Communication across Divisions: Trends Emerging from the 2019 Annual Conference of ASEE and Some Possibilities for Strategic Action

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Dr. Judith Shaul Norback, Georgia Institute of Technology

Biography Judith Shaul Norback, PhD, is academic faculty and Director of Workplace and Academic Communication in the Stewart School of Industrial and Systems Engineering at Georgia Tech. She applies her skills as a social psychologist to gather data from executives about stellar presentations and other oral communication skills and she conducts research on communication, to improve instruction for both undergraduates and PhD students. Dr. Norback has developed and provided instruction for students in industrial and biomedical engineering and has advised on oral communication instruction at other universities. Since she founded the Presentation Coaching Program in 2003, the coaching has had over 41,000 student visits. As of winter 2015, she shared her instructional materials, including a scoring system evaluated for reliability, with over 400 schools from the U.S., Australia, Germany, and South Korea. Dr. Norback has studied communication and other basic skills in the workplace and developed curriculum over the past 30 years—first at Educational Testing Service; then as part of the Center for Skills Enhancement, Inc., which she founded, with clients including the U.S. Department of Labor, the National Skill Standards Board, and universities. Since arriving at Georgia Tech in 2000 her work has focused on oral communication for engineering students and engineers. Dr. Norback has published over 20 articles in the past decade alone, in the ASEE Annual Conference Proceedings, IEEE Transactions on Professional Communication, INFORMS Transactions on Education, and the International Journal of Engineering Education, and others. She authored the book Oral Communication Excellence for Engineers and Scientists, published in summer 2013. Over the past 15 years Dr. Norback has given over 40 conference presentations and workshops at nation-wide conferences such as ASEE, where she has served as chair of the Liberal Education/Engineering & Society (LEES) Division. She has been an officer for the Education Forum of INFORMS and has served as Associate Chair for the National Capstone Design Conference. Dr. Norback has a Bachelors' degree from Cornell University and a Masters and PhD from Princeton University. Her current research interests include 1) clarifying the effectiveness of video distribution and the use of exit tickets in oral communication instruction for engineers, 2) identifying the mental models engineering students use when creating graphical representations, and 3) learning the trends and themes represented in the communication-related papers across various divisions of ASEE. As part of this effort, Norback is working with Kay Neeley of U of VA to start an ASEE Communication across Divisions Community, now numbering 80 people.

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Abstract

This paper extends an effort begun in 2015 to create a comprehensive and holistic view of communication as that subject is treated across the divisions of ASEE based on analysis of all of the papers on communication that were published in the proceedings of the 2019 Annual Conference. The quantitative results of the analysis reveal increases in the

(1) total number of papers on communication (67 in 2019 vs. 33 in 2015),
(2) number of divisions sponsoring papers on communication (20 in 2019 vs. 15 in 2015),
(3) number of sessions with all or most papers focusing on communication (13 in 2019 vs. 6 in 2015).

Taken together, the quantitative results demonstrate that interest in communication is both growing and dispersed across ASEE. Qualitative analysis of the papers focused on the backgrounds and institutional affiliations of the authors and trends with respect to the focus, scope, and funding of the work reported in the papers. The 2019 papers demonstrated the intensification, diversification, and evolution of four trends that were evident in 2015 : (1) disciplinary and workplace communication, (2) communication tasks as a way to simultaneously develop communication competency and subject matter mastery, (3) interdisciplinary integration and multi-institutional collaboration, and (4) collecting large amounts of data about student outcomes in a single course or institution with relatively little effort devoted to synthesizing experiences across institutions.

The paper concludes by enumerating strategies LEES might implement in collaboration with other divisions and ASEE headquarters to develop a Communication across Divisions Network to efficiently and effectively advance teaching, research, and practice in communication in engineering.

