State of Engineering Education Departments (SEED): Perceptions of Engineering Education Departments Across Different College Ecosystems

Mrs. Kalene Marie Thomas, North Carolina State University at Raleigh

Kalene is a part-time PhD student at North Carolina State University studying Industrial and Systems Engineering, with a minor in engineering education. She also works full-time at NC State as the Assistant Director for the Master of Engineering Management program, and teaches the Engineering First Year curriculum.

Gimantha N Perera, University of South Carolina, Upstate

Gimantha Perera is a Sri Lankan born researcher and educator from NC State University. He was inspired to be an engineer by his maternal grandfather Anil, who would consistently come home from work covered in grease and grime after climbing bodily into machines to fix them. He shares a promise with his grandfather, now departed, that he will continue to innovate, contribute, and revolutionize industry through engineering and teaching. His world view that can be summed up in two statements: ”Just because it works, doesn’t mean in can’t be better.” – Shuri, Black Panther and ”First, think. Second, believe. Third, dream. And finally, dare.” – Walt Disney. He obtained a Bachelor of Science in Industrial and Systems Engineering from North Carolina State University while a part of the Accelerated Bachelors-Master’s program. He proceeded to finish his master’s at North Carolina State University under the guidance of Dr. Julie Ivy and Dr. Karen Chen. ”I want my life to have mattered, I want to look back and feel like I made a difference in my brief time here. I know I won’t always be able to do this but I want to look back at the people in my life and not regret the ways in which I interacted with them; I want them to remember me and remember me fondly”. Emmerson said ”The purpose of life is not [merely] to be happy. It is to be useful, to be honorable, to be compassionate, to have it make some difference that you have lived and lived well.”, I hope to live up to that ideal in the service of science and my community.

Dr. Laura Bottomley, North Carolina State University at Raleigh

Dr. Laura Bottomley is the Director of Engineering Education and Senior Advisor to WMEP at NC State University. She has been working in the field of engineering education for more than 30 years, having taught every grade level from kindergarten to engineering graduate school. She is a Fellow of the IEEE and ASEE and has been recognized with the PAESMEM award.

Dr. Karen B Chen, North Carolina State University at Raleigh

Karen B. Chen is an Associate Professor in the Fitts Department of Industrial and Systems Engineering. She received her Ph.D. in Biomedical Engineering from the University of Wisconsin–Madison in 2015 (M.S. 2010, B.S. 2009). She was a postdoctoral researcher at Healthcare Systems Engineering Institute at Northeastern University before joining NC State University in 2016, where she directs the Virtual and Augmented Reality Laboratory. Her research, funded by the NSF and NIOSH, focuses on augmenting human performance outcomes by leveraging immersive environments. She is part of the Occupational Safety and Ergonomics program within NC OSHERC and collaborates with The Ergonomics Center of North Carolina. Her outreach includes K–12 STEM engagement, media dissemination, and public panels.

Investigating the Perceptions of Engineering Education Departments Across Different College Ecosystems: A Preliminary Examination

1. Introduction

The Bureau of Labor Statistics [1] reports that engineering disciplines are projected to grow faster than the average for all occupations from 2023 to 2033 - yet over one-third of engineering job postings may go unfulfilled each year due to a lack of a prepared workforce [2]. The National Academy of Engineering (NAE), in their report the *Engineer of 2020* [3], placed emphasis on the need to equip the next generation of engineers with the skills and knowledge that the workforce will need to create and integrate new technologies. To do so, the NAE argues in its follow up report, *Educating the Engineer of 2020* [4], that our higher education system, among other improvements, "should endorse research in engineering education as a valued and rewarded activity for engineering faculty and should develop new standards for faculty qualifications."

There is not a clear standard for how universities integrate the engineering education discipline into their existing collegiate structure. There are approximately 25 institutions in the United States offering a variation of a graduate degree in engineering education, and others that offer graduate certificates or affiliated credentials [5]. In addition to formal education departments, many universities have centers for teaching and learning that support STEM educators in understanding and implementing pedagogical innovations, which do not act as a department but are adjacent to engineering education. In the United States, Engineering Education (EEd) departments are being integrated into engineering colleges [5]. These EEd programs vary significantly in terms of their structures, roles, resources, and challenges. As more EEd departments- or other programs- are formed, it becomes critical to understand the benefits of different department structures and their impact on engineering student and faculty outcomes.

