

Work in Progress: Who Are Graduate Program Directors and What Are Their Roles in Healing within Graduate Engineering Education?

Ms. Mais Kayyali, Florida International University

Mais Kayyali is the Associate Director of Academic Support Services in the Office of the Dean at Florida International University's (FIU) College of Engineering and Computing (CEC). In her current role, she oversees all aspects of Graduate Education and Admissions for the schools and departments under CEC. Her duties vary from admissions, recruitment, marketing, data analysis, graduate funding, etc. She also provides administrative support to the Associate Dean for Academic Affairs. Prior to her current position, she was the Program Coordinator/Coordinator of Administrative Services at the Department of Electrical and Computer Engineering (ECE) and prior to that the Program Assistant at the Department of Civil and Environmental Engineering (CEE) at the college. Mais holds a Bachelor's degree in Finance, Master's degree in Hospitality Management, and is currently a doctoral student in the Engineering and Computing Education program at FIU. Her research interests are in graduate and postdoctoral education with a focus on mentorship and transitions as well as faculty development and the use of technology in engineering and computing education.

Mr. Derrick James Satterfield, University of Nevada, Reno

Derrick Satterfield is a doctoral candidate in Engineering Education at the University of Nevada, Reno. His research focuses on engineering graduate students' experiences and motivation centered on career planning and preparation.

Dr. Adam Kirn, University of Nevada, Reno

Adam Kirn is an Associate Professor of Engineering Education at University of Nevada, Reno. His research focuses on the interactions between engineering cultures, student motivation, and their learning experiences. His projects involve the study of student

Dr. Alexandra Coso Strong, Florida International University

As an assistant professor of engineering education at Florida International University, Dr. Alexandra Coso Strong works and teaches at the intersection of engineering education, faculty development, and complex systems design. Alexandra completed her graduate degrees in Aerospace Engineering from Georgia Tech (PhD) and Systems Engineering from the University of Virginia (UVa). Prior to attending Georgia Tech, Alexandra received a bachelor's degree in aerospace engineering from MIT and a master's degree in systems engineering from the University of Virginia. Alexandra comes to FIU after completing a post-doctoral fellowship at Georgia Tech's Center for the Enhancement of Teaching and Learning (CETL) and three years as a faculty member at Olin College of Engineering in Massachusetts. Alexandra's research aims to amplify the voices and work of students, educators, and Minority-Serving Institutions (MSIs) overall and support continued educational innovation within engineering at these institutions. Specifically, she focuses on (1) educational and professional development of graduate students and faculty, (2) critical transitions in education and career pathways, and (3) design as central to educational and global change.

WIP: Who are Graduate Program Directors and What are their Roles in Healing within Graduate Engineering Education

Abstract

This Work in Progress (WIP) paper proposes a synthesis of available literature to (1) define the roles and responsibilities of Graduate Program Directors (GPD) in engineering education and (2) examine how GPDs are incorporating trauma-informed frameworks of care to promote healing within their academic departments. Whether it is in response to the propagation of the mental health crisis or the widespread inequities and discrimination within engineering graduate programs, the graduate engineering education community needs to take targeted action to create systemic change and healing from standing systemic issues. Within many programs graduate program faculty administrators, also called GPDs, serve as potential change agents at the departmental level and act as liaisons between the academic unit and other parties that are inside and outside of the programs they serve. These individuals are in positions to improve and create new programmatic structures that could address graduate student needs.

While GPDs play an important role in the management of graduate programs, research in graduate engineering education has focused mostly on student experiences, advisors, or departmental policies. With little attention given to GPDs, there is no clear definition of their roles and responsibilities, the necessary support they need, or requested opportunities for professional development to help perform their expected duties. Considering the positions of power GPDs hold, they are central to improving and sustaining graduate students' mental health, well-being, and healing from systemic inequities by creating environments that prioritize the graduate student as a person.

As such, in this WIP, a scoping literature review was conducted using an adapted version of Arksey and O'Malley's five-stage approach of knowledge synthesis to identify trends and gaps to accomplish the goal of defining GPD roles, responsibilities, and approaches taken to promote healing using trauma-informed frameworks of care. In brief, the five stages were: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing and reporting the result. By defining GPDs' roles and responsibilities as well as understanding their position as stakeholders who impact and are impacted by graduate students' mental health and well-being, we can push for programmatic change and inform the development of methods to train GPDs to implement evidence-based healing practices to support engineering graduate students.

Keywords: Graduate education, Graduate program director, Graduate program director role, Higher education administration, Trauma-informed care

Introduction

This Work in Progress (WIP) paper proposes a synthesis of available literature to (1) define the roles and responsibilities of Graduate Program Directors (GPD) in engineering education and (2) examine how GPDs are incorporating trauma-informed frameworks of care to promote healing within their academic departments.

Research on engineering graduate education has shown that 40% of students have anxiety and depression, compared to 20% in the general population [1]. Furthermore, engineering graduate education has been found to be exclusive and inequitable for traditionally underserved students, with 16% of students citing discrimination from their primary advisor [2], despite the importance of this relationship for underserved students [3], [4] and especially for those with intersectional identities [5]. Without addressing the structural and inequitable failings of the graduate education system, the prevalence of role models and diversity within the student population are in jeopardy.

Whether it is in response to the propagation of the mental health crisis or the widespread inequities and discrimination within engineering graduate programs, the graduate engineering education community needs to take targeted action to create systemic change and healing from standing systemic issues. To make strides toward this systematic change, one opportunity comes from leveraging the power of those in administrative positions related to graduate education. Within many programs, the emergence of graduate program faculty administrators, also called GPDs, typically serve as key administrators at the departmental level and act as liaisons between the academic unit and other parties that are inside and outside of the programs they serve. These GPDs have been identified in a survey, as the individuals whom most graduate schools share information with about campus activities and resources aimed at supporting graduate students' mental health and well-being [6]. Therefore, these administrators are in positions which enable them to shape their department's culture, establish policies, and improve and/or create new programmatic structures that could address graduate students' needs [6].

Objective

While GPDs play an important role in the management of graduate programs, research in graduate engineering education has focused mostly on student experiences, advisors, and departmental policies e.g., [7]–[18]. With little attention given to GPDs, there is no clear definition of their roles and responsibilities, the support they need, or requested opportunities for professional development to help perform their expected duties. Considering the positions of power GPDs hold, they are central to improving and sustaining graduate students' mental health, well-being [6], and healing from systemic inequities [19]–[22] by creating environments that prioritize the graduate student as a person.

Therefore, this WIP paper proposes a synthesis of available literature to answer the following research questions:

- (1) What are the roles and responsibilities of GPDs in engineering education?

(2) How are GPDs incorporating trauma-informed frameworks of care to promote healing within their academic departments?

By synthesizing definitions of GPDs' roles and responsibilities as well as understanding their position as stakeholders who impact and are impacted by graduate students' mental health and well-being, we can push for programmatic change and inform the development of methods to train GPDs to implement evidence-based healing practices to support engineering graduate students.

Methodology

In this WIP, a scoping literature review was conducted using an adapted version of Arksey and O'Malley's [23] five-stage approach of knowledge synthesis to identify research gaps in the existing literature regarding the definition of GPD roles, responsibilities, and approaches taken to promote healing using trauma-informed frameworks of care. Scoping reviews enable researchers to broadly map complex topics where many alternative study designs may be appropriate [23]. In brief, the five stages we followed were: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing, and reporting the results [23]. Refer to Table 1 below for a description of each stage in the framework.

Table 1. Summary of Arksey and O'Malley Scoping Review Framework [23]

Framework Stage	Description
1. Identifying the research question	Determine the research question to be addressed, since this will influence the development of search approaches.
2. Identifying relevant studies	This stage entails selecting the relevant studies and creating a strategy for where to search, what terms to use, what sources to search, time range, and what language to use.
3. Study selection	Post hoc inclusion and exclusion criteria are used in the selection of studies. These standards are based on the particulars of the research question and on new knowledge gained from reading the studies.
4. Charting the data	Data from each research is extracted using a form designed for data charting. The contextual or process-oriented information from each research is extracted using a narrative review or descriptive analytical approach.
5. Collating, summarizing, reporting results	An overview of the depth of the literature is presented using an analytical framework or thematic construction, but not a synthesis. Using tables and figures, a numerical analysis of the scope and type of studies is given. Then, a thematic analysis is provided.

Stage 1. Identifying the research questions

In the first stage, Arksey and O'Malley [23] explain how it is critical to consider which components of the research question are especially significant, such as the study population. Therefore, defining engineering specific GPD roles, responsibilities, and approaches taken to promote healing using trauma-informed frameworks of care was identified as the area of interest for the scoping review. The research questions addressed are highlighted above in the Objective section.

Stage 2. Identifying relevant studies

The second stage of the Arksey and O'Malley's [23] framework focuses on identifying relevant literature, as guided by the research questions and purpose of the study. As such, multiple literature searches were conducted utilizing different sources. We initially identified three electronic databases to use to capture literature within education, engineering, and engineering education:

- Education database - *ERIC (ProQuest)*: This database is sponsored by the U.S. Department of Education to provide extensive access to education-related literature; ERIC provides coverage of journal articles, conferences, meetings, government documents, theses, dissertations, reports, audiovisual media, bibliographies, directories, books and monographs.
- Engineering database - *Compendex & Inspec (Engineering Village)*: 1884 - Current; Indexes 2,600+ international scholarly and trade journals and conference proceedings in all aspects of engineering. Compendex is Elsevier's flagship engineering-focused database that provides comprehensive and trustworthy content to improve research outcomes and maximize the impact of your engineering research.
- Engineering Education database - *Papers on Engineering Education Repository (PEER)*: This is the American Society for Engineering Education (ASEE) conference proceedings database.