Introduction

As Gianniny [1] and other historical treatments of engineering education have established, communication has been a focus in the American Society for Engineering Education (ASEE) since ASEE's predecessor, the Society for the Promotion of Engineering Education (SPEE), formed a committee on English in 1914. The enduring consensus that communication ability is essential for the effective practice of engineering can obscure an equally important and virtually perpetual state of confusion about *how* engineering educators should go about developing communication competency in their students, *who* should be offering the instruction, and *what, exactly,* those competencies should be. Recognizing these circumstances, members of the Liberal Education/Engineering & Society Division of ASEE (LEES) began an effort in 2015 to create a comprehensive and holistic understanding of significant initiatives and trends in communication scholarship and instruction across all divisions of ASEE under the title of "Communication across Divisions." Rather than aiming to establish a Communication Division of ASEE, Communication across Divisions seeks to bring some coherence to the scholarly conversation on

communication within the organization and to identify some actions we might take to translate the relatively large amount of publishing on various aspects of engineering communication into efficient, evidence-based instructional programs and a more fully synthesized body of research.

The results of that initial effort were published in the proceedings of the ASEE Annual Conference in 2016 by two of this paper's authors (Neeley and Norback [2]), who identified an overall pattern of "fragmentation of the scholarly community." This fragmentation, we argued, results in lost "opportunity for cross-fertilization, especially with regard to scholarship that could inform [instructors'] work and save them time." The 2016 paper recommended several action items, all aimed at making the participants in the scholarly conversation about communication within ASEE more visible to each other.

This paper extends the effort begun in 2015 to create a comprehensive and holistic view of communication as that subject is treated across the divisions of ASEE. The interval between the 2016 survey and the research we present here allows some informative comparisons and helps establish the trajectory that may shape communication instruction in engineering in the near future. The remaining sections of this paper describe the methods we used, provide evidence of both increased and sustained interest in communication in ASEE, and offer observations about the ways in which the trends noted in 2016 have evolved.

Methods: creating an inventory of communication-focused papers based on the conference program

Given the numbers of papers published and the range of topics covered, the program of the ASEE Annual Conference constitutes a reasonably representative (though certainly not definitive) view of contemporary concerns in engineering education. Our approach to analyzing the program consisted of the following steps:

- Identify papers that appear to deal with various aspects of communication in engineering practice and education using the paper titles (and session titles, if available).
- Determine the total number of papers and sessions on communication and the total number of divisions that sponsored or co-sponsored them.
- Gather information on the titles, academic backgrounds, institutional affiliations, and stated research interests of the authors from the biographical sketches that accompany the papers.
- Scan the text of the papers to get a sense of (1) how they define the problem their instructional intervention or research seeks to address; (2) the sources on which they draw; (3) the conceptual and theoretical frameworks they use; (4) the kinds of data they gather; and (5) whether or not the work reported in the paper has been externally funded by a government agency such as the National Science Foundation (NSF) or internally funded through institutional curricular development programs.

Previous work suggested that there was no significant difference between the communication papers presented in LEES as compared to other divisions of ASEE, so we did not attempt to separate those two sets of papers in this analysis. The complete list of papers we identified and analyzed for this paper follows the reference list.

Quantitative results: increasing numbers of papers and divisions involved 2015-2019

The most striking difference between 2015 and 2019 was the total number of papers published: 67 in 2019 compared with 33 in 2015. There was also an increase in the number of divisions sponsoring papers on communication: 20 divisions total in 2019 compared with 15 in 2015. The lists below are in alphabetical order by division and indicate whether a division had papers in both years included in the study.