Engineering Education as a discipline is in the beginning stages of identity development, and as such the way it is integrated into a collegiate system at large is not well understood, which can lead to misconceptions as to what the role of the program is. In this work, a pilot exploration of the perceived roles and positioning of engineering education departments or centers within their university ecosystems was conducted. The goal was to understand the role of an engineering education department, as perceived by both its members and the engineering faculty at an institution at large. Future work will take these perceptions and propose an identity or possible structure for introducing engineering education into a university ecosystem.

2. Methods Section

2.1 Participants

A total of 31 individuals participated in the study, all of which were faculty members from higher education institutions. Table *I* shows the demographics of the participating faculty. Of the participants, 18 were faculty within an Engineering Education department, meaning they have a primary or secondary appointment in EEd or other such meaningful distinction, and 13 were faculty from other engineering departments. Participants in the Engineering Education Department were recruited from the American Society of Engineering Education (ASEE) listserv and from those in attendance at the 2025 ASEE Annual Conference. Faculty members outside of the Engineering Education Department were recruited through distributing the survey via email requests to department heads and faculty listservs.

Table I.
Participant Demographics

	Out-EED 13	**In-EED 18**	**Total 31**
Department Style			
Cross-disciplinary program housed under the college of education	1	1	**2**
Cross-disciplinary program housed under the college of engineering	4	7	**11**
Physical department housed under the college of education	0	1	**1**
Physical department housed under the college of engineering	5	6	**11**
Task Force of faculty members	1	2	**3**
Unknown	2	0	**2**
Unofficial program offering a small number of special topics courses through faculty collaboration	0	1	**1**
Gender			
Blank	1	4	**5**
Female	6	7	**13**
Male	6	5	**11**
Non-Binary	0	1	**1**
Prefer Not to Say	0	1	**1**
Home Dept			
Aerospace/Mechanical Engineering	2	3	**5**
Biomedical/Chemical Engineering	0	4	**4**
Civil/Environmental Engineering	1	0	**1**
Computer Science Engineering	0	1	**1**
Electrical/Computer Engineering	1	2	**3**
Engineering Education	0	6	**6**
Industrial/Systems Engineering	9	1	**10**
STEM Education	0	1	**1**
Years in Academia			
Blank	1	5	**6**
Five or less	2	3	**5**
Six to Ten	2	1	**3**
Eleven to Fifteen	1	1	**2**
Sixteen to Twenty	2	2	**4**
Twenty-one to Twenty-five	1	1	**2**
Twenty-six to Thirty	2	2	**4**
Thirty-one or more	2	3	**5**
Institution Type			
Master's College or University	0	1	**1**
R1: Doctoral University – Very High Research Activity	13	17	**30**

Inclusion criterion was such that only faculty members at institutions that had an Engineering Education group or department were included. Informed consent approved by the North Carolina State University Institutional Review Board was obtained from all participants.

2.2 Procedure

Upon informed consent, participants completed an electronic questionnaire that consisted of three major sections. The first section included the following demographic questions: age (selected from a range), gender, years in academia, title, home department, and type of institution (e.g., R1, R2, teaching university). Additional questions were asked regarding the participant's current affiliation with the engineering education unit at their institution, and if they were aware of such a unit. The final question in this section asked participants to select from a list of choices that would best classify and describe their EEd group (physical department, cross-disciplinary program, research center, task force, or ad hoc committee) as well as the college in which the department resides (College of Engineering or the College of Education).

The second section of the questionnaire focused on roles and responsibilities of the engineering education unit at their institution. The participants were asked to select all the roles that the engineering education unit holds at their institution from a list of potential roles. The selections included coordinating or conducting engineering education research, offering graduate or undergraduate courses on collegiate engineering education, offering courses on K-12 STEM education, conferring degree programs, community outreach, recruitment, faculty or teaching assistant (TA) professional development, developing curriculum changes, and advising administrations on DEI or other topics. There was room for a write-in response. The participants were next asked to select their perceived most important top three topics that an EEd group should be responsible for from their curated list of all roles of their EEd group.