For the first two databases, to ensure populated results were adequate in achieving the scoping review's goal, a search strategy was performed on subject, title, and abstract using the following keyword "Graduate Program Director," to maximize the relevance of our search results. We then separated the search term with AND, in order to also include and thus narrow our search to "engineering." We added additional limits to the search which included using English as the language and limiting the search to a specific time range; literature published after 01/01/2013 and before 12/31/2022. Furthermore, we determined that conference papers & proceedings and scholarly journals would be the most effective source/document types to answer the research questions as they are some of the most widely utilized resources by the engineering community. For the last database, it was specific to engineering and limited to conference proceedings, we searched for "Graduate Program Director" everywhere over the past 10 years. We used well-matched quotation marks to demarcate the phrase. Table 2 highlights the initial search results for each of the above-mentioned electronic databases. The above search procedures were discussed with a university librarian to ensure alignment with best practices.

While suggestions were provided for additional search terms, our consultation with the librarian indicated alignment with best practices.

Table 2. Electronic Database Search Results for Graduate Program Directors

Database	Terms used for search	Source/ Document type	Results	Include	Exclude
ERIC (ProQuest)	subject,title,abstract (graduate program director AND engineering)	Conference Papers & Proceedings	1	X	
	Additional limits - Date: From January 01 2013 to December 31 2022; Language: English	Scholarly Journals	1	X	
Compendex & Inspec (Engineering Village)*	((graduate program director AND engineering)	Book (BK)	1		X
		Book chapter (CH)	1		X
	Compendex & Inspec for 2013-2022: ((graduate program director AND engineering) WN KY) AND (English WN LA)	Conference article (CA)	48	X	
		Journal article (JA)	26	X	
		Erratum (ER)	2		X
Papers on Engineering Education Repository (PEER)	Looked for "graduate program director" Published after 01/01/2013 & Published before 12/31/2022	Conference Proceedings	70	X	

**Results do not include duplicate records removed before screening (Engineering Village Database, n = 10)*

Stage 3. Study selection

In the study selection stage, post-hoc inclusion and exclusion criteria were used. The titles and abstracts of the identified literature were reviewed for eligibility based on the following criteria: (1) graduate engineering education contexts; (2) published in journals or conference proceedings over the past 10 years; (3) published in the English language. Exclusion of undergraduate programs and non-engineering programs allowed us to focus on scoping our search. The literature was stored for evaluation of the abstract or the subsequent level of inspection in the review process if the researcher was unclear whether to include a document based only on the title. The final step for the identified results was to read the full text if titles and abstracts were not sufficient in the appraisal of the literature. The inclusion and exclusion criteria for determining an acceptable review are listed below in Table 3 for each database.

Table 3. Inclusion and Exclusion Criteria for Databases

ALL Databases	<i>ERIC</i> (ProQuest)	<i>Compendex & Inspec</i> (Engineering Village)	<i>Papers on Engineering Education Repository</i> (PEER)
Language in English	Advanced search Graduate Program Director AND engineering in Subject/Title/Abstract	Quick search for Graduate Program Director AND engineering in Subject/Title/Abstract	Looked for “graduate program director”
Published after 2013 and before 2022	Excluded duplicate documents	Removed duplicates (Compendex database preferred)	No duplicates were found

Figure 1 displays the findings of database searches and reviews of chosen literature that resulted in the 160 articles plotted for final analysis. A PRISMA flow chart was used to help illustrate the screening process used in this scoping review, which also included the inclusion and exclusion of papers at each stage of the screening process [24].

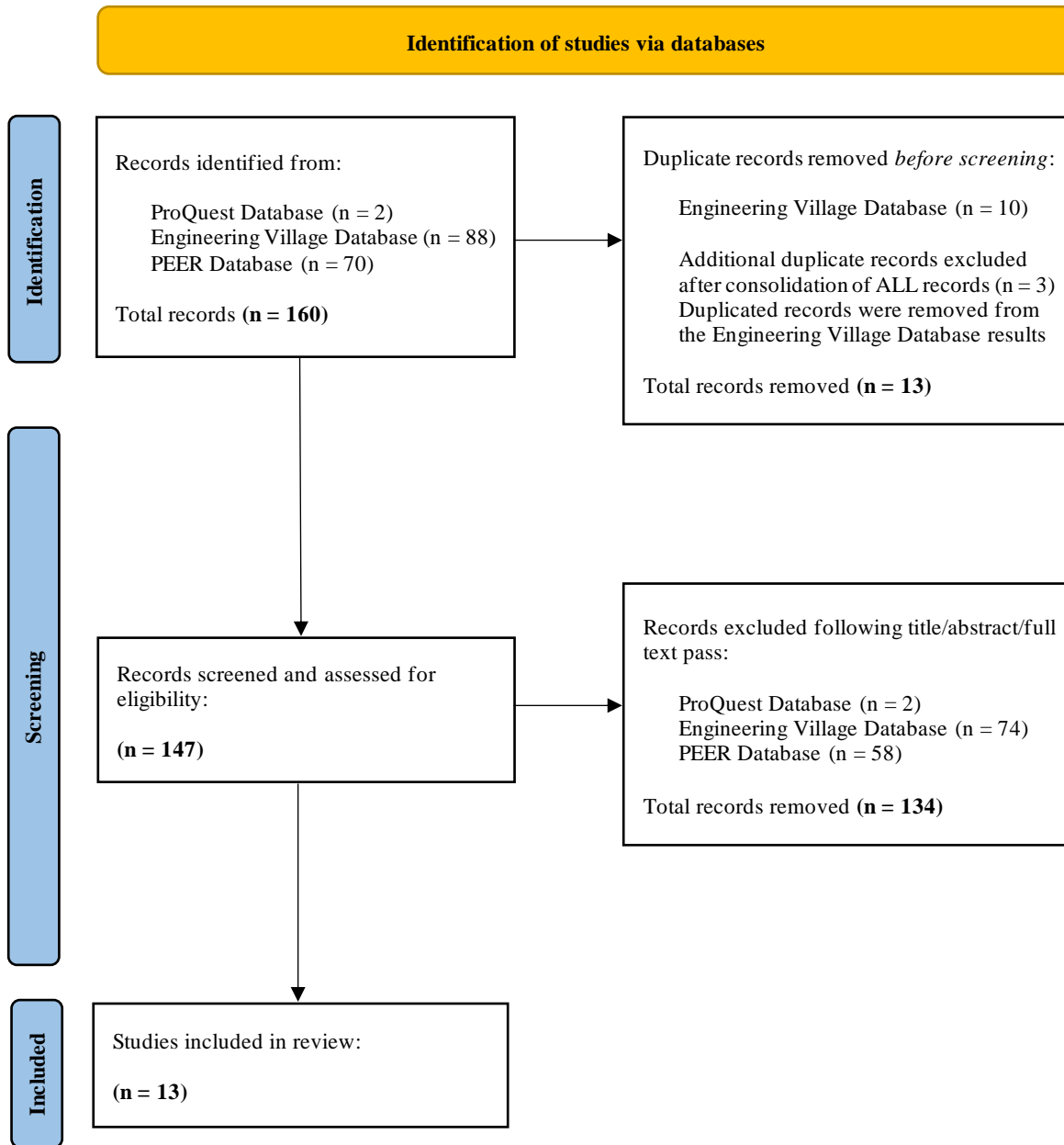


Figure 1. Scoping Review Selection of Studies using PRISMA 2020 Flow Diagram [24]

Stage 4. Charting the data

For convenience of review and record keeping, all literature was collected, downloaded from the databases, and maintained in an electronic format. We consolidated all instances of a particular record into only one result for each database. You will find a list of the identified 150 records from each database in the appendix (includes duplicate records prior to consolidation of ALL records). To enable the synthesis of data and the interpretation of results, a data charting table was created in an Excel spreadsheet and then one of the researchers charted a list of information extracted from each identified document according to the following criteria:

author/s, publication date, document type, purpose, study design/methods/sample, and outcomes or conclusions.

Stage 5. Collating, summarizing, reporting results

There were 90 papers identified from the first two databases that included “graduate program director” and “engineering” as search terms in the title/abstract/subject and 70 identified results in the last database that searched specifically for “graduate program director” in all fields. In the screening phase, a total of 147 were screened and 134 excluded following inclusion/exclusion criteria which included the title and abstract review and a skim of the full text when needed, thus leaving 13 records for analysis.

Before fully addressing RQ1, we note a significant gap identified in this WIP scoping literature review. The lack of literature using the term “graduate program director” indicates the GPD position is not well defined within engineering literature. Further, results did not indicate other dominant terminology to describe this position. Throughout the review, our search results did not populate literature that specifically studied this population within engineering graduate contexts. In some of the literature, these individuals were referred to as “graduate faculty.” This implies that these roles may not be formally defined or existent in all engineering graduate programs. In one of the included papers in this scoping literature review, which explored the challenges in developing and offering interdisciplinary programs, it was explained that since there were no existing program faculty in these areas and because there were no departmental structures in place, new processes had to be established for the review and action on graduate applications [25]. As such, dedicated staff who did not have graduate program director titles were tasked with providing the majority of advising to students regardless of their discipline, and served as liaisons as they helped students navigate information related to program details, frequently asked questions and answers, etc. [25].