Divisions sponsoring papers on communication in 2015

1. Chemical Engineering (also in 2019)
2. Civil Engineering (also in 2019)
3. Computer & Information Technology
4. Continuing Professional Development
5. Educational Research and Methods (also in 2019)
6. Engineering Entrepreneurship & Innovation
7. Engineering Management
8. Engineering Technology
9. First Year Programs (also in 2019)
10. Liberal Education/Engineering & Society (also in 2019)
11. Materials
12. Manufacturing Materials and Processes
13. Mechanical Engineering (also in 2019)
14. Multidisciplinary Engineering (also in 2019)
15. Technological & Engineering Literacy/Philosophy of Engineering (also in 2019)

Divisions sponsoring papers on communication in 2019

1. Chemical Engineering (also in 2015)
2. Civil Engineering (also in 2015)
3. College Industry Partnerships
4. Design
5. Educational Research and Methods (also in 2015)
6. Engineering Ethics
7. Engineering Physics and Physics
8. Experimental and Laboratory Oriented Studies
9. First Year Programs (also in 2015)
10. Graduate Studies
11. International
12. Liberal Education/Engineering & Society (also in 2015)
13. Manufacturing
14. Mechanical Engineering (also in 2015)
15. Military and Veterans
16. Minorities in Engineering
17. Multidisciplinary (also in 2019)
18. Pre-College

19. Student
20. Technological & Engineering Literacy/Philosophy of Engineering (also in 2019)

Divisions with papers on communication in both years

1. Chemical Engineering
2. Civil Engineering
3. Educational Research and Methods
4. First Year Programs
5. Liberal Education/Engineering & Society
6. Mechanical Engineering
7. Multidisciplinary
8. Technological & Engineering Literacy/Philosophy of Engineering

2019 also saw a significant increase in the number of technical sessions in which all or most of the papers dealt with communication: 13 in 2019 compared with 6 in 2015. In 2019 as in 2015, LEES sponsored more sessions on communication than any other division. The lists below are in alphabetical order by division and indicate the total number of sessions each division sponsored.

Sessions with all or most papers on communication (2015)
6 total

1. Chemical Engineering (1 session)
2. Educational Research and Methods (1 session)
3. Liberal Education/Engineering and Society (4 sessions)

Sessions with all or most papers on communication (2019)
13 total

1. Educational Research and Methods (U514C)*
2. *Experimental and Laboratory Oriented Studies* (W426)
3. *First-Year Programs* (T127)
4. *Graduate Studies* (2 total: M328, M528)
5. *International Division* (T434A)
6. Liberal Education/Engineering & Society (4 total: U534B, T134, W134, W441†)
7. *Multidisciplinary Engineering* (W441‡)
8. *Pre-College Engineering Education* (U533B)
9. Technological Literacy/Philosophy of Engineering (U549)

The divisions new to the on the list for 2019 are in italics.

* The numbers in parentheses in this list designate the particular session or sessions in the 2019 program that had papers on communication in them.
† Session co-sponsored with Multidisciplinary Engineering
‡ Session co-sponsored with LEES

Intensification, diversification, and evolution of trends

The four trends identified in the 2016 study are listed below. The respects in which they have intensified, diversified, and evolved provide insight into the structural factors that either promote or impede coherence in the scholarly conversation on communication within ASEE and suggest strategies for moving forward.

1. Focusing on communication in a particular engineering discipline or in a workplace context
2. Having students engage in various forms of communication as a way of simultaneously teaching and learning course content and developing communication competency
3. Interdisciplinary integration and multi-institutional collaboration
4. Collecting lots of assessment data but not making much of it[§]

The first two trends listed above have gained momentum since 2016. Approximately half of the papers we reviewed reported on curricular interventions in the related but distinct categories listed below:

- Writing across the curriculum (WAC, sometimes also called "writing across engineering"): embedding writing (and sometimes other forms of communication) in multiple courses over the four years of a typical engineering degree program
- Writing to learn (WTL, sometimes also includes using writing to assess student learning): using experiences with different kinds of writing to enhance and assess learning, usually more a pedagogical strategy than a formal program
- Writing in the disciplines (WID): helping students recognize and master the conventions of writing followed in their particular discipline, in engineering usually conceived as a major or degree program (as opposed to "engineering" as a whole or generic "technical writing")

These models (WAC/WAE, WTL, and WID) can be embodied in numerous permutations, typically with the goals of achieving efficiency and facilitating knowledge transfer between courses.