The last aspect of the questionnaire focused on how participants felt the EEd group was positioned and supported in terms of reaching its goals. 'Positioned' was defined as possessing the faculty, staff, and resources needed, where 'supported' was stipulated to be from administration. A free-response block was provided so that participants could expand upon their answer for each question. Participants were then asked who should be responsible for supporting the EEd group at their institution and if they felt engineering education research was happening outside of the EEd department.

At the end of the survey, the participants had the choice to opt for an additional interview to further expand their thoughts. A link was provided to the calendar to sign up for an interview spot. The interview and its qualitative results were not within the scope of the present work.

2.3 Instrumentation

A Qualtrics questionnaire was created by the researchers, as the specific points about roles and responsibilities, department structure, and support for the EEd group were a unique combination of points not accounted for by any known survey tool from human factors, organizational psychology, or engineering education. Survey creation was a Delphi process that was generated

via consensus amongst a diverse team of experts in Human Factors Engineering or Engineering Education. Content for survey questions, like the selections for potential roles and responsibilities of an EEd group are from topics found in engineering education literature. A 5-point Likert scale was used to quantify participants' perceived level of support for the department. Almost all questions provided an "other" write-in option, in which participants could provide feedback not already available in the preset categorical responses.

2.4 Variables and Analysis

The descriptive variable was a binary variable whether the faculty member was in the engineering education group at their institution or not. From this, the participants were split into two subgroups: InEEd and OutEEd.

Standard demographics data were gathered to potentially analyze trends based on further subdivisions of the participants, including age range, type of institution (R1, R2, teaching college), job role (Assistant Professor, Associate Professor, etc.), home department, secondary department (if any), gender, and years spent in academia.

The main survey results for this paper looked at the most selected current roles and responsibilities of an EEd group, then ranked most important roles from that generated list, and compared the results across the two subgroups. To allow for a direct comparison between subgroups with different numbers of participants, the frequency of each category was calculated and then converted into a proportion. This same methodology—identifying and calculating proportions—was then applied to the participants' desired roles and responsibilities of EEd groups and their choices for most important desired roles.

The difference between the two groups proportions, called Delta in the table, is the proportion of OutEEd - InEEd, so it can be negative. A negative Delta indicates that there was a high proportion of participants InEEd that selected the role than those OutEEd.

3. Results

Only survey responses that answered a minimum of 50% of the overall questions were considered complete, and 10 incomplete responses were excluded from analysis. Since demographic questions were at the end of the survey, 50% completion rates answered the roles and responsibilities questions needed for this current work. The participant free-response for EEd roles were cleaned and added to the current roles table. One submission entered "*unknown"* and thus was excluded.

Both faculty in EEd and faculty outside of EEd identified the following as the most frequently performed roles by EEd faculty: *conducting EEd research, offering graduate classes in EEd, and conferring masters degrees in EEd*. Similarly, for outside-EEd faculty *conducting EEd research, offering graduate classes in EEd, and conferring doctorate degrees in EEd* are the most frequently assumed roles. Table II shows Roles and Responsibilities that the engineering education department at their institution was currently responsible for, which was aggregated across the two subgroups.

Table II.
Compares results of current roles and responsibilities selected across both faculty groups.

