheet," that emphasized faculty's impact on inclusivity through simple everyday teaching practices and distributed it to the faculty.

Inspired by the insights of this previous study, the current study will conduct further interviews with ECE faculty, now with a semi-structured interview protocol based on the reasoned action model and focusing specifically on inclusive teaching. The interviews will be loosely structured to assess the effects of the inclusive teaching tip sheet on faculty's attitude, perceived norm, perceived behavioral control, and intention to implement inclusive teaching practices. However, the assessment of the tip sheet as an intervention also serves as a catalyst for discussion of influences on the intention toward inclusive teaching more generally. Thus, using the tip sheet to focus the interviews, we will investigate the question:

> How does an intention toward inclusive teaching manifest, function, and change in the context of an electrical and computer engineering department in the presence of a change initiative?

## Study design

This study is grounded in an interpretivist research philosophy that acknowledges a subjective, socially constructed reality [11]. Consistent with this philosophy, we will use open-ended questions in an interview setting to understand the participants' realities through their own perspectives. Throughout the research process, we will refer to Walther et al.'s quality framework for interpretive research, which provides guiding questions to ensure quality through all the stages of research – from "making data" to "handling data" – and across six quality constructs: theoretical validation, procedural validation, communicative validation, pragmatic validation, ethical validation, and process reliability [12]. Our considerations for each of these quality constructs are summarized in Appendix A.

### *Sampling*

This study focuses on an electrical and computer engineering (ECE) department in a large research university. Since ECE departments in the United States have particularly low representation of women and other underrepresented students compared to other engineering programs [13], we hope that studying an ECE department can give us rich insight into the problems of diversity and inclusion in engineering. Additionally, two of the researchers involved have technical backgrounds in ECE and connections to the department in question, which will add to the depth of data collection and analysis.

The interviews will be centered around an inclusive teaching tip sheet that was distributed to ECE faculty at a faculty meeting. Faculty who did not attend the meeting were delivered a physical copy of the tip sheet to their office. The front of the tip sheet was designed to motivate faculty by emphasizing how their everyday approach to teaching can impact inclusivity and by showcasing quotes from students in the program who have felt excluded by professors' actions. The back of the tip sheet explained interest, capacity, and belongingness as three vital factors for the persistence of underrepresented students and listed 24 specific ideas for inclusive teaching practices. Examples included "facilitate class discussions or debates on course material" for fostering interest, "encourage asking questions by responding with 'thanks for asking' or 'that's a great question'" for fostering capacity, and "ask students how they're doing when you see them outside of class" for fostering belongingness. Attached to each tip sheet was a request to contact the researchers if willing to participate in an interview.

The ECE department under investigation consists of approximately 100 faculty members. Therefore, we will utilize purposeful sampling strategies to achieve a representative range of perspectives in the interviews. First, we will use convenience sampling by interviewing faculty who respond to the call for interviews attached to the tip sheet, which has already been distributed. Throughout the data collection process, we will also use strategic sampling to increase the diversity of the sample demographically (i.e., gender, race). We will also strive to increase ideological diversity (i.e., participants with a range of initial reactions to the tip sheet, and a range of prior involvement with diversity and inclusion initiatives) by seeking further data collection if initial results seem to show a narrow range of perspectives.

***Interview protocol***

Interviews will be one hour in length, with a protocol (see Appendix B) based on Fishbein and Ajzen's recommendations for assessing attitude, perceived norm, perceived behavioral control, and intention within the reasoned action model. However, due to the interpretive and exploratory nature of our study, we allow some flexibility in our assessment of these constructs compared to quantitative studies that commonly use this model.

The first step in investigating a behavior with the reasoned action model is to carefully define the behavior in question. This definition includes a target, action, context, and time period, and is held consistent and understood by both researcher and participant throughout data collection [1]. For the purpose of this study, the actions under consideration are multiple, because we are interested not in one behavior but a *behavioral category* under the umbrella of "inclusive teaching." In interviews, we will use the examples on the tip sheet to help define inclusive teaching, which we say consists of "initiating interactions with students in class or office hours intended to improve their capacity, interest, or belongingness in engineering." After providing this definition, we will ask participants to list examples of inclusive teaching to gauge their understanding of the definition. The target of the behavior of inclusive teaching is students, and the context is the ECE department. We will leave the time period ambiguous to avoid excluding any potentially useful data from different time periods.