In addressing RQ1, we shift to papers that specifically used the title “graduate program director.” The key findings in answering this research question are that most papers did not clearly define these GPD roles and responsibilities nor was that the purpose of the paper. This illustrates the gap that exists in understanding this population of graduate faculty in engineering. Of the 13 papers that did examine or mention GPDs, their roles often fell into two categories. These two categories are administrative and student-centric support. In the first category of administrative responsibilities, papers specifically discussed reviewing applications and recommending admissions to the program [26], maintaining an informal support network of faculty and staff for students [27], and administrative and program planning [28]. The second category was student-centric responsibilities. The papers that fell under this category specifically outlined GPD roles as providing insights and resources for graduate studies and academics [28]–[30]; career advising, mentoring, and conflict resolution [28], [31], [32]; and sharing of program level or external opportunities for career advancement and research participation [33]–[35]. From the variety of responsibilities that these GPDs can enact, results reaffirm that these faculty have power to speak on behalf of the department or program they oversee and act as liaisons between graduate students, faculty, and other parties within the institution. Within the literature reviewed, Douglas and colleagues [28] indicate that while these graduate faculty or GPDs sit in positions of leadership and hold power, they lack the knowledge and confidence to mentor and are not

prepared to take on these ill-defined roles and responsibilities. A limitation in the literature is the interchangeable use of the phrases mentoring and advising, which could explain why a GPD title is sometimes synonymous with graduate advisor.

Shifting to RQ2, as previously discussed in [25], GPDs may not exist within all graduate programs, nor are these roles formally defined in many programs. Meaning that these roles and responsibilities are either potentially handled by staff members within the graduate program or by individual faculty advisors. As such, it was difficult to examine how GPDs are incorporating trauma-informed frameworks of care to promote healing within their academic departments. In our scoping literature review, none of the papers addressed trauma-informed frameworks of care or mentioned healing within graduate contexts. Again, this might be due to the role ambiguity and lack of preparedness that were addressed previously, but also the culture of doing [28]. Culture of doing highlights how the science identity is based on doing; necessitating less focus on the individual and more focus on the task (doing) [28]. We do note two papers that focused on GPDs enactment of their role related to students' development and well-being and thus unpack these results in brief. Across these two papers, the focus was on student productivity as an outcome of programmatic practices. The first study by Douglas et al. [28] included three GPDs and their descriptions of the practices they enact. The key finding was that their major responsibility was to produce scientists [28]. When talking about their students, participants in this study mentioned keeping students on track so that they graduate on time, and that students are employees that should be able to work autonomously with little instruction from them. This perspective indicates efforts that focus only on student growth in terms of completing a task. Conversely, Feil-seifer and colleagues [36] examined faculty and graduate student attitudes on stress and mental health and demonstrated how faculty seem to address stress and mental health with the primary objective of sustaining productivity. Personal experiences seemed to strongly influence how faculty evaluate mental health and stress in graduate programs, with productivity being used as the main criterion by them to examine students' mental health experiences that mostly aligns with theirs [36]. Considering the diversity of faculty experiences with mental health, this framing may limit care-focused practices for many students. While some GPDs demonstrated potential for expanding how they understand mental health, many still delegate the responsibility for assisting students in managing stress and mental health to university organizations [36].

Limitations and Implications for Further Research

Limitations of the scoping review should be taken into account when evaluating search results, summarizing findings, and drawing conclusions. While Arksey and O'Malley [23] emphasized the need of using a team-based approach in scoping review technique, Levac et al. [37] particularly argued that teams be explicitly incorporated into the methodology as a means of providing content expertise [38]. With that said, in this scoping review, one researcher handled the majority of the literature search and extraction for this scoping literature review. Discussion with the broader graduate education research would improve the literature for inclusion through methods such as snowball sampling (e.g., chain-referral to track down references to identify new papers). Another possible limitation of our scoping review is that important studies may have been overlooked since we excluded alternate words that may have been used to address GPDs. The scope of the evaluation was also confined to engineering and three databases.

As such, it may be beneficial in future work to expand the search terms to include “director” or “graduate advisor” to help generate more results that we can filter through. Not to mention, broadening the review to include other types of literature such as books and other fields which may include science, technology, mathematics, education, etc. might also help us expand our search. Finally, to allow us to have a more thorough picture of these GPD roles, responsibilities and practices in engineering, next steps will focus on the last optional stage outlined in the Arksey and O’Malley’s [23] scoping review framework, which involves expert consultation on the literature review synthesis. Therefore, future work will interview content experts within the field of engineering education as means to help us expand our search, adding any additional citations that the content experts direct us to, and the reference lists of the identified literature will be reviewed to allow us to search for new literature to review. The reference lists will be reviewed until saturation of relevant data is reached. After that, the literature will be checked for inclusion, recorded, and sorted so that it can be used for the final appraisal of the scoping review. This approach will pave the way for our future work which will focus on addressing the second research question of the study.

Conclusions

Our goal through this preliminary scoping literature review and future work was to outline a foundation to push for programmatic change and inform the development of methods to train a community of GPDs to implement evidence-based care practices that enables us to better support engineering graduate students. However, results indicated that there is not a literature-based foundation for this work. There is not a consistent set of terms or definitions used to describe the faculty who serve as leaders for graduate programs. Further, of the limited literature that does exist, results indicated that inconsistent definitions, expectations, and training for the role led to confusion and reduced confidence of graduate faculty. Overall, the results of this scoping review indicate the need to generate a shared definition by the engineering community and develop training to foster the uptake of practices to support student well-being.

References

- [1] D. Evans, G. A. Borriello, and A. P. Field, "A Review of the Academic and Psychological Impact of the Transition to Secondary Education," *Frontiers in Psychology*, vol. 9, 2018.
- [2] M. Bahnson, D. J. Satterfield, and A. Kirn, "Students' Experiences of Unfairness in Graduate Engineering Education," presented at the 2021 CoNECD, Jan. 2021. Accessed: Feb. 12, 2023. [Online]. Available: <https://peer.asee.org/students-experiences-of-unfairness-in-graduate-engineering-education>
- [3] B. A. Burt, K. L. Williams, and W. A. Smith, "Into the Storm: Ecological and Sociological Impediments to Black Males' Persistence in Engineering Graduate Programs," *American Educational Research Journal*, vol. 55, no. 5, pp. 965–1006, Oct. 2018, doi: 10.3102/0002831218763587.
- [4] B. A. Burt, K. L. Williams, and G. J. M. Palmer, "It Takes a Village: The Role of Emic and Etic Adaptive Strengths in the Persistence of Black Men in Engineering Graduate Programs," *American Educational Research Journal*, vol. 56, no. 1, pp. 39–74, Feb. 2019, doi: 10.3102/0002831218789595.
- [5] M. Bahnson, E. C. Hope, D. Satterfield, M. Wyer, and A. Kirn, "Development and initial validation of the Discrimination in Engineering Graduate Education (DEGrE) Scale.," *Journal of Diversity in Higher Education*, Jul. 2022, doi: 10.1037/dhe0000429.
- [6] Council of Graduate Schools, & The Jed Foundation, "Supporting graduate student mental health and well-being: Evidence-informed recommendations for the graduate community." Council of Graduate Schools, 2021.
- [7] M. S. Artiles, D. B. Knight, and H. M. Matusovich, "Doctoral advisor selection processes in science, math, and engineering programs in the United States," *International Journal of STEM Education*, vol. 10, no. 1, p. 6, Jan. 2023, doi: 10.1186/s40594-022-00392-6.
- [8] M. S. Artiles and H. M. Matusovich, "Examining Doctoral Degree Attrition Rates: Using Expectancy-Value Theory to Compare Student Values and Faculty Supports," vol. 36, no. 3, pp. 1071–1081, 2020.
- [9] M. S. Artiles and H. M. Matusovich, "Doctoral Advisor Selection in Chemical Engineering: Evaluating Two Programs through Principal-Agent Theory," vol. 2, no. 2, pp. 120–140, Feb. 2022, doi: 10.21061/see.57.
- [10] S. Baker, P. Tancred, and S. Whitesides, "Gender and Graduate School: Engineering Students Confront Life after the B. Eng.," *Journal of Engineering Education*, vol. 91, no. 1, pp. 41–47, 2002, doi: 10.1002/j.2168-9830.2002.tb00671.x.
- [11] C. G. P. Berdanier, C. Whitehair, A. Kirn, and D. Satterfield, "Analysis of social media forums to elicit narratives of graduate engineering student attrition," *Journal of Engineering Education*, vol. 109, no. 1, pp. 125–147, 2020, doi: 10.1002/jee.20299.
- [12] S. J. Bork and J.-L. Mondisa, "Engineering graduate students' mental health: A scoping literature review," *Journal of Engineering Education*, vol. 111, no. 3, pp. 665–702, 2022, doi: 10.1002/jee.20465.
- [13] Council of Graduate Schools, "Completion and Attrition in STEM Master's Programs: Pilot Study Findings." Council of Graduate Schools, 2013.
- [14] G. C. Fleming *et al.*, "The fallacy of 'there are no candidates': Institutional pathways of Black/African American and Hispanic/Latino doctorate earners," *Journal of Engineering Education*, vol. 112, no. 1, pp. 170–194, 2023, doi: 10.1002/jee.20491.