Current Roles of EEd Group	In EEd	Out EEd	% In EEd	% Out EEd	Delta
Conferring certifications or minors in engineering education at any degree level	8	2	44.0%	15.0%	-29.0%
Conferring masters degrees in engineering education	9	3	50.0%	23.0%	-27.0%
Championing inclusion of DEI components in engineering curricula across engineering departments	3	0	17.0%	0.0%	-17.0%
Dissemination of pedagogical best practices (conducting workshops for engineering departments and presenting emerging research etc.)	7	3	39.0%	23.0%	-16.0%
Providing professional development opportunities for engineering faculty and staff	7	4	39.0%	31.0%	-8.0%
Coordinating disparate engineering education research initiatives	5	3	28.0%	23.0%	-5.0%
Supporting study abroad programs hosted through the college of engineering	2	1	11.0%	8.0%	-3.0%
Developing and engaging students across all departments in engineering service activities	3	2	17.0%	15.0%	-2.0%
Offering graduate courses on K-12 STEM education	3	2	17.0%	15.0%	-2.0%
Offering undergraduate courses on collegiate engineering education	3	2	17.0%	15.0%	-2.0%
Conducting engineering summer camps and/or other public engineering engagement activities	4	3	22.0%	23.0%	1.0%
Advising on student-centered administrative changes within the college of engineering	1	1	6.0%	8.0%	2.0%
Conferring undergraduate degrees in engineering education	1	1	6.0%	8.0%	2.0%
Offering undergraduate courses on K-12 STEM education	1	1	6.0%	8.0%	2.0%
Consulting on faculty teaching evaluations across departments	2	2	11.0%	15.0%	4.0%
Implementing curriculum changes and updates across engineering departments	2	2	11.0%	15.0%	4.0%
Offering graduate courses on engineering education	13	10	72.0%	77.0%	5.0%
Teaching non EED focused engineering classes (e.g., engineering graphics)[a]	0	1	0.0%	8.0%	8.0%
Outreach and recruitment of college first years to engineering departments	1	2	6.0%	15.0%	9.0%
Conferring doctorates in engineering education	8	7	44.0%	54.0%	10.0%
Control and administration of first year engineering programs (common curriculum)	2	3	11.0%	23.0%	12.0%
Providing professional development opportunities for graduate students interested in academia	6	6	33.0%	46.0%	13.0%
Conducting engineering education research	13	11	72.0%	85.0%	13.0%
Outreach and recruitment of middle and high-school students to engineering departments	1	3	6.0%	23.0%	17.0%

[a] *submission from participant free response from 'other' category*

When asked to pare down from their own selected roles and responsibilities to the top three most important roles, both groups of participants ranked conducting *EEd research* and *offering graduate classes in EEd* as the highest importance of roles and responsibilities. EEd group members also brought forth *conferring doctorate degrees in EEd,* while outside-EEd faculty did not have a clear third choice. The difference in the two groups' proportions of selection is displayed in Table III.

Table III.
Most important current roles considered by both faculty in EEd and out of EEd

Most Important Current Roles of EEd Group	In EEd	Out EEd	% In EEd	% Out EEd	Delta
Conferring doctorates in engineering education	6	1	33.0%	8.0%	-25%
Dissemination of pedagogical best practices (conducting workshops for engineering departments and presenting emerging research etc.)	4	1	22.0%	8.0%	-14%
Conferring certifications or minors in engineering education at any degree level	3	1	17.0%	8.0%	-9%
Championing inclusion of DEI components in engineering curricula across engineering departments	1	0	6.0%	0.0%	-6%
Developing and engaging students across all departments in engineering service activities	1	0	6.0%	0.0%	-6%
Providing professional development opportunities for engineering faculty and staff	1	0	6.0%	0.0%	-6%
Conferring masters degrees in engineering education	2	1	11.0%	8.0%	-3%
Coordinating disparate engineering education research initiatives	0	1	0.0%	8.0%	8%
Outreach and recruitment of college first years to engineering departments	0	1	0.0%	8.0%	8%
Control and administration of first year engineering programs (common curriculum)	1	2	6.0%	15.0%	9%
Offering undergraduate courses on collegiate engineering education	1	2	6.0%	15.0%	9%
Providing professional development opportunities for graduate students interested in academia	1	2	6.0%	15.0%	9%
Conducting engineering education research	10	9	56.0%	69.0%	13%
Offering graduate courses on engineering education	5	9	28.0%	69.0%	41%

From the above generated list of desired roles and responsibilities of EEd groups, the participants ranked their perceived most important (top three) roles. These were not rank-ordered by participants.

Table IV.
Desired roles reported by faculty in and outside of the EEd group.