Reference to and investigation of workplace contexts for communication remained a strong theme in the papers presented at the 2019 conference. Scholars working on workplace contexts research industry requirements through activities such as polling industry representatives or having them participate in course activities. In some cases, the authors build on the findings from these activities in practical ways. For instance, "Returning to an Industry-Informed Technical Writing and Communication Course Design" by Eggleston and Rabb (26024)[**] described conducting structured interviews with the industry partner. Those interviews led to advocating

[§] The wording in the earlier paper now seems unnecessarily pejorative. It is probably more precise to say that collecting data about interventions used in individual courses or at one institution has become standard practice in engineering education, largely because of accreditation requirements. The accreditation process, however, does nothing to encourage individual faculty or institutions to synthesize the assessment data into useful conclusions that are transferable to other institutions.

[**] To facilitate accurate retrieval, we include the paper number for each of the specific papers we discuss in the text.

for key changes in the teaching methodology like recording elevator pitches, giving short presentations, and writing summary reports. Other papers, such as "Improving Undergraduate STEM Writing through Common Language as a Tool to Teach Engineering 'Dialects'" by Clippinger, Jernquist, Nozaki, and Niterright (27049), explore how improving undergraduate STEM writing will help undergraduate engineers recognize the importance of writing in professional development or focus on specific forms of communication (executive summaries, for example). "Perception versus Reality: Skill Perceptions in First-year Engineering Students" by Russell and Zafonte (26643) focuses on job-preparedness in students. The article examines industry needs by gathering student perceptions of those needs. Students ranked the importance of various skills and then faculty used the results to improve their strategies to communicate the importance of skills taught in class.

Some of the strongest papers and sessions of the 2019 annual conference exemplified the third trend observed in papers presented in 2015: interdisciplinary integration and multi-institutional collaboration. One of these sessions, W441: Multidisciplinary Endeavors: Engineering and Liberal Arts, was co-sponsored by the Multidisciplinary Engineering Division and LEES. (It was, in fact, our only co-sponsored session in 2019.) The papers in this session amply illustrate the power of multidisciplinary learning. One paper, "Work in Progress: Multidisciplinary Learning between Engineering, Communication, and Fine Arts Majors through the Creation of Movie Special Effects" by Harron (27404), reported on a curricular design that brought students from three undergraduate majors (fine arts, communication, and engineering) together in a design-based learning (DBL) course. Another paper described a collaboration of engineering and English faculty to develop and assess teamwork and leadership skills in a technical writing course.

The fullest realization of interdisciplinary integration and multi-institutional collaboration in this particular session (W441) was "Experiments in the Communication Lab: Adaptations of the Comm Lab Model in Three Institutions" by Summers, Olivier-Mason, Dang, and Chien (25341). The three institutions were Rose-Hulman Institute of Technology, Brandeis University, and the Massachusetts Institute of Technology. The expertise and research interests within the group of authors ranged from rhetoric and composition, writing in the disciplines, and peer coaching to microbiology and chemistry. All of the authors had been trained in the Communication Lab (Comm Lab) program, "a STEM-specific writing center where students can meet face-to-face with a peer knowledgeable in their discipline to get feedback on STEM writing and communication genres." The research reported in the paper compared "adaptations of the Comm Lab across several disciplines and three institutions by drawing on quantitative and qualitative Comm Lab and institutional contexts." The authors concluded that the Comm Lab model was flexible enough to adapt to varying disciplinary and institutional needs while still gaining the benefits of the peer-to-peer tutoring model. Like much of the strongest research presented at ASEE in 2019, this work was funded by the National Science Foundation.