- [15] E. Hocker, E. Zerbe, and C. G. P. Berdanier, "Characterizing Doctoral Engineering Student Socialization: Narratives of Mental Health, Decisions to Persist, and Consideration of Career Trajectories," in *2019 IEEE Frontiers in Education Conference (FIE)*, Oct. 2019, pp. 1–7. doi: 10.1109/FIE43999.2019.9028438.
- [16] S. L. Rodriguez, R. J. Perez, and J. M. Schulz, "How STEM lab settings influence graduate school socialization and climate for students of color," *Journal of Diversity in Higher Education*, vol. 15, pp. 58–72, 2022, doi: 10.1037/dhe0000361.
- [17] A. Wofford, "Inequitable Interactions: A Critical Quantitative Analysis of Mentorship and Psychosocial Development Within Computing Graduate School Pathways," *AERA Open*, vol. 9, 2023, Accessed: Feb. 13, 2023. [Online]. Available: <https://journals.sagepub.com/doi/full/10.1177/23328584221143097>
- [18] E. Zerbe, G. M. Sallai, K. Shanachilubwa, and C. G. P. Berdanier, "Engineering graduate students' critical events as catalysts of attrition," *Journal of Engineering Education*, vol. 111, no. 4, pp. 868–888, 2022, doi: 10.1002/jee.20481.
- [19] R. E. Anderson and H. C. Stevenson, "RECASTing racial stress and trauma: Theorizing the healing potential of racial socialization in families.," *American Psychologist*, vol. 74, no. 1, pp. 63–75, Jan. 2019, doi: 10.1037/amp0000392.
- [20] J. Carello and L. D. Butler, "Practicing What We Teach: Trauma-Informed Educational Practice," *Journal of Teaching in Social Work*, vol. 35, no. 3, pp. 262–278, May 2015, doi: 10.1080/08841233.2015.1030059.
- [21] N. Y. Chavez-Dueñas, H. Y. Adames, J. G. Perez-Chavez, and S. P. Salas, "Healing ethno-racial trauma in Latinx immigrant communities: Cultivating hope, resistance, and action.," *American Psychologist*, vol. 74, no. 1, pp. 49–62, Jan. 2019, doi: 10.1037/amp0000289.
- [22] S. Ginwright, "The Future of Healing: Shifting From Trauma Informed Care to Healing Centered Engagement," *Medium*, 2018. <https://ginwright.medium.com/the-future-of-healing-shifting-from-trauma-informed-care-to-healing-centered-engagement-634f557ce69c> (accessed Feb. 24, 2023).
- [23] H. Arksey and L. O'Malley, "Scoping studies: towards a methodological framework," *International Journal of Social Research Methodology*, vol. 8, no. 1, pp. 19–32, Feb. 2005, doi: 10.1080/1364557032000119616.
- [24] M. J. Page *et al.*, "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," *BMJ*, vol. 372, p. n71, Mar. 2021, doi: 10.1136/bmj.n71.
- [25] E. Rutz, "Adaptable and Agile - Programs to Meet Emerging Workforce Needs," presented at the 2019 ASEE Annual Conference & Exposition, Jun. 2019. Accessed: Feb. 12, 2023. [Online]. Available: <https://peer.asee.org/adaptable-and-agile-programs-to-meet-emerging-workforce-needs>
- [26] S. Barker and A. Clobes, "Work in Progress: A Holistic PhD Admissions Rubric--Design & Implementation," presented at the 2021 ASEE Virtual Annual Conference Content Access, Jul. 2021. Accessed: Feb. 12, 2023. [Online]. Available: <https://peer.asee.org/work-in-progress-a-holistic-phd-admissions-rubric-design-implementation>
- [27] M. and Gumpertz, "An Institutional Transformation Model to Increase Minority STEM Doctoral Student Success," *2019 CoNECD - The Collaborative Network for Engineering and Computing Diversity*, Apr. 2019, Accessed: Feb. 12, 2023. [Online]. Available: <https://par.nsf.gov/biblio/10098657-institutional-transformation-model-increase-minority-stem-doctoral-student-success>

- [28] N. and Douglas, C. Howell, L. Merriweather, and A. Sanczyk, "Mentoring is not created equal: Doctoral STEM faculty perceptions of mentoring and implications for underrepresented STEM learners.," *CoNECD - Collaborative Network for Computing and Engineering Diversity - Conference*, Jan. 2021, Accessed: Feb. 12, 2023. [Online]. Available: <https://par.nsf.gov/biblio/10221624-mentoring-created-equal-doctoral-stem-faculty-perceptions-mentoring-implications-underrepresented-stem-learners>
- [29] B. Bond-Tritto, N. Kumar, S. Secules, and T. Solis, "Future Career Pathway Perceptions of Lower-Income Computing Students Through the Lens of Capital Exchange," presented at the 2022 ASEE Annual Conference & Exposition, Aug. 2022. Accessed: Feb. 12, 2023. [Online]. Available: <https://peer.asee.org/future-career-pathway-perceptions-of-lower-income-computing-students-through-the-lens-of-capital-exchange>
- [30] M. Cousins, M. K. Markey, and H. G. Rylander, "Graduate Internship/Externship Experiences in NIBIB Funded Graduate Training Programs," presented at the 2014 ASEE Annual Conference & Exposition, Jun. 2014, p. 24.650.1-24.650.16. Accessed: Feb. 12, 2023. [Online]. Available: <https://peer.asee.org/graduate-internship-externship-experiences-in-nibib-funded-graduate-training-programs>
- [31] N. Barr, "Extending WID to Train Mechanical Engineering GTAs to Evaluate Student Writing," in *2016 ASEE Annual Conference & Exposition Proceedings*, New Orleans, Louisiana: ASEE Conferences, Jun. 2016, p. 26873. doi: 10.18260/p.26873.
- [32] R. G. Tull, M. A. Nino, and K. M. Holmes, "Building a Community of Practice Among STEM Graduate Students to Foster Academic and Professional Success," presented at the 2014 ASEE Annual Conference & Exposition, Jun. 2014, p. 24.237.1-24.237.12. Accessed: Feb. 12, 2023. [Online]. Available: <https://peer.asee.org/building-a-community-of-practice-among-stem-graduate-students-to-foster-academic-and-professional-success>
- [33] M. Bahnsen, D. Satterfield, M. Wyer, and A. Kirn, "Interacting with Ruling Relations: Engineering Graduate Student Experiences of Discrimination," *Studies in Engineering Education*, vol. 3, no. 1, Art. no. 1, Jul. 2022, doi: 10.21061/see.76.
- [34] E. L. Ingram, R. M. Ellestad, C. Hixson, and J. M. Williams, "Why We Failed: Barriers to Participation, Management, and Sustainability of an Immersive Faculty Experience Supporting Graduate Student Professional Development," *2021 ASEE Virtual Annual Conference Content Access*, Jul. 2021, Accessed: Feb. 12, 2023. [Online]. Available: <https://par.nsf.gov/biblio/10326878-why-we-failed-barriers-participation-management-sustainability-immersive-faculty-experience-supporting-graduate-student-professional-development>
- [35] E. J. Stewart, J. G. Younger, and M. J. Solomon, "Impact of a Graduate Elective in Microbial Soft Matter on Interdisciplinary Learning," presented at the 2014 ASEE Annual Conference & Exposition, Jun. 2014, p. 24.692.1-24.692.14. Accessed: Feb. 12, 2023. [Online]. Available: <https://peer.asee.org/impact-of-a-graduate-elective-in-microbial-soft-matter-on-interdisciplinary-learning>
- [36] D. Feil-Seifer, M. Parker, and A. Kirn, "Examining Faculty and Graduate Student Attitudes on Stress and Mental Health," presented at the 2022 ASEE Annual Conference & Exposition, Aug. 2022. Accessed: Feb. 12, 2023. [Online]. Available: <https://strategy.asee.org/examining-faculty-and-graduate-student-attitudes-on-stress-and-mental-health>

- [37] D. Levac, H. Colquhoun, and K. K. O'Brien, "Scoping studies: advancing the methodology," *Implementation Sci*, vol. 5, no. 1, p. 69, Sep. 2010, doi: 10.1186/1748-5908-5-69.
- [38] K. K. Westphaln *et al.*, "From Arksey and O'Malley and Beyond: Customizations to enhance a team-based, mixed approach to scoping review methodology," *MethodsX*, vol. 8, p. 101375, Jan. 2021, doi: 10.1016/j.mex.2021.101375.

