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

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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) Additional limits - Date: From January 01 2013 to December 31 2022; Language: English	Conference Papers & Proceedings	1	X	
		Scholarly Journals	1	X	
Compendex & Inspec (*Engineering Village*)*****	((graduate program director AND engineering) Compendex & Inspec for 2013-2022: ((graduate program director AND engineering) WN KY) AND (English WN LA)	Book (BK)	1		X
		Book chapter (CH)	1		X
		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	***ERIC*** *(ProQuest)*	***Compendex & Inspec*** *(Engineering Village)*	***Papers on Engineering Education Repository*** *(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].

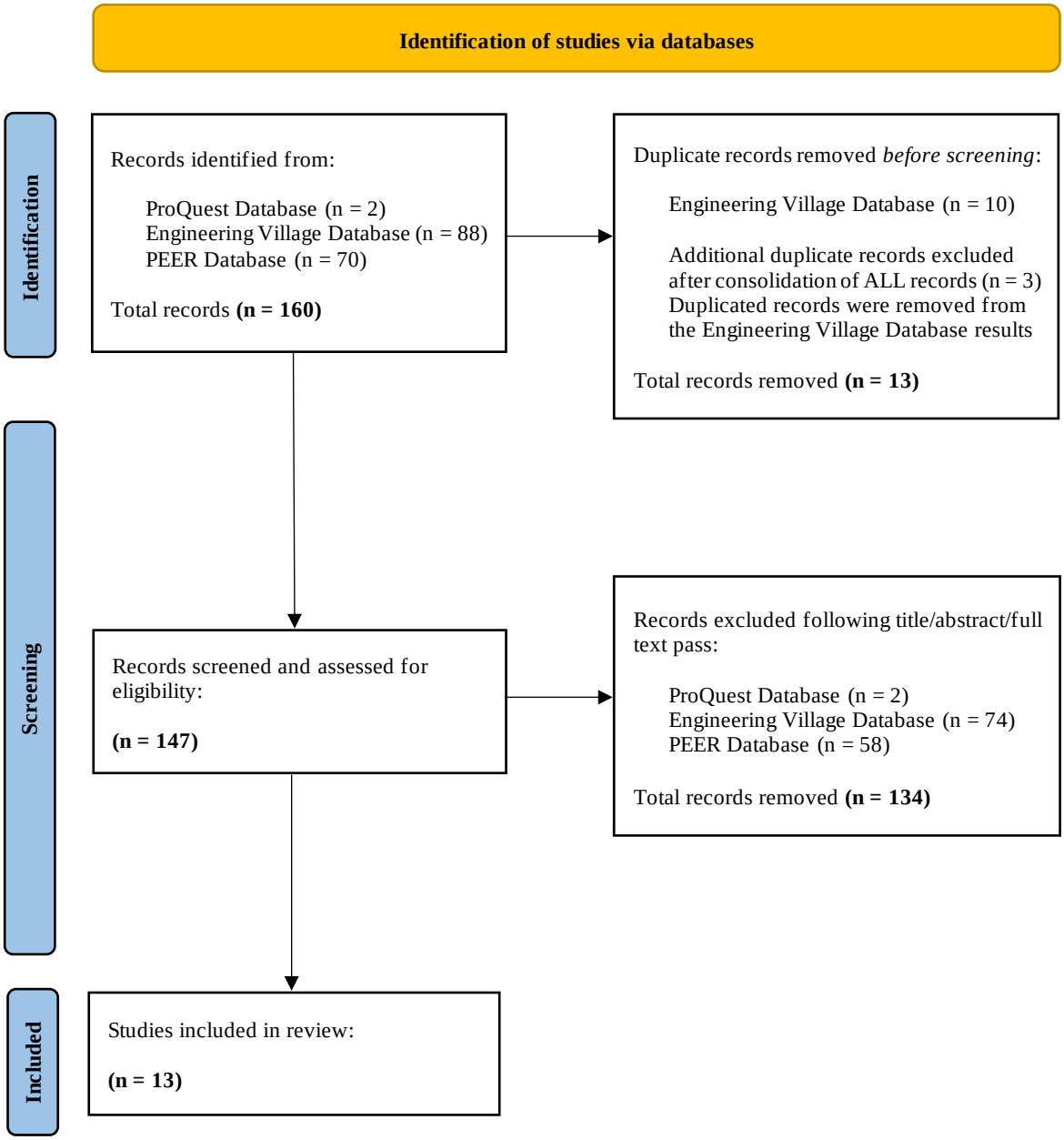

Figure 1. Scoping Review Selection of Studies using PRISMA 2020 Flow Diagram [24]

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.