In contrast the last paper discussed above and that session as a whole, many if not most papers that dealt with communication, reported on work done at a single institution. A few examples of substantial projects based on WAC/WAE/WID/WTL frameworks were "Improving Undergraduate Engineering Education through Writing: Implementation in the Classroom Alongside a Hands-on Learning Pedagogy" by Kaiphanliam, Adesope, Gartner, Reynolds, and

Van Wie (26946), "Using Reflection to Facilitate Writing Knowledge Transfer in Upper-Level Materials Science Courses" by Mallette and Ackler (26638), and "Writing across Engineering: A Collaborative Approach to Support STEM Faculty's Integration of Writing Instruction in their Classes" by Ware, Turnipseed, Gallagher, Elliott, Popovics, Prior, and Zilles (26720). These papers were presented in three different sessions (2 in LEES and 1 in chemical engineering); one was funded by the NSF, while another had significant institutional funding.

Many of the papers presented at the 2019 conference exemplify the fourth trend observed in the 2016 analysis: collecting data (typically from student evaluations or surveys) for a single course (sometimes even for a single offering of a course) at a single institution. As long as the majority of papers report on a single intervention or single institution, with little reference to what other institutions are doing, coherence in the scholarly conversation will be an elusive goal. The "one-off," as we might call it, creates a publishable unit but gains significance for the broader scholarly community only when it is integrated into a larger pattern of practice and assessment.

To identify areas for potentially strategic action, we focused papers that either demonstrated or suggested potentially more impactful ways of organizing research and publishing on communication in engineering. One example of a potentially more impactful design was "Preliminary Investigation of Undergraduate Students' Zone of Proximal Development (ZPD) in Writing Lab Reports in Entry-level Engineering Laboratory Courses at Three Universities" by Kim, Riley, and Lulay (25572). All three authors are integrative individuals in the sense that they combine expertise in an engineering discipline/research area with an interest in writing pedagogy. They work at three different institutions (Washington State University, Oregon Institute of Technology, and University of Portland) and received funding for their work from the NSF. Kim, Riley, and Lulay's paper provides an in-depth literature review that draws on a variety of sources, scholarly communities, and concepts. Perhaps most importantly, the pedagogical strategies they describe are based on a well-defined theoretical framework, for example, "Vygotsky's theory of scaffolding" and "zone of proximal development (ZPD)," [which is] "the learning zone between what students can do by themselves and what cannot be achieved without the explicit support of an instructor." The authors also make interesting distinctions such as writing as metacognition, writing as disciplinary meaning-making, and writing as technical communication. All of these strategies both strengthen the research presented and increase the potential impact of the methods and findings reported in the paper.

Conclusions: what does our analysis demonstrate or suggest and what should we do?

Perhaps the most significant finding emerging from the research and analysis presented here is that interest in communication is growing across ASEE, with growth most pronounced in the broad area of WAC/WAE/WID/WTL. Emerging areas of common interest are graduate level courses in communication and writing in laboratory courses. Interest in communication also appears to be diffusing throughout ASEE, with an increased number of divisions including papers on communication and many of those papers being the only paper on communication within a session. Given these circumstances, creating a network that makes all of the people working in the area more visible to each other becomes simultaneously more important and more challenging.

The process of identifying particular papers as ones that dealt with engineering communication demonstrated the difficulty of drawing boundaries around communication pedagogy and research. Combined with growing and increasingly dispersed interest, this lack of clear boundaries poses challenges for making communication pedagogy and research comprehensible and visible. It seems clear that integrative, multidisciplinary, and multi-institutional pedagogical approaches are more powerful than smaller scale, less diverse approaches. At the same time, the character of the papers presented at the 2019 conference suggested that integrative approaches with broad participation may be becoming less common.

We propose five concrete actions that LEES might ask ASEE's headquarters to undertake or undertake on our own as part of a Communication across Divisions Network aimed at increasing visibility, promoting coordinated activity, and advancing teaching, research, and practice in communication in engineering. Specifically, we recommend these actions:

1. Add "communication" (or possibly "engineering communication") to the list of interests offered in Monolith so that authors can identify their own work with the communication thread when they enter papers in the system.