The interview will then explicitly request feedback on the inclusive teaching tip sheet, before moving on to questions intended to assess attitude, perceived norm, and perceived behavioral control toward inclusive teaching and elicit the underlying beliefs and background factors that

contribute to each of these factors. Participants will be asked about each factor directly according to Fishbein and Ajzen's definitions. Then for each factor participants will be asked how they have been influenced by their experiences in the ECE department. At this point, participants may speak on recent diversity and inclusion initiatives in the department, including the tip sheet and diversity and inclusion design sessions put on by our larger NSF-funded study. Finally, participants will be asked how each factor could be improved for themselves or other ECE faculty.

It is possible that reflection during the interview itself will have some effect on participants' intention toward inclusive teaching. To observe this effect, participants will be asked to complete an open-ended electronic survey question once before and once after the interview. Before the interview, we will ask directly about the participant's intention to implement inclusive teaching. After the interview, we will ask if they believe they have gained anything from the interview process. The presentation of these questions as a survey is intended to mitigate the influence of the researcher's presence on the answers.

### *Analysis*

We will analyze the interview data with a theoretical thematic analysis, as defined by Braun and Clarke [14], meaning that the reasoned action model will be applied as an initial framework for the coding process. This approach contrasts with our previous study, an inductive thematic analysis, in which we began with no framework and discovered the final research question during analysis. An initial coding scheme will be based on the three primary factors for intention and the three components of our research question ("How does the intention manifest, function, and change?"). We will follow the guidelines for quality thematic analysis laid out by Braun & Clarke, which gives quality considerations throughout the analysis process [14].

## Preliminary results

We have conducted one pilot interview for this study, after which we revised the interview protocol to make the conversation more streamlined and natural. This pilot interview raised several promising themes, including: time pressure to cover course content as an obstacle, the department's reward system which does not incentivize improvements in teaching, and the positive motivating influence of peers in the department who try new teaching methods. These themes are consistent with and expand upon our results from our past round of interviews.

## Significance

This study aims to uncover underlying beliefs and background factors within the context of an engineering department that help or hinder faculty's intention toward inclusive teaching. With this insight, we will provide recommendations for other engineering departments interested in improving inclusivity at their school. The underlying beliefs and background factors we discover can serve as starting points for investigations of other departments, who can adapt our findings to their own contexts. This study also provides a methodology for identifying opportunities for change in engineering schools using the reasoned action model. By using an established psychological model, we hope to uncover the deep underlying factors which can be addressed to create sustainable change towards more inclusive teaching practices in engineering.

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**References**

[1] M. Fishbein and I. Ajzen, *Predicting and Changing Behavior: The Reasoned Action Approach*. New York, NY: Psychology Press, 2010.

[2] K. D. Kendricks, K. V. Nedunuri, and A. R. Arment, "Minority student perceptions of the impact of mentoring to enhance academic performance in STEM disciplines," *J. STEM Educ. Innov. Res.*, vol. 14, no. 2, pp. 38–46, Apr. 2013.

[3] B. W.-L. Packard, *Successful STEM Mentoring Initiatives for Underrepresented Students: A Research-Based Guide for Faculty and Administrators*. Sterling, VA: Stylus, 2016.

[4] S. Bjorklund, J. Parente, and D. Sathianath, "Effects of faculty interaction and feedback on gains in student skills," *J. Eng. Educ.*, vol. 93, no. 2, pp. 153–160, Apr. 2004, doi: 10.1002/j.2168-9830.2004.tb00799.x.

[5] C. M. Vogt, "Faculty as a critical juncture in student retention and performance in engineering programs," *J. Eng. Educ.*, vol. 97, no. 1, pp. 27–36, Jan. 2008, doi: 10.1002/j.2168-9830.2008.tb00951.x.

[6] M. Micari and P. Pazos, "Connecting to the professor: Impact of the student-faculty relationship in a highly challenging course," *Coll. Teach.*, vol. 60, no. 2, pp. 41–47, Apr. 2012, doi: 10.1080/87567555.2011.627576.

[7] L. E. Davis, I. Ajzen, J. Saunders, and T. Williams, "The decision of African American students to complete high school: An application of the theory of planned behavior," *J. Educ. Psychol.*, vol. 94, no. 4, pp. 810–819, 2002, doi: 10.1037/0022-0663.94.4.810.

[8] C. J. Armitage, P. Norman, and M. Conner, "Can the theory of planned behaviour mediate the effects of age, gender and multidimensional health locus of control?," *Br. J. Health Psychol.*, vol. 7, no. 3, pp. 299–316, 2002, doi: 10.1348/135910702760213698.