Appendix

Database	Document Title	Author Names
ProQuest	Work-Integrated Learning Competencies: A Case Study in a Food Engineering Practice School Program	Ruayruay, Ekarut;Kirtikara, Krissanapong;Nopharatana, Montira;Chomsuwan, Komkrit;Suwannathep, Sasitorn
	Proceedings of the International Association for Development of the Information Society (IADIS) International Conference on e-Learning (Las Palmas de Gran Canaria, Spain, July 21-24, 2015)	
Engineering Village	Teaching Assistant Team in a Graduate-Level Engineering Course	Holmes, Philip Michael(1); Leng, Shuai(1); McCollough, Cynthia(1)
	Understanding Engineering Doctoral Preparation and Socialization through McNair Scholars Program Alumni	Shanachilubwa, Kanembe; Berdanier, Catherine G.P.; Sallai, Gabriella M.
	Improving graduate outcomes : Implementation of problem-based learning in TVET systems of Nigerian higher education	Okolie, U.C.(1); Elom, E.N.(2); Igwe, P.A.(3); Binuomote, M.O.(1); Nwajiuba, C.A.(4); Igu, N.C.N.(1)
	Diversity in research and engineering of advanced materials (DREAM) internship program	
	Living Testimonios: How Latinx Graduate Students Persist and Enact Social Justice Within Higher Education	Phillips, L.(1); Deleon, R.(1)
	Piloting an undergraduate engineering mentoring program to enhance gender diversity	Hart, Elizabeth(1); Mott, Andrea(1); Furterer, Sandra L.(1)
	State of Evaluating the Effectiveness of Teaching Development Programs for Students in Engineering	Agarwal, Jutshi(1); Khanamani, Samieh Askarian(1); Bucks, Gregory(1); Murphy, Teri J.(1)
	Using an embedded researcher approach to explore student outcomes and relationship development during an intensive engineering apprenticeship program (RTP)	Caldwell, Lori(1); Minichiello, Angela(1)

Engineering futures: Updating a successful professional development program to address new challenges	Luchini-Colbry, Katy(1); McComb, Christopher(2); Rojewski, Julie(1); Briliyanti, Astri(1); Colbry, Dirk Joel-Luchini(1)
Evaluation of curriculum quality in Architectural Academic Program, Case Study - Outcomes of Architectural Academic Program – (graduates Architects)	Rizco, N.J.(1); Yousif, S.Y.(1)
Tamuh: Implementing a graduate development scheme for fast tracking young professionals in petroleum development Oman	Lamki, Amal(1); Abri, Yaqoob(1); Al-Jumah, Ali(1); Mahruqi, Shabib(1)
Classroom instructors' perceptions of site leadership and interest outcomes within a summer engineering program (evaluation)	Fletcher, Trina L.(1); Ross, Monique S.(2); Carr, Christopher Alexander(3); Boyd, Brittany(3)
Impact of a computer programming support center on (chemical) engineering students' success and satisfaction	White, Jason R.(1)
ENGINEERING MANAGEMENT MASTERS PROGRAMS: ADMINISTRATIVE AND CURRICULAR STRUCTURE	Asgarpoor, Jena(1); Vanek, Gary Todd(2)
An academic template for graduate programs in Engineering and Technology Management (ETM)	Van Wyk, Rias J.(1); Gaynor, Gerard(1)
Seeds, the international post-graduate master program for space exploration	Viola, Nicole(1); Gargioli, Eugenio(2); Messidoro, Piero(2); Lizy-Destrez, Stéphanie(3); Escudier, Benedicte(3); Zenou, Emmanuel(3); Ambrosi, Richard(4); Bannister, Nigel(2); Hutchinson, Ian(4); Williams, Hugo(5); Saccoccia, Giorgio(2)
Work in progress: The construction of a new first-year engineering program	Ricco, George D.(1); Lump, Janet K.(1)
First Year Experience from RET Site: High School Teacher Experience in Engineering Design and Manufacturing	Zhu, Weihang; Hernandez, Francisco Robles; El Nahas,

	Medhat; Basaran, Burak; Alba, Kamran
The Pransky interview: Dr. Hugh Herr – Professor, MIT Media Lab; Director, Biomechatronics Group and Co-director, MIT Center for Extreme Bionics; Founder, BionX Medical Technologies Inc.	Pransky, Joanne(1)
Industrial and Mechanical Engineering Scholars with Scholarships, Career Mentoring, Outreach and Advisement, Professional Societies and Engineering Learning Community (SCOPE) S-STEM Program	Zhu, Weihang(1); Yoo, Julia(1); Curry, James C.(2); Craig, Brian(1); Zhou, Jiang(1); Chu, Hsing-Wei(1); Brake, Nicholas Andres(1)
What is the future of engineering technology?	Fox, Patricia(1); Sorge, Brandon(1); Gordon, Martin E.(2); Danielson, Scott(3); Land, Ronald(4); Richmond Nettey, I.(5); Perry, Thomas J.(6); Gaines, Kim W.(7); Irwin, John(8)
Assessing Impact of the Leadership Development Program during the COVID-19 Pandemic	DeRuntz, Bruce(1); Withee, Tom(3); Henson, Harvey(2)
Distance learning experience in a construction engineering program	Shadravan, Behnam(1); Anglade, Yves J.(2); Torruella, Keshia(3)
Engineering education, development and growth in Africa	Sheikheldin, G.(1); Nyichomba, B.(2)
Development of a new Biomedical Engineering Education Program at Institut Teknologi Bandung	Tjondronegoro, Suhartono(1); Soegijoko, Soegijardjo(1)
A mentoring workshop for an REU program	Barry, Carol(1); Alpert, Carol Lynn(2); Thate, Karine(2)
Graduate recruiting for emerging one-year professional master's programs	Mohr, Donna M.(1); Gross, Jennifer H.(1); Pearson, Raymond A.(1); Ochs, John B.(1); Alexandrescu, Ana-Iulia(1)
Am i a boss or a coach? Graduate students mentoring undergraduates in research	Tsai, Janet Y.(1); Kotys-Schwartz, Daria A.(2); Louie, Beverly(3); Ferguson, Virginia

	Lea(4); Berg, Alyssa Nicole(1)
Graduate internship/externship experiences in NIBIB funded graduate training programs	Cousins, Margo(1); Markey, Mia K.(2,3)
Lithium-Sulfur Batteries: Attaining the Critical Metrics	Bhargav, Amruth(1); He, Jiarui(1); Gupta, Abhay(1); Manthiram, Arumugam(1)
Work in Progress: A Holistic PhD Admissions Rubric-Design & Implementation	Barker, Shannon(1); Clobes, Amy(1)
Closing a theoretical-methodological gap in the internationalisation of engineering curricula	Fedorov, Andrei N.(1)
A comprehensive ASAP framework that uses career-steering/shaping projects to train engineering students develop critical life/professional skills : PPart II - Case studies from students working on funded projects	Rodriguez, Armando A.(1); Pradhan, Pragyan A.(2); Puttannaiah, Karan(2); Das, Nirangkush(2); Mondal, Kaustav(3); Sarkar, Aratrik(3); Sonawani, Shubham(2); Lu, Shi(2); Bui, Kimberly(3); Cederstrom, Charles(3); Christie, Carolyn(4); Giacometti, Zakk(4); Kurowski, Corey(4); Lopez, Nikki(4); Pedroza, Bryce(4); Rosenthal, Tanner(4); Sabet, Mohamed(4); Soni, Bhavica(4); Waggoner, Trae(4)
Starting from scratch: Incorporating communication instruction in a revised Mechanical Engineering curriculum	Barr, Nancy(1)
The AFRL scholars program: A STEM-based summer internship initiative	Spencer, Mark F.(1,2); Atencio, Imelda J.(1); McCullough, Julie A.(3); Hwang, Eunsook S.(1)
Post-secondary Work Integrated Learning Through STEM Outreach	Ross, Tracy L.(1); Romkey, Lisa(2)
Business process modeling: Case of undergraduate program	Zhukova, K.V.(1); Pleshkova, A.Yu.(2)
Expanding Access to and Participation in MIDFIELD (Year 6)	Lord, Susan M.(3); Ohland, Matthew W.(1); Orr, Marisa K.(3); Roy, Joe(2); Brawner,

	Catherine E.(3); Layton, Richard A.(3); Long, Russell Andrew(3); Osman, Hayaam(3)
Address the "alkalinity problem" in CO2 electrolysis with catalyst design and translation	Chen, Chubai(1,2); Li, Yifan(1,2); Yang, Peidong(1,2,3,4)
Oral history project of underrepresented leaders in science, technology, engineering, and mathematics (STEM)	Irvin, Kelsey Morgan(1); Hiteshue, Elizabeth(2); Lanzerotti, Mary Yvonne(3); Geselowitz, Michael(4)
Engineering achievement: An exploratory case study of minority engineering organization chapter activities	Yates, Nicole M.(1); Nagle, Barry(2)
Joseph G. Gavin, Jr. and MIT's contribution to aerospace in the Apollo era and beyond	Erickson, Andrew Sven(1,2)
ASCENT - A program designed to support STEM students through undergraduate research and mentoring	Das, Kumer Pial(1); Daniel, B.D.(1); Andrei, Stefan(1); Osborne, Lawrence Joseph(2)
Improving oral presentation in an electrical and computer engineering department: A four course study	Bousaba, Nabila A.(1); Conrad, James M.(2); Coco, Jean L.(2); Miri, Mehdi(2); Cox, Robert W.(3)
Diversity and the duke BME PhD program: Then, now and moving forward	Reichert, William M.(1)
Employer perceptions of undergraduate student entrepreneurial experience	Morehouse, Elizabeth Rose(1); James, Thomas P.(1)
Faculty Perspectives on Developing Interdisciplinary Computing Programs: Benefits, Necessary Supports, and Recommendations	Smith, Maureen; Carr, Valerie; Wei, Belle
Vertical lift aircraft design through the Georgia tech integrated product and process development approach for over the past 30 years	Schrage, Daniel(1)
The 2015 Asia-Pacific international symposium on electromagnetic compatibility	Wu, Tzong-Lin
Work-in-progress: Multidisciplinary vertically integrated projects course on 3D printed biomedical devices	Gale, Vy-Linh(1); Bill, Victoria(1); Si, Jessica(1)
Factors influencing participants' selection of individual REU sites	Economy, D.R.(1); Martin, J.P.(1); Kennedy, M.S.(1)