2. Reach out to and actively pursue opportunities for collaboration with the other seven divisions that had papers on communication in their programs in both of the years included in our analysis (2015 and 2019): Chemical Engineering, Civil Engineering, Educational Research and Methods, First Year Programs, Mechanical Engineering, Multidisciplinary Engineering, and Technological & Engineering Literacy/Philosophy of Engineering.

3. Organize more complete sessions that deal with communication broadly defined, preferably with co-sponsorship from other divisions, with the initial effort focused on the seven divisions listed immediately above.

4. Encourage the writing of review papers that deal with the broad range of communication-related topics such as those identified in this research. Such papers would create more coherence in the scholarly conversation around communication in engineering and tend to be cited more frequently than papers that present the results of a single intervention and, thus, have a larger impact. Perhaps more importantly, review papers would provide great benefit to authors who have no formal background in writing or communication studies but want to engage in curricular innovation and educational research in those areas.

5. Recognizing the correlation between NSF or institutional funding and the quality of research/papers, make members more aware of funding opportunities and programs chairs and others more aware of the need for consolidating work in the area of communication.

We welcome collaboration and participation in the effort to define the purposes of and create a Communication across Divisions Network. Please contact either Judith Norback (jnorback.isye.gatech.edu) of Kay Neeley (neeley@virginia.edu).

References

[1] Gianniny, O. A. (1995). A century of ASEE and liberal education (or how did we get here from there, and where does it all lead? *1995 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 1995. Reproduced in D. F. Ollis, K.A. Neeley, & H.C. Luegenbiehl (Eds.), *Liberal education for twenty-first century engineering: Responses to ABET/EC 200 Criteria*. New York: Peter Lang, pp. 320-346.

[2] Neeley, K.A. & Norback, J. S. (2016). Communication across divisions: Overview, trends, and implications based on the ASEE 2015 conference. *Proceedings of the ASEE 2015 Annual Conference.* Washington, DC: ASEE.

Appendix

Papers Included in this Study

Alley, M., Cutler, S., and Tise, J., "Work in Progress: Embedding a Large Writing Course in Engineering Design - A New Model to Teach Technical Writing", W134, 25994, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Brand, M., and Lanning, J., "Improving Student Writing Outcomes Through Dynamic Feedback, Design Oriented Projects and Curriculum Modification", M506, 27076, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Buccalo, M., and Miskioglu, E., "Work in Progress: Training Chemical Engineers as Technical Communicators", W405, 27237, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Chang, C-N., Patterson, D., Lavadia, C., Fowler, D., and Arroyave, R., "Showcasing Interdisciplinary Capabilities: Employers' Perceptions on Reflective ePortfolios", M328, 26426, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Clippinger, D., Jernquist, K., Nozaki, S., and Nitterright, F., "Improving Undergraduate STEM Writing through Common Language as a Tool to Teach Engineering 'Dialects'", U449, 27049, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Clobes, A., and Wheeler, L., "SciComm: An Oral Communication Professional Development Program for STEM Graduate Students", M528, 26824, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Cunningham, K., "Graduate Engineering Peer Review Groups: Developing Communicators and Community", M528, 25266, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Degenhardt, D., and Woodard, B., "Applying Project-based Learning with an Emphasis on Engineering Communication for First-Year Students", T127, 26486, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

