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Organizational Barriers to Conducting Engineering Education Research in Education-adjacent Industries

Dr. Nikitha Sambamurthy, zyBooks, A Wiley Brand

Nikitha Sambamurthy is the Editorial Director at zyBooks, at Wiley Brand. She completed her Ph.D. in engineering education at Purdue University, and has since been dedicated to bridging engineering education research and engineering education industry.

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Abstract

Engineering education researchers in university settings have many resources available to conduct efficient and effective research. Some examples include an Institutional Review Board (IRB) to review human subject research, the use of university libraries for literature, and access to classrooms to conduct experimental research. Thus, it is no surprise that engineering education research is most often conducted within and by researchers in universities. As interest in engineering education grows, members of the engineering education community who work in industry sectors adjacent to the formal education sector are also looking for ways to get involved with the engineering education research community and conduct engineering education research. Organizations like ASEE encourage industry-academia collaborations through offering workshops and highlighting divisions such as the College Industry Partnerships Division. However, these collaborations rely heavily on the resources of the academic partner. This prompts the question: To what extent is it possible for industry professionals to conduct engineering education research without an academic partner? What barriers exist for those conducting engineering education research while working in education-adjacent industries? This work in process paper outlines our approach to addressing these research questions by collecting data from colleagues at two education-adjacent companies. From this research, we hope to gain a better understanding of how industry members can overcome barriers to conducting engineering education research. We also hope to shed light on specific barriers that academic collaborations should be aware of, and ways academia can support industry in conducting engineering education research.

Key words: industry involvement, research-to-practice, educational technology

Introduction

Some engineering companies develop products that are used by academia in two ways. In the first case, the company's core product might be an industry tool that is taught to students in order to build their skills for future engineering careers. In these instances, the company may have their own educational division dedicated to providing students and instructors with resources for learning with or teaching how to use the products. For example, Intel offers several programs for students to learn and solidify AI skills (Intel® Distribution of OpenVINO™ Toolkit) and developing in cloud environments (Intel® Developer Cloud) [1]. For instructors, they offer a collection of lesson plans, labs, and assessments for the same curriculums mentioned [2]. In the second case, the company develops core products specifically meant for assisting instructors and students in learning. For example, Blackboard's core product is a learning management system

for hosting courses and handling classroom management. In addition to publishing textbooks, Pearson has developed the Mastering platform to provide interactive assessments for various courses and textbooks.

In both of these cases, industry has an interest in conducting education research to better understand the use of products by instructors and impact of these products on things like student learning. Conducting such research not only leads to insights that can help improve products to better help students and instructors, but also provides opportunities to hear directly from the academic community on problems that can be solved by new innovations. Moreover, such insights may also be useful to the research community, as members pose various questions that advance the body of knowledge. However, conducting such research can be difficult due to numerous factors, not like having direct access to classrooms in which technology is implemented, students using technology, or/and research infrastructure (e.g., Institutional Review Board (IRB) to review the ethics around the research) that is necessary for doing research well. To this end, the purpose of this work-in-progress paper is to outline a plan for investigating the barriers to conducting engineering education research from an industry viewpoint. The questions guiding this study are: To what extent is it possible for industry professionals to conduct engineering education research without an academic partner? What barriers exist for conducting those engineering education research in education-adjacent industries?

This paper aims to build upon the work done by Boden and Borrego [3] to advance our understanding of the organizational barriers to conducting research in industries that are education-adjacent. Two companies with strong ties to engineering education will participate in this study: a software company whose product is widely used and taught in engineering courses across US universities, and an educational technology company whose product supports student learning and faculty classroom management. Both companies have an interest in ensuring their products support engineering learning and would like to conduct research around this area. The findings of this study will be based on in-depth interviews with industry professionals about their motivations for conducting engineering education research, research goals, research processes & infrastructure, and barriers they have encountered. Thematic analysis will be as part of developing a descriptive case study that highlights key barriers for conducting engineering education research when not in a university setting and opportunities for overcoming them.

Surveying the Nature of Existing Industry-Academia Relationship

While much literature exists for exploring the relationship between engineering industry and academia, literature focusing solely on industry and the barriers within industry to conducting engineering education research is limited. Previous literature has described the roles of faculty in industry-academia relations in three ways: (1) entrepreneur, (2) inventor, and (3) consultant [4]. The roles of industry in this relationship can be viewed in a similar way: (1) as a consultant, and (2) as a sponsor.