A framework for a hydrogen economy	Majumdar, Arun(1,5); Deutch, John M.(2,5); Prasher, Ravi S.(3,5); Griffin, Thomas P.(4)
Minority STEM doctoral student success (experience)	Schimmel, Keith A.(1); Dean Campbell, C.(2); Gumpertz, Marcia(3); Huet, Yvette Maria(4); Kelkar, Ajit D.(2); Kizito, John P.(1)
Impact of ICT Tools in Logic Development of Computer Programming Skills	Patil, J.A.(1); Kale, S.P.(1)
Fighting dust explosion hazards in the process industries	Eckhoff, R.K.
United States Radiation Oncology Fellowship Growth From 2010 to 2020	Chowdhary, Mudit(1); O'Bryant, Sinéad(2); Peters, Gabrielle W.(3); Vapiwala, Neha(4); Mohamad, Osama(5); Royce, Trevor J.(6,7)
Is there a 'leaky pipeline' for women in clinical medical physics in Canada?	Conroy, Leigh(1,2); Watt, E.(1,2); Smith, W.L.(1,2,3)
Best Practices and Lessons Learned on Organizing Effective Cohort-based Undergraduate Summer Research during COVID-19	Hou, Daqing(1); Liu, Yu(1)
Impact of ICT Tools in Logic Development of Computer Programming Skills	Patil, J.A.(1); Kale, S.P.(1)
A vision for the first product innovation sequence for chemical engineers	Bodnar, Cheryl A.(1); Beckman, Eric J.(2); McCarthy, Joseph J.(3); Little, Steven R.(3)
The state of gender diversity in medical physics	Covington, Elizabeth L.(1); Moran, Jean M.(2); Paradis, Kelly C.(2)
Spaceflight-relevant stem education and outreach: Social goals and priorities	Caldwell, Barrett S.(1)
Six Degrees of Separation: Connecting Research with Users and Cost Analysis	Dave, Shreya H.(1,2); Keller, Brent D.(2); Golmer, Karen(2); Grossman, Jeffrey C.(1,2)
The Former Fort Gillem: a Unique Case History in Closed Army Base Redevelopment	Monteleone, M.(1)

	Erratum: A Linear Programming Model for Determining Distribution of User Sessions in a Voice over Internet Protocol Network (IT Prof. (2020) 22:6 (97–103) DOI: 10.1109/MITP.2019.2953905)	Lemberg, Vyacheslav(1); Irizarry, Michael(1); Taglienti, Claudio(1)
	Spaceflight-relevant stem education and outreach: Social goals and priorities	Caldwell, Barrett S.(1)
	The Pransky interview: Harry Kloor, PhD, PhD – CEO and Co-Founder, Beyond Imagination Inc.; scientist; entrepreneur; inventor; filmmaker	Pransky, Joanne(1)
	The Professional Career Path; A Structured and Transparent Guide for Career Progression and Strengthening Professional In-House Capabilities	Al Mandhari, Sumaiya Mohamed(1); Al Ghamhari, Khalid Salim(1)
	Developing a reliability, availability and maintainability process	Knight, R.T.(1)
	Penn State's Applied Research Laboratory contributions to underwater acoustics	Liszka, E.G.(1)
	The Pransky interview: Dr Cory Kidd, founder and CEO at Catalia Health	Pransky, Joanne(1)
	Why diversity programs fail-and how to fix them	Pena, Kylee(1); Hinsen, Katie(1); Wilbur, Meaghan(2)
	Mono-crystalline Perovskite Photovoltaics toward Ultrahigh Efficiency?	Wang, Kai(1,2); Yang, Dong(1,2); Wu, Congcong(1,2); Shapter, Joe(3); Priya, Shashank(1,2)
	Small area estimation and microsimulation modeling	Rahman, Azizur(1); Harding, Ann(2)
	Execution: Improving On-Time Performance	Gaynor, G.
	The Pransky interview: Dr Robert Ambrose, Chief, Software, Robotics and Simulation Division at NASA	Pransky, Joanne(1)
	Erratum: Effects of relational schema congruence on leader-member exchange (The Leadership Quarterly (2017) 28(2) (268–284)(S1048984316302296)(10.1016/j.leaqua.2016.11.005))	Schwartz, Cris(1)
	Why diversity programs fail - And how to fix them	Pena, Kylee(1); Hinsen, Katie(2); Wilbur, Meaghan(3)
PEER	The Narrative Engineer	Ian Gravagne
	“Mentoring is Not Created Equal” : Doctoral STEM Faculty Perceptions of	Niesha C. Douglas, Educate, Activate, Transform; Cathy

Mentoring and Implications for Underrepresented STEM Learners	Howell, University of North Carolina at Charlotte; Lisa R. Merriweather, University of North Carolina at Charlotte; Anna Sanczyk, University of North Carolina at Charlotte
An NSF AGEP Program's Unintended Effect on Broadening Participation: Transforming "Non-STEM" Graduate Students into Engineering Education Faculty, Researchers, K-12 Educators, and Advocates	Renetta G. Tull, University of Maryland, Baltimore County; Alexis Y. Williams, University of Maryland Baltimore County; Shawnisha Shontá Hester, University of Maryland Baltimore County
Impacting First-Year Engineering Retention	Sally J. Steadman, University of South Alabama; Gail D. Jefferson, University of South Alabama; Tom G. Thomas, University of South Alabama; Kuang-Ting Hsiao, University of South Alabama
Converting Point Estimates for Cost-Risk Analysis	Robert C. Creese, West Virginia University
Adaptable and Agile - Programs to Meet Emerging Workforce Needs	Eugene Rutz, University of Cincinnati
Demonstration of Shape Memory and Super-elastic Effects of Nitinol Alloys	Mohamed Samir Hefzy, The University of Toledo; Mohammad Elahinia, The University of Toledo; Ahmadreza Jahadakbar, The University of Toledo; Bethany Arn, The University of Toledo; Mohammadreza Nematollahi, University of Toledo
Why We Failed: Barriers to Participation, Management, and Sustainability of an Immersive Faculty Experience Supporting Graduate Student Professional Development	Ella L. Ingram, Rose-Hulman Institute of Technology; Rachel McCord Ellestad,

	University of Tennessee at Knoxville; Cory Hixson, Colorado Christian University; Julia M. Williams, Rose-Hulman Institute of Technology
Comparatively Mapping Genres in Academic and Workplace Engineering Environments	Vukica M. Jovanovic, Old Dominion University; Megan McKittrick, Old Dominion University; Pilar Pazos, Old Dominion University; Daniel Richards, Old Dominion University; Julia Romberger
Innovation and Entrepreneurship through Industry-Academic Collaborations: A Collegiate Model for Economic Development	Nada Marie Anid, New York Institute of Technology; Marta A Panero, New York Institute of Technology; Brian Carbonette, New York Institute of Technology
Discrimination & Identity: How Engineering Graduate Students Navigate Pathways to Persistence	Elan Hope, North Carolina State University at Raleigh; Matthew Bahnson, North Carolina State University at Raleigh; Adam Kirn, University of Nevada, Reno; Derrick Satterfield, University of Nevada, Reno; Anitra Alexander; Alexis Briggs; Laila Allam, North Carolina State University at Raleigh
Building a Community of Practice Among STEM Graduate Students to Foster Academic and Professional Success	Renetta G. Tull, University of Maryland, Baltimore County; Miguel Alfonso Nino, Virginia Polytechnic and State University; Kimberly Monique

	Holmes, George Mason University
Simultaneous Implementation of Experimental Centric Pedagogy in 13 ECE Programs	Kenneth A Connor, Rensselaer Polytechnic Institute; Yacob Astatke, Morgan State University; Charles J. Kim, Howard University; Abdelnasser A Eldek, Jackson State University; Hamid R. Majlesein, Southern University and A&M College; Petru Andrei, Florida A&M University & Florida State University; John Okyere Attia P.E., Prairie View A&M University; Kathy Ann Gullie PhD, University at Albany/SUNY; Corey A Graves, North Carolina A&T State University; Ali Reza Osareh, NC A&T State University
Spanglish Software Engineering: A Curious International Learning Experience	Barbara Victoria Bernal, Kennesaw State University, Marietta; Jeffrey Chastine, Southern Polytechnic State University
Present Value Analysis of Traditional Loans	Robert C. Creese, West Virginia University
QUICK-RETURN MECHANISM REVISITED	Raghu Echempati, Kettering University; Theodore Paul Dani; Ankita Sahu; Nathan Marshall LeBlanc
Student Perceptions of Online Homework Tools in Undergraduate Statics Course	Ryan N. Fries P.E., Southern Illinois University, Edwardsville; Brad Cross, Southern Illinois University, Edwardsville; Mark P. Rossow, Southern Illinois University, Edwardsville;