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Eggleston, A., and Rabb, R., "Experiential Learning and Communication: iFixit in the Technical Writing Classroom", W134, 26021, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Eggleston, A, and Rabb, R., "Returning to an Industry-informed Technical Writing and Communication Course Design", M507, 26024, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Eggleston, A., and Rabb, R., "Student Teamwork and Leadership in an Engineering Technical Writing Course", W441, 26016, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Eggleston, A., and Rabb, R., "Veteran Student Leadership Skills in an Engineering Technical Writing Course", T156, 26003, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Evans, M. and Jordan, M., "How Writing for the Public Provides Affordances and Constraints in Enacting Expert Identity for Undergraduate Engineering Students", U534B, 27378, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Evans, K., and St.Amant, K., "Structure of Professional Components for a Multidisciplinary REU Program", W441, 25449, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Fenner, R., and O'Neill, P., "Board 44: W in Progress: Integrating Writing into Engineering Labs: Developing Curriculum and Creating a Writing Fellows Program", T314, 26469, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Fife, E., "Making the Case for Technical Communication Courses in Ph.D. Engineering Curricula", U514C, 26643, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Frenkel, M., Bringardner, J., and Rajguru, S., "Work in Progress: Student to Scholar: A Learning Community Model for Professional Skills Development", M414C, 26796, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Friesel, A., and Dubikovsiky, S., "Intercultural and Interdisciplinary Communication Skills as a Component of Engineering Education: International Design Projects", T532B, 26091, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Garner, J., Alley, M., Kuhn, M., "WIP: Common Practices in Undergraduate Engineering Outreach, T134, 25386, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Gravé, I., "Improving Technical Writing Skills Through Lab Reports", W426, 26094, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Haluschak, E., Tank, K., Moore, T., and Johnston, A., "Actions and Approaches of Teachers Communicating Computational Thinking and Engineering Design to First Grade Students (RTP)", T533A, 26465, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Harron, J., "Work in Progress: Multidisciplinary Learning between Engineering, Communication, and Fine Arts Majors through the Creation of Movie Special Effects", W441, 27404, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Heywood, J., "Cui Bono. Engineering and Technological Literacy and Higher Education", U549, 25326, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Hilgarth, C., "'Where do we go from here?' A Discussion Regarding Technological Literacy/Philosophy of Engineering", U549, 26509, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Hillsley, J.V., and Zhang, X., "Work in Progress: Improving Critical Thinking and Technical Understanding as Measured in Technical Writing by Means of I-depth Oral Discussion in a Large Laboratory Class", W405, 26429, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

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Hubka, D., Chi, E., Chen, Y., Svihla, V., Gomez, J., Datye, A., and Mallette T., "A Writing in the Disciplines Approach to Technical Report Writing in Chemical Engineering Laboratory Courses", W426, 25222, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Jarvie-Eggart, M., Kasson Fiss, L., Kitalong, K. S., "Exploring the Relationship between Communication Skills and Performance in First-Year Engineering," T127, 25357, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Johnson-Glauch, N., and Herman, G., "Board 77: Visual Representations Guide Students' Use of Conceptual Knowledge and Problem-solving Strategies", M286, 25041, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Joseph, S., Oh, J., and Dandu, R., "Adapting Graduate Courses to Meet Industry Needs", M328, 25107, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Kaiphanliam, K. M., Adesope, O., Gartner, J., Reynolds, O., and Van Wie, B., "Work in Progress: Improving Undergraduate Engineering Education Through Writing: Implementation in the Classroom Alongside a Hands-on Learning Pedagogy", W405, 26946, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Keyvani, L., and Grahame, K., "Preparing First-Year Engineering Students for a Career where Communication Skills Matter", T127, 25765, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Kim, D., and Kim, J-H., "How Engineering Students Draw Conclusions from Lab Reports and Design Project Reports in Junior-level Engineering Courses", M335, 25557, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Kim, D., Riley, D., and Lulay, K., "Preliminary Investigation of Undergraduate Students' Zone of Proximal Development (ZPD) in Writing Lab Reports in Entry-level Engineering Laboratory Courses at Three Universities", T126, 25572, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

Kim, J., Campbell, R., Nguyen, N., Taraban, R., Reible, D., and Na, C., "Exploring Ways to Develop Reflective Engineers: Toward Phronesis-Centered Engineering Education", U534B, 26319, *2019 American Society for Engineering Education Annual Conference Proceedings*, Washington, DC: ASEE, 2019.

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