[9] C. H. C. Drossaert, H. Boer, and E. R. Seydel, "Prospective study on the determinants of repeat attendance and attendance patterns in breast cancer screening using the theory of planned behaviour," *Psychol. Health*, vol. 18, no. 5, pp. 551–565, 2003, doi: 10.1080/0887044031000141207.

[10] M. E. Matters, C. B. Zoltowski, A. O. Brightman, and P. M. Buzzanell, "An engineering faculty and an intention to make change in diversity and inclusion: Creating sustainable change efforts," to be presented at the CoNECD - The Collaborative Network for Engineering and Computing Diversity, Crystal City, Virginia, Jan. 2021.

[11] S. B. Merriam, *Qualitative Research: A Guide to Design and Implementation*, 4th ed. San Francisco, CA: Jossey-Bass, 2016.

[12] J. Walther *et al.*, "Qualitative research quality: A collaborative inquiry across multiple methodological perspectives," *J. Eng. Educ.*, vol. 106, no. 3, pp. 398–430, 2017, doi: 10.1002/jee.20170.

[13] J. Roy, "Engineering by the numbers," ASEE, Jul. 2019. Accessed: Nov. 30, 2019. [Online]. Available: http://www.asee.org/documents/papers-and-publications/publications/college-profiles/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf.

[14] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual. Res. Psychol.*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.

## Appendix A: Quality Considerations

| **Quality construct as defined by Walther et al. [12]** | **Study considerations** |
|---|---|
| **Theoretical validation**<br>Fit between theory generated and social reality | Including the impact of the interview itself in analysis (via survey questions) |
| **Procedural validation**<br>How the methods ensure fit between theory generated and social reality | Use of Braun & Clarke's guidelines for quality thematic analysis [14] |
| **Communicative validation**<br>Integrity of the process of shared meaning-making between relevant parties | Interviews with open-ended questions allow us to observe participants' realities from their perspective |
| **Pragmatic validation**<br>Fit between theoretical constructs and empirical reality | Use of the reasoned action model, which is well-tested and compatible with examining any human behavior [1] |
| **Ethical validation**<br>Ethical integrity and responsibility throughout the research process | All research protocols and instruments approved by IRB for protection of all subjects |
| **Process reliability**<br>Mitigation of random influence on the study | Strategic sampling to increase the diversity among participants, both demographically and ideologically |

## Appendix B: Interview Protocol

### *Pre-interview survey question*

- Do you intend to implement any inclusive teaching strategies in your classes? How?

***Introduction***

- Tell me a bit about yourself.

***Explanation***

We are doing a study to determine how to get more engineering professors involved in inclusive practices. We are exploring the idea of professors using inclusive teaching methods to help students succeed in ECE classes. We are defining inclusive teaching methods as initiating interactions with students in class or office hours intended to improve their capacity, interest, or belongingness in engineering (as defined on the tip sheet). In other words, inclusive teaching involves bringing typical mentoring strategies into the classroom on a smaller scale. The tip sheet gives many examples of these strategies.

- So that we can get your understanding of the definition, what are some examples that come to mind when you think of inclusive teaching?

***Feedback on tip sheet***

- What feedback do you have about the tip sheet?

***Assessing perceived behavioral control***

- What are some obstacles you see to you personally implementing inclusive teaching strategies, and how difficult would it be to overcome them?
- Have any experiences you've had in the ECE department affected your views on these obstacles?
- What do you think could be done to make ECE professors feel more in control of implementing inclusive teaching?

***Assessing attitude***

- What do you believe would be some positive or negative outcomes to you personally implementing inclusive teaching strategies in your classes?
- Have any experiences you've had in the ECE department affected your views on these outcomes?
- What do you think could be done to improve yours or other professors' attitude towards inclusive teaching (seeing more pros than cons)?

***Assessing perceived norm***

- Do you feel that many professors in ECE currently use inclusive practices, or think that they should be used?
- Have any experiences you've had in the ECE department affected your views on the norm of inclusive teaching within ECE?
- What do you think could be done to make inclusive teaching the norm in ECE?

***Conclusion***

- What in the ECE department has most impacted your views on diversity & inclusion?
- Is there something you expected us to ask that we didn't?
- Do you have anything else to say?

***Post-interview survey question***

- Did you gain anything from this interview process?