	Daniel M Woehl, Southern Illinois University Edwardsville
Examining Faculty and Graduate Student Attitudes on Stress and Mental Health	David Feil-Seifer; Mackenzie Parker, University of Nevada, Reno; Adam Kirn, University of Nevada, Reno
Impact of Engineering Ambassador Program on Academic Attainment of Minority Students in Engineering	Mohsen Mosleh, Howard University; Claudia Marin-Artieda, Howard University
Graduate Research Data Management Course Content: Teaching the Data Management Plan (DMP)	Joseph H. Holles, University of Wyoming; Larry Schmidt, University of Wyoming
Design of a Virtual Laboratory for Automation Control	Zelin Zhu; Yuzhong Shen, Old Dominion University; Cheng Y. Lin P.E., Old Dominion University; Shuo Ren, Old Dominion University; Katherine Smith, Old Dominion University; Anthony W. Dean, Old Dominion University
Work in Progress: What is the Impact of Research in Engineering Education on University Administrators?	Alan Cheville, Bucknell University; Atsushi Akera, Rensselaer Polytechnic Institute; Donna M. Riley, Purdue University, West Lafayette; Jennifer Karlin, Minnesota State University, Mankato; Sarah Appelhans, University at Albany ; Thomas De Pree, Rensselaer Polytechnic Institute; Soheil Fatehiboroujeni, Purdue University
Study of the Impact of the University on Sustainability in Far West Texas	Anand Raj, University of Texas at El Paso; Peter

	<p>Golding, University of Texas at El Paso; Diane Elisa Golding, University of Texas at El Paso; Scott A. Starks, University of Texas at El Paso; Luis Rene Contreras Sapien, University of Texas at El Paso; Suzan Aranda Luna, University of Texas at El Paso</p>
<p>Alternate Pathways to Careers in Computing: Recruiting and Retaining Women Students</p>	<p>Shaundra Bryant Daily, Clemson University; Juan E Gilbert, Clemson University; Wanda Eugene, University of North Carolina Charlotte; Christina Gardner-McCune, Clemson University; Kyla Alanna McMullen, Clemson University; Phillip Wendell Hall Jr, Clemson University ; Sekou L Remy, Division of Human Centered Computing - School of Computing, Clemson University; Damon Lamar Woodard, Clemson University; Tania Roy, Clemson University</p>
<p>Graduate Internship/Externship Experiences in NIBIB Funded Graduate Training Programs</p>	<p>Margo Cousins, The University of Texas at Austin; Mia K. Markey, The University of Texas at Austin; Henry Grady Rylander III P.E.</p>
<p>Impact of a Graduate Elective in Microbial Soft Matter on Interdisciplinary Learning</p>	<p>Elizabeth J. Stewart, University of Michigan; John G. Younger, University of Michigan; Michael J. Solomon, University of Michigan</p>

Engagement Overload: Using Augmented Reality to Promote Student Interest in Computing	Jeffrey Chastine, Southern Polytechnic State University
Students'™ Experiences of Discrimination in Engineering Doctoral Education	Matthew Bahnson, North Carolina State University at Raleigh; Elan Hope, North Carolina State University at Raleigh; Derrick Satterfield, University of Nevada, Reno; Anitra Alexander; Alexis Briggs; Laila Allam, North Carolina State University at Raleigh; Adam Kirn, University of Nevada, Reno
Student Responses to a Gender-Neutral Engineering Ethics Case Study	Charles Riley, Oregon Institute of Technology; Franny Howes, Oregon Institute of Technology; Yasha Rohwer, Oregon Institute of Technology
Work in Progress: Supporting Engineering Laboratory Report Writing with Modules Targeted for Instructors	Charles Riley, Oregon Institute of Technology; Dave Kim, Washington State University-Vancouver; Ken Lulay, University of Portland; John Lynch, Washington State University
Implications of Emergency Remote Teaching During COVID-19 Lockdown : an Exploratory Analysis	Tajmilur Rahman, Gannon University; Joshua Nwokeji, Gannon University; Terry Holmes, Gannon University; Yudi Dong, Gannon University
Comparing Expert Predictions to Student Performance on Challenging Conceptual Questions: Towards an Adaptive Learning Module for Materials Science	Nutnicha Nigon, Oregon State University; Dana Simionescu, Oregon State University; Thomas Ekstedt, Oregon State University; Julie Tucker; Milo Koretsky, Tufts University

<p>The Importance of Research in Student Formation</p>	<p>Kenneth Van Treuren, Baylor University; Cynthia Fry, Baylor University; Bradley Norris</p>
<p>Integration and Evaluation of Peer Grading in a Graduate-level Engineering Design Course</p>	<p>Elissa Morris, Texas A&M University; Daniel A. McAdams, Texas A&M University</p>
<p>Students'™ Perception of a Summer Undergraduate Research Experience: Across the Disciplines</p>	<p>Simon Thomas Ghanat P.E., The Citadel; Dena Garner, The Citadel; Jason Howison, The Citadel; Rebecca A. Hunter, The Citadel; Breeanne Baker Swart, The Citadel; Shankar Madhab Banik, The Citadel; Michael P. Verdicchio, The Citadel; Nathan John Washuta P.E., The Citadel</p>
<p>Lean LaunchPad and Customer Discovery as a Form of Qualitative Research</p>	<p>Cory Hixson, Rowan University; Ella Lee Ingram, Rose-Hulman Institute of Technology; Rachel McCord Ellestad, University of Tennessee, Knoxville; Julia M. Williams, Rose-Hulman Institute of Technology</p>
<p>Board 103: EAGER: Barriers to Participation in Intensive Professional Development Opportunities</p>	<p>Stephanie Jarek, University of Tennessee; Rachel McCord Ellestad, University of Tennessee, Knoxville; Cory Hixson, Colorado Christian University; Ella Lee Ingram, Rose-Hulman Institute of Technology; Julia M. Williams, Rose-Hulman Institute of Technology</p>
<p>Board 16: Work in Progress: Design of "Risk and Resilience" Focused Courses for</p>	<p>Lei Wang P.E., University of the District of Columbia; Pradeep K.</p>

Undergraduate Engineering Education Towards a Hazard-Resilient Built Environment	Behera P.E., University of the District of Columbia; Sasan Haghani, University of the District of Columbia; Jiajun Xu, University of the District of Columbia
Board 72: Why Engineering Ethics? How Do Educators and Administrators Justify Teaching Engineering Ethics?	Soheil Fatehiboroujeni, Indiana-Purdue University; Atsushi Akera, Rensselaer Polytechnic Institute; Donna M. Riley, Purdue University-Main Campus, West Lafayette (College of Engineering); Alan Cheville, Bucknell University; Jennifer Karlin, Minnesota State University, Mankato; Sarah Appelhans, University at Albany; Thomas De Pree, Rensselaer Polytechnic Institute
An Institutional Transformation Model to Increase Minority STEM Doctoral Student Success	Marcia Gumpertz, North Carolina State University; Rebecca Brent, Education Designs, Inc; C. Dean Campbell, North Carolina A&T State University ; Maureen Grasso, North Carolina State University; Yvette Maria Huet, University of North Carolina, Charlotte; Keith A. Schimmel P.E., North Carolina A&T State University
Remote Versus In-Class Active Learning Exercises for an Undergraduate Course in Fluid Mechanics	John Michael Cotter, University of South Florida; Rasim Guldiken, University of South Florida
Situating Engineering Education in a World Impacted by COVID-19	Thomas A. De Pree, University of New

	Mexico; Sarah Appelhans, University at Albany-SUNY; Alan Cheville, Bucknell University; Atsushi Akera, Rensselaer Polytechnic Institute; Melissa Shuey, Rensselaer Polytechnic Institute
A Review of Practical Design Integration Methods for Existing Engineering Curriculum	Elissa T. Morris, Texas A&M University; Daniel A. McAdams, Texas A&M University
Scholarships for Academic Success Program: A Final Report	Carolyn Skurla, Baylor University; Steven R. Eisenbarth, Baylor University
Global Competency: Are Engineering Students Ready?	Steven H. Billis, New York Institute of Technology; Nada Marie Anid, New York Institute of Technology; Marta A Panero, New York Institute of Technology
Success Factors in Distance Education: A Case of Master of Construction Management at East Carolina University	Syed Mahmood Ahmed P.E., East Carolina University; Kiersten Marie Mahaffy, East Carolina University; Lincoln Harding Forbes, Harding Associates Inc., Miami; Rachel M. Robinson-Watts, East Carolina University; Ashley Lauren Gregory, East Carolina University
Mobile App Development: A Cross-Discipline Team-based Approach to Student and Faculty Learning	Sarvesh S. Kulkarni, Villanova University; Frank Klassner, Villanova University; Vijay Gehlot, Villanova University; E.J. Dougherty III, Villanova University; Sue McFarland Metzger,