Desired Roles of EEd Group	In EEd	Out EEd	% In EEd	% Out EEd	Delta
Championing inclusion of DEI components in engineering curricula across engineering departments	7	2	39%	15%	-24%
Implementing curriculum changes and updates across engineering departments	3	0	17%	0%	-17%
Advising on student-centered administrative changes within the college of engineering	7	3	39%	23%	-16%
Consulting on faculty teaching evaluations across departments	7	3	39%	23%	-16%
Conferring undergraduate degrees in engineering education	4	1	22%	8%	-14%
Supporting study abroad programs hosted through the college of engineering	3	1	17%	8%	-9%
Offering undergraduate courses on collegiate engineering education	4	2	22%	15%	-7%
Providing professional development opportunities for engineering faculty and staff	9	6	50%	46%	-4%
Developing and engaging students across all departments in engineering service activities	2	1	11%	8%	-3%
Offering undergraduate courses on K-12 STEM education	2	1	11%	8%	-3%
Offering graduate courses on K-12 STEM education	6	4	33%	31%	-2%
Dissemination of pedagogical best practices (conducting workshops for engineering departments and presenting emerging research etc.)	11	8	61%	62%	1%
Coordinating disparate engineering education research initiatives	8	6	44%	46%	2%
Control and administration of first year engineering programs (common curriculum)	6	5	33%	38%	5%
Conducting engineering education research	14	12	78%	92%	14%
Conducting engineering summer camps and/or other public engineering engagement activities	4	5	22%	38%	16%
Offering graduate courses on engineering education	11	10	61%	77%	16%
Outreach and recruitment of college first years to engineering departments	1	3	6%	23%	17%
Outreach and recruitment of middle and high-school students to engineering departments	1	3	6%	23%	17%
Conferring masters degrees in engineering education	9	9	50%	69%	19%
Conferring certifications or minors in engineering education at any degree level	10	10	56%	77%	21%
Providing professional development opportunities for graduate students interested in academia	7	8	39%	62%	23%
Conferring doctorates in engineering education	9	10	50%	77%	27%

Table V.
Desired roles and responsibilities as respondents perceived to be the most important

Most Important Desired Roles of EEd Group	In EEd	Out EEd	% In EEd	% Out EEd	Difference
Providing professional development opportunities for engineering faculty and staff	4	0	22.0%	0.0%	-22.0%
Championing inclusion of DEI components in engineering curricula across engineering departments	2	0	11.0%	0.0%	-11.0%
Conferring doctorates in engineering education	4	2	22.0%	15.0%	-7.0%
Advising on student-centered administrative changes within the college of engineering	1	0	6.0%	0.0%	-6.0%
Conferring masters degrees in engineering education	1	0	6.0%	0.0%	-6.0%
Conferring undergraduate degrees in engineering education	1	0	6.0%	0.0%	-6.0%
Implementing curriculum changes and updates across engineering departments	1	0	6.0%	0.0%	-6.0%
Offering graduate courses on K-12 STEM education	1	0	6.0%	0.0%	-6.0%
Dissemination of pedagogical best practices (conducting workshops for engineering departments and presenting emerging research etc.)	5	3	28.0%	23.0%	-5.0%
Conferring certifications or minors in engineering education at any degree level	3	2	17.0%	15.0%	-2.0%
Control and administration of first year engineering programs (common curriculum)	0	1	0.0%	8.0%	8.0%
Coordinating disparate engineering education research initiatives	0	1	0.0%	8.0%	8.0%
Offering undergraduate courses on collegiate engineering education	0	1	0.0%	8.0%	8.0%
Outreach and recruitment of college first years to engineering departments	0	1	0.0%	8.0%	8.0%
Outreach and recruitment of middle and high-school students to engineering departments	0	2	0.0%	15.0%	15.0%
Providing professional development opportunities for graduate students interested in academia	1	4	6.0%	31.0%	25.0%
Conducting engineering education research	9	11	50.0%	85.0%	35.0%
Offering graduate courses on engineering education	3	8	17.0%	62.0%	45.0%

4. Discussion

This preliminary study investigated the perception of roles that EEd faculty should assume. Faculty who are currently in EEd and outside of EEd were surveyed. The number of participants in each subset leads to a low statistical power for this preliminary dataset. However, future plans

are to increase survey participant numbers and layer the qualitative interviews to complement the dataset.

Current Roles & Responsibilities for EEd Groups

For most current roles and responsibilities, the two groups (InEED, OutEED) of faculty were in alignment that conducting engineering education research (72%, 85%), and teaching graduate engineering education classes (72%, 77%) were not only the most common role of EEd groups but also of the highest importance. Over 70% in both groups identified conducting engineering education research and teaching graduate EEd classes as core responsibilities of an EEd group.

As for lower priorities, *conducting engineering summer camps and/or other public engineering engagement activities* as both EEd groups did not identify it as a prominent role for EEd groups.