Consultant

Engineering industry has long partnered with academia to guide universities and departments in producing engineers with skills that are valued in the workforce. Industries have consulted on curriculum [5] and research projects with real-world and industry use cases [6][7]. In these cases, industry members share their knowledge about the skillsets they need employees to have upon entry into the workplace. They may also directly provide research opportunities or guidance on research for projects that are of interest and importance to the company.

Sponsor

Literature in engineering education research has focused on the role of industry in sponsoring discipline-specific technical research and projects [7][8][9]. While a lot of these instances involve providing funding, other instances include donating technology like laboratory equipment, providing laboratory space, and sponsoring research talks within the industry.

In all of these instances of literature, discussions of industry involvement focus more on the involvement in discipline-specific courses research, such as providing data solar data for an engineering course [7], and less on industry involvement in engineering education research. Additionally, obstacles in the industry-academia relationship have focused more on the academic side, especially on the expectations from academia, and ways to make such relationships more beneficial for both parties [10].

The intent of our research in progress aims to address the gap in understanding organizational barriers that exist solely within industry in their attempts to conduct engineering education research. This paper aims to achieve this goal by building on previous work that examined organizational barriers in interdisciplinary research, this time with a lens on the industry side of the academia-industry relationship.

Proposed Methods

We aim to conduct in-depth interviews about their motives, research goals, processes, and barriers they have encountered. We then will conduct qualitative analysis resulting in a descriptive case study that highlights key barriers for conducting engineering education research when not in a university setting.

Company Participants

We have identified two companies, each of whom falls into one of the categories described previously. The first company is a software company whose product is widely taught in engineering courses across US universities. This company's core product is an industry

standard used by engineers across many industries, and they offer several programs to assist students in learning the product. They also offer instructor forums for instructors to connect and share tips on teaching this tool in their courses. The second company is an educational technology company whose core products directly involve teaching engineering students various engineering courses, as well as handling some aspects of course management. Both companies have a vested interest in conducting engineering education research to ensure their products support engineering learning. Additionally, both companies have previously participated in research efforts, including attending various ASEE conferences as both presenters and sponsors.

The Interview Process

Initial interviewees in both companies were identified as people who had previously successfully or unsuccessfully tried to conduct engineering education research. We plan to identify other interviewees by asking participants to identify other members involved directly in the research, or who had any decision making influence in the research. Questions asked are guided along by understanding the company's interests and motivations for conducting engineering education research, describing their research, and understanding external and internal barriers to achieving their research goals. Some examples of questions include:

Company motivations
- Please describe the goals of your research.
- Why is your company interested in conducting engineering education research?
- Do you have a personal interest in conducting engineering education research?

Resources
- What resources did you have available to conduct research?
- What resources were lacking?
- Were you officially given resources like time and money to dedicate to this research or is this more of a side project you have created?

Academic partners
- Did you have an academic partner in this research? Why or why not?
- If the company had an academic partner: please describe the role of your academic partner in your research.

Data Analysis and Potential Expected Themes

While the goal of qualitative case studies is to organically discover themes, this section presents some examples of themes we anticipate to potentially see emerge, based on our experiences and initial conversations with participants.

Values

Previous research has identified the different outcomes expected and valued by both academia and industry. While academia places an emphasis on research and publication of results, industry values quick turnaround times resulting in products and patents [3][8]. As a result, frustrations around the perceived value of conducting research may arise in interviews, especially when participants do not receive support (in time given and/or money) to conduct research.

Access

Engineering education researchers in university settings have many resources available to conduct efficient and effective research. Some examples include an Institutional Review Board (IRB) to review human subject research, the use of university libraries for literature, and access to classrooms to conduct experimental research. Because companies do not easily have access to these resources, we expect to see some references to the difficulties in conducting literature searches and collecting student data in interviews.

Next Steps

From this research, we hope to gain a better understanding of how industry members can overcome barriers to conducting engineering education research. We also hope to shed light on specific industry barriers that academic collaborations should be aware of, and ways academia can help support industry in conducting engineering education research.

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