	<p>Villanova University; William P. Wagner, Villanova University</p>
<p>ASCE's™ Response to the Pandemic: Development of a Remote ExCEED Teaching Workshop</p>	<p>Audra Morse, Michigan Technological University; Patricia Clayton, Wake Forest University; Carolyn Rodak, State University of New York, Polytechnic Institute; Jacob Henschen, University of Illinois at Urbana - Champaign; Pinar Omur-Ozbek, Colorado State University; Charles Riley, Oregon Institute of Technology; David Saftner, University of Minnesota Duluth; Anthony Cioffi, American Society of Civil Engineers</p>
<p>Matched Assessment Data Set for Experiment- Centric Pedagogy Implementation in 13 HBCU ECE Programs</p>	<p>Kenneth A. Connor, Rensselaer Polytechnic Institute; John C. Kelly Jr., North Carolina A&T State University; Mohamed F. Chouikha, Howard University; Yacob Astatke, Morgan State University; Petru Andrei, Florida A&M University/Florida State University; Mandoye Ndoye, Tuskegee University; Abdelnasser A. Eldek, Jackson State University; John Okyere Attia P.E., Prairie View A&M University; Dianna Newman, University at Albany-SUNY; Kathy Ann Gullie PhD, University at Albany-</p>

	SUNY; Ali Reza Osareh, North Carolina A&T State University; Lisa D. Hobson, Prairie View A&M University
Designing an Interprofessional Educational Undergraduate Clinical Experience	Barbara Jean Muller-Borer, East Carolina University; Stephanie M. George, East Carolina University
Extending WID to Train Mechanical Engineering GTAs to Evaluate Student Writing	Nancy B. Barr, Michigan Technological University
Work in Progress: Sustainable Collaborations Between Math and Engineering	Afroditi Vennie Filippas, Virginia Commonwealth University; Rebecca Segal, Virginia Commonwealth University ; Alen Docef, Virginia Commonwealth University
Just a Moment – Classroom Demonstrations for Statics and Solid Mechanics	James Giancaspro P.E., University of Miami; Diana Arboleda, University of Miami
Board 137: Persistence of Women of Color in Undergraduate Engineering Programs	Courtney S. Green P.E., University of North Carolina in Charlotte; Sandra Loree Dika, University of North Carolina, Charlotte; April C Smith, University of North Carolina, Charlotte
From "Leaky Pipelines" to "Diversity of Thought": What Does "Diversity" Mean in Engineering Education?	Sarah Appelhans, University at Albany; Thomas De Pree, Rensselaer Polytechnic Institute; J. Thompson, Rensselaer Polytechnic Institute; Joerene Acerrador Aviles, Rensselaer Polytechnic Institute ; Alan Cheville, Bucknell University; Donna M. Riley, Purdue University-Main Campus, West Lafayette (College

	<p>of Engineering); Jennifer Karlin, Minnesota State University, Mankato; Soheil Fatehiboroujeni, Indiana-Purdue University; Atsushi Akera, Rensselaer Polytechnic Institute</p>
<p>The Modalities of Governance in Engineering Education</p>	<p>Atsushi Akera, Rensselaer Polytechnic Institute; Soheil Fatehiboroujeni, Purdue University, West Lafayette; Sarah Appelhans, University at Albany-SUNY; Alan Cheville, Bucknell University; Jennifer Karlin, Minnesota State University, Mankato; Donna M. Riley, Purdue University, West Lafayette; Thomas A. De Pree, Bucknell University; Rafael Julián Burgos-Mirabal, University of Massachusetts- Amherst</p>
<p>Work in Progress on a Model to Improve the Preparation and Transition of Hispanic STEM Doctoral Students into Community College Faculty Positions - Lessons Learned</p>	<p>Miguel Velez-Reyes P.E., University of Texas at El Paso; Ivonne Santiago P.E., University of Texas at El Paso; Victor Manuel Garcia Jr., The University of Texas at El Paso; Irma Y. Torres-Catanach, The University of Texas at El Paso; Dawn M. Horton, University of Massachusetts, Amherst; Yajaira Mejia, The City College of New York; Dugwon Seo, Queensborough Community College; Jorge E. Gonzalez, City</p>

	<p>University of New York, City College; Joseph Barba, City University of New York, City College; Fenot Aklog, Teachers College Columbia University; Fred Moshary, City University of New York, City College; Jeff Sivils, El Paso Community College; Yasser Hassebo, The City University of New York, LaGuardia CC</p>
<p>ArchiGaming: Finding the Overlap</p>	<p>Jeffrey Chastine, Southern Polytechnic State University (ENG); Charles Richard Cole, Southern Polytechnic State University; Christopher Welty, Southern Polytechnic State University</p>
<p>NSF TUES Grant: A Collaborative, Multi-Campus Program to Enhance STEM Learning in Energy Science, Technology and Policy</p>	<p>Gary P. Halada, Stony Brook University; Nada Marie Anid, New York Institute of Technology; Marta A Panero, New York Institute of Technology; Nicole Simon, Nassau Community College; Yeong Ryu, State University of New York, Farmingdale; Barbara Hillery, SUNY Old Westbury</p>
<p>The Implementation of Experimental Centric Pedagogy in 13 ECE Programs - The View from Students and Instructors</p>	<p>Kenneth A. Connor, Rensselaer Polytechnic Institute; Dianna Newman, University at Albany/SUNY; Kathy Ann Gullie Ph.D., Evaluation Consortium University at</p>

	Albany/SUNY; Yacob Astatke, Morgan State University; Charles J. Kim, Howard University; John Okyere Attia P.E., Prairie View A&M University; Petru Andrei, Florida A&M University/Florida State University; Mandoye Ndoye, Tuskegee University
Future Career Pathway Perceptions of Lower-Income Computing Students Through the Lens of Capital Exchange	Bailey Bond-Tritto, Florida International University; Stephen Secules, Florida International University; Nivedita Kumar, Florida International University; Tiana Solis, Florida International University
High-Enrollment Mechanical Engineering Programs Meeting the Challenge of Career Advising Through a Seminar Course	Rachal E Thomassie, Texas A&M University; Kathryn Kirsch, Pennsylvania State University; Eric R Marsh, Pennsylvania State University, University Park; Timothy J. Jacobs, Texas A&M University
Experimental Centric Pedagogy in First-Year Engineering Courses	Kenneth A. Connor, Rensselaer Polytechnic Institute; Dianna Newman, University at Albany - SUNY; Kathy Ann Gullie PhD, Evaluation Consortium University at Albany - SUNY; Yacob Astatke, Morgan State University; Mohamed F. Chouikha, Howard University; Charles J. Kim, Howard University; Otsebele E. Nare, Hampton University; John Okyere

	<p>Attia P.E., Prairie View A&M University; Petru Andrei, Florida A&M University/Florida State University; Lisa D. Hobson, Prairie View A&M University</p>
<p>The Distributed System of Governance in Engineering Education: A Report on Initial Findings</p>	<p>Atsushi Akera, Rensselaer Polytechnic Institute; Donna M. Riley, Purdue University, West Lafayette; Alan Cheville, Bucknell University; Jennifer Karlin, Minnesota State University, Mankato; Thomas A. De Pree, Rensselaer Polytechnic Institute</p>
<p>ABET & Engineering Accreditation - History, Theory, Practice: Initial Findings from a National Study on the Governance of Engineering Education</p>	<p>Atsushi Akera, Rensselaer Polytechnic Institute; Sarah Appelhans, University at Albany; Alan Cheville, Bucknell University; Thomas De Pree, Rensselaer Polytechnic Institute; Soheil Fatehiboroujeni, Indiana-Purdue University; Jennifer Karlin, Minnesota State University, Mankato; Donna M. Riley, Purdue University, West Lafayette</p>
<p>Student Perspectives on Navigating Engineering Pathways</p>	<p>Atsushi Akera, Rensselaer Polytechnic Institute; Soheil Fatehiboroujeni, Purdue University, West Lafayette; Sarah Appelhans, University at Albany-SUNY; Joerene Acerrador Aviles, Rensselaer Polytechnic</p>

	Institute; Eva Dibong; Beatrice Mendiola, Rensselaer Polytechnic Institute; Michelle Murray, Rensselaer Polytechnic Institute; Melissa Shuey, Rensselaer Polytechnic Institute; Marta Tsyndra, Rensselaer Polytechnic Institute; Makayla Wahaus, Rensselaer Polytechnic Institute
Graduate Student Perceptions of an Ideal Mentor in Engineering and Computing at a Minority-Serving Institution: Preliminary Results	Luis Enrique Guardia, Florida International University; Mais Kayyali, Florida International University; Alexandra Coso Strong, Florida International University
Work in Progress: A Holistic PhD Admissions Rubric--Design & Implementation	Shannon Barker, University of Virginia; Amy Clobes, University of Virginia
Student Experience with COVID-19 and Online Learning: Impact of Faculty's Ability to Successfully Navigate Technological Platforms for Remote Instruction	Melissa Shuey, Rensselaer Polytechnic Institute; Atsushi Akera, Rensselaer Polytechnic Institute; Sarah Appelhans, University at Albany-SUNY; Alan Cheville, Bucknell University; Thomas De Pree, University of New Mexico; Soheil Fatehiboroujeni, Cornell University
ABET's Maverick Evaluators and the Limits of Accreditation as a Mode of Governance in Engineering Education	Atsushi Akera, Rensselaer Polytechnic Institute; Sarah Appelhans, University at Albany-SUNY; Alan Cheville, Bucknell University; Thomas De Pree, Rensselaer Polytechnic Institute;

		Soheil Fatehiboroujeni, Cornell University; Jennifer Karlin, Minnesota State University, Mankato; Donna M. Riley, Purdue University at West Lafayette
--	--	--