While there were alignments in perception of roles across the two faculty groups, namely the faculty in and outside of EEd, there were also mismatches. Specifically, the faculty outside of EEd unanimously agreed that championing inclusion of DEI components in engineering curriculum across engineering departments was not a role that EEd groups currently had-- a small contrast to the EEd faculty where 17% said it was a current role.

The greatest mismatch for current roles, as indicated by the largest delta between the two groups, was *conferring certifications or minors in engineering education at any degree level,* potentially indicating that faculty outside of EEd groups are not aware of certificates that are currently being offered on campuses.

Most Important Current Roles & Responsibilities for EEd Groups

The extent to which a role is perceived to be important is different from the currently assumed roles in EEd faculty. In particular, 72% of EEd faculty currently have roles in *conducting engineering education research* and *offering graduate courses on engineering education*, yet only 56% of them perceive that these should be the important roles. This means that the assigned jobs to EEd faculty do not align with what they perceive to be most important. Moreover, this mismatch is also present in what faculty outside of EEd believe EEd faculty should be doing. The difference is even more pronounced for offering graduate courses on engineering education, where 69% of OutEEd faculty placed it as a top priority, but only 28% of InEEd faculty did.

Desired Roles for EEd Groups

An interesting observation was the increase in roles that both groups of faculty selected when given the option to prescribe potential desired EEd group roles. From current roles to ideal scope, EEd faculty members had a 38% increase in roles, and outside-EEd faculty members had a 51% change of additional roles. Both groups saw an addition of about 2 roles per participant on average. This suggests that both groups of faculty agree that the scope of EEd groups should increase on campus. Out of the 23 potential roles listed in the survey, EEd faculty added them to 17 of them, and held the same proportion of

Faculty outside of EEd groups unanimously agreed that *implementing curriculum changes and updates across engineering departments* should not be a role for an EEd group. This is to be expected as traditional engineering departments own their own curriculum. However, EEd group members could be called upon on matters of engineering curricula if the EEd group was structured to do so as in an embedded model.

4.1 Mismatches

Mismatches between the two subgroups are to be expected, as the OutEEd group cannot be expected to know the entire scope of the EEd group's roles and responsibilities at an institution. The prevalence of some large gaps in agreement as discussed above, and the frequency of the mismatches, indicates that there is a trend of non-agreement between the two faculty groups. Even within the InEEd group there are internal mismatches- perhaps due to the number of different styles of EEd group that were represented in the participants. If an EEd group is a full department as compared to an interdisciplinary task force, the roles and the perceptions of the roles they own would be different.

This confusion is also mirrored in how engineering education *departments* are in a bit of an identity crisis-- should they look like a standard engineering department? Do they add to typical engineering departments' tenure requirements the additional roles like running First Year Engineering, championing DEI across the college, or coordinating disparate engineering education research projects around the University? Do they act as a support office---but focused on students' outcomes, or faculties?

4.2 Limitations

There is a limitation in comparing paired results from EED faculty to outside-EED faculty from the same institution in the survey. Due to IRB privacy considerations, the survey does not take down the name of the institution. A subsequent limitation of this work is the inability to verify faculty members' responses. For the faculty outside of the Engineering Education group, whether they correctly identified the department style or roles and responsibilities could not be externally validated.

There was no universal agreement on a role being included or excluded from the two groups. However, this could be a form of confirmation bias coming through that it was expected from an EEd group. Proposing this question as an open format in a future interview would create a more grounded response to avoid some of this bias.

4.3 Conclusions

These preliminary results show that there is a gap in agreement both within and outside of EEd group faculty on what the designated roles and responsibilities of an engineering education group are. A factor that most likely influences this misalignment is the structure of the engineering education group at a particular institution. The next steps in this work are to gather more data so that responses can be broken out by EEd group structure to analyze if this offers any clarity.

Engineering education has been going through a series of rapid changes over the past century [6] and the emergence of Engineering Education as a field of research [7] is still in its adolescence. This pilot study signals a misalignment amongst and about EEd groups regarding their roles and responsibilities, and what they should be in the future. The direction for future research is to investigate how the EEd group structure and institutional ecosystem can influence faculty's perceptions both within and outside of an EEd group.

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