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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)

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	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); Lumpp, 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)
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	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)
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	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)
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	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
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	The 2015 Asia-Pacific international symposium on electromagnetic compatibility	Wu, Tzong-Lin
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	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)
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	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)
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	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)
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	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)
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	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 Ghammari, Khalid Salim(1)
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	Penn State's Applied Research Laboratory contributions to underwater acoustics	Liszka, E.G.(1)
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	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)
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	Execution: Improving On-Time Performance	Gaynor, G.
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	Why diversity programs fail - And how to fix them	Pena, Kylee(1); Hinsen, Katie(2); Wilbur, Meaghan(3)
PEER	The Narrative Engineer	Ian Gravagne
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	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
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	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
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	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
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		University of Tennessee at Knoxville; Cory Hixson, Colorado Christian University; Julia M. Williams, Rose-Hulman Institute of Technology
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	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
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		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
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	Integration and Evaluation of Peer Grading in a Graduate-level Engineering Design Course	Elissa Morris, Texas A&M University; Daniel A. McAdams, Texas A&M University
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	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
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		Mexico; Sarah Appelhans, University at Albany-SUNY; Alan Cheville, Bucknell University; Atsushi Akera, Rensselaer Polytechnic Institute; Melissa Shuey, Rensselaer Polytechnic Institute
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	Scholarships for Academic Success Program: A Final Report	Carolyn Skurla, Baylor University; Steven R. Eisenbarth, Baylor University
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	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,

		Villanova University; William P. Wagner, Villanova University
	ASCEâ€™s Response to the Pandemic: Development of a Remote ExCEEd Teaching Workshop	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
	Matched Assessment Data Set for Experiment-Centric Pedagogy Implementation in 13 HBCU ECE Programs	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-

		SUNY; Ali Reza Osareh, North Carlina 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 â€“ 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

		of Engineering); Jennifer Karlin, Minnesota State University, Mankato; Soheil Fatehiboroujeni, Indiana-Purdue University; Atsushi Akera, Rensselaer Polytechnic Institute
	The Modalities of Governance in Engineering Education	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 JuliÃ¡n Burgos-Mirabal, University of Massachusetts- Amherst
	Work in Progress on a Model to Improve the Preparation and Transition of Hispanic STEM Doctoral Students into Community College Faculty Positions - Lessons Learned	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

		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
	ArchiGaming: Finding the Overlap	Jeffrey Chastine, Southern Polytechnic State University (ENG); Charles Richard Cole, Southern Polytechnic State University; Christopher Welty, Southern Polytechnic State University
	NSF TUES Grant: A Collaborative, Multi-Campus Program to Enhance STEM Learning in Energy Science, Technology and Policy	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
	The Implementation of Experimental Centric Pedagogy in 13 ECE Programs - The View from Students and Instructors	Kenneth A. Connor, Rensselaer Polytechnic Institute; Dianna Newman, University at Albany/SUNY; Kathy Ann Gullie Ph.D., Evaluation Consortium University at

		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-Trittipo, 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

		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
	The Distributed System of Governance in Engineering Education: A Report on Initial Findings	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
	ABET & Engineering Accreditation - History, Theory, Practice: Initial Findings from a National Study on the Governance of Engineering Education	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
	Student Perspectives on Navigating Engineering Pathways	Atsushi Akera, Rensselaer Polytechnic Institute; Soheil Fatehiboroujeni, Purdue University, West Lafayette; Sarah Appelhans, University at Albany-SUNY; Joerene Acerrador Aviles, Rensselaer Polytechnic

		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 Facultyâ€™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