Work in Progress: What is the Impact of Research in Engineering Education on University Administrators?

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Background

This work is part of a multi-institutional project to understand how governance structures in engineering education impact educational reforms. Here governance refers to the diffuse process involving negotiation of institutional priorities, accreditation standards, and the content of blue-ribbon panel reports that often occurs out of the public eye. The goal of the larger research project is to develop a better understanding of the complex, interdependent structure of educational governance in engineering education. Unlike Europe where the Bologna Process [1] sets common standards for higher education, engineering in the US has a complex ecosystem consisting of many entities—some looking to support broad policy goals and others focused on narrow disciplinary interests—that together create the structural conditions that shape changes in engineering education. The project as a whole looks broadly at governance, particularly ABET accreditation, since it provides a common language across programs and recent changes to the criteria have created an opportunity to understand how change processes occur. Another aspect of the study is aimed at understanding the epistemic habits of engineers. Epistemic habits—or how individuals utilize and value knowledge—influence how engineering education reform efforts are supported and implemented through lens of the knowledge and the methods of a discipline.

Framework – symbolic interactionism

This work uses a symbolic interactionism framework. Symbolic interactionism derives from the social sciences [2] and is based on the premise that social structures are created through micro-scale interactions between individuals. These interactions occur both person-to-person and through culturally relevant symbols that allow individuals to construct social/symbolic "worlds" which influence their behavior. For example two individuals who interact can find the interaction rewarding if their worlds overlap since they have similar interpretation of events and meaning. Individuals who inhabit different worlds due to a lack of shared meaning or interaction may have very different interpretations of symbols and conversations and thus create misunderstandings. The symbolic interactionist framework posits that actions are based on internally held meanings—of other people, social structures, and objects—which are constructed over time through social interaction with others. Change, which may be internal and perceptual rather than external and organizational, occurs as meanings evolve over time through further interactions such as sharing information or negotiation of differences. When the individuals are administrators (department chairs, deans, or provosts) or faculty leaders the actions they take are assumed here to influence organizational trajectories. Change may thus occur through formal change processes as well as through day-to-day decisions that affect the trajectory of engineering degree programs.

In engineering education symbolic interactionism has been used in grounded theory research approaches [3]. The framework is often cited in work understanding engineering identities [4], [5], particularly non-dominant identities or those of under-represented groups given that their social worlds may not align with majority views. Symbolic interactionism has been used to

understand how change occurs in environmental behaviors [6] as well as change processes in higher education more generally [7]. Change processes have received considerable attention in the engineering education literature due to the perception of a gap between the guidance research has offered to improving education and the practice of engineering education. Change occurs through actions of individual faculty in their courses, but also through the diffuse and generally unseen processes of governance; it is this second form of change this work is concerned with. An underlying assumption of this work is that the results and methods of engineering education research (EER) develop actions and symbols that can inform and therefore affect governance processes which in turn impact or inform change efforts [8].

For this work the symbols investigated were conversational references to ideas from published work on engineering education—e.g. journal articles and reports—as well as subjects' descriptions of experiencing ideas from EER either through exposure through a workshop, presentation, or seminar or by interacting with an individual versed in engineering education research. In particular interview data was coded to find instances where such symbols from EER were used by individuals either in attempts to create meaning or mentioned in discussion of change or strategic thinking.

While still in the early stages due to the ongoing data collection efforts, the overarching goal of this part of the larger project is to arrive at a better understanding of the role research plays in engineering education change processes [9]–[11] as well as the relative effectiveness of different dissemination mechanisms. At this early stage the study is being framed around two research questions:

1) To what extent, and how, do academic administrators and policy makers in higher education draw on insights from EER in deriving policies and making decisions?
2) To what extent do the issues and challenges articulated by administrators match those articulated or identified by EER community?

Methodology

At the current point of this work-in-progress interview data is being coded in MaxQDA to understand how various representations or symbols that emerge from engineering education research are perceived by decision makers and used in both day-to-day and strategic decision making. The current data set consists of over 150 interviews from over 20 institutions which include universities as well as other governance agencies that play a role in engineering education including ABET, the National Academy of Engineering, and the National Science Foundation. Only a subset of the university data is analyzed here from schools that broadly represent the larger ecosystem of engineering education; the larger data set ranges from research intensive to predominately undergraduate, public and private, with an over-sample of minority serving institutions. Interviews were conducted using a semi-structured approach with questions focusing on elucidating the structure of governance at each institution. Interview subjects were selected by occupying a range of organizational levels at each institution—provost, dean, department chair, faculty member, staff member—determined by availability at the time of the visit.

To address the first research question a set of codes is being developed to identify symbols or interactions related to educational change processes and a second set for references to, or symbols of, EER. Codes are tagged as either direct and indirect references where direct references include reference to specific documents or events, or an interaction with specific individuals. Indirect references do not cite specific work but rather the symbols uses indicate knowledge of results or experts in EER. Coded data is further tagged with information about the institution and role of the interviewee in their institution. To address the second research question data will be analyzed from bottom-up and top-down perspectives. For the bottom-up view university interview data is being coded to identify key themes or motivations of change such as initiatives, issues, or strategic directions at each institution and the extent to which these map to, or are informed by, policy documents from national organizations (e.g. ABET, ASEE, NAE) that provide widely visible perspectives. For the top-down view interviews at governance organizations will be coded for drawing from EER or mentions of institutions that serve as examples. Mentions will be coded as direct or indirect. This WIP paper reports only on initial results from first RQ and bottom-up processes of the second RQ. Input from the larger community on ways to extend or improve codes is sought.

A set of draft codes have been developed based on a small subset of the data (approved interview transcripts). Based on the structural interactionist perspective coding included conversational references to artifacts or symbols such as papers or reports, organizations (e.g. NAE, ASEE), individuals (colleagues, visitors, experts, students), interactions (workshops, faculty hiring, etc.), issues or perceived needs (enrollment pressures, finances, etc.), and constraints that prevent actions such as value of disciplinary research, lack of time, financial resources, etc. Initial themes (discussed below) are beginning to emerge from the partially complete data set that are further informing code development.

Preliminary Results

The results reported here are part of the initial code development which focused on a large research-intensive university, a national private liberal arts university, and a regional minority serving institution. In terms of the first research question—how administrators and policy makers draw on insights from EER—the data coded so far indicates that change efforts in engineering education are mostly local and involve navigating a series of constraints which act as symbols administrators interact around and which shape their responses to the changing landscape of engineering education. Examples include resource constraints such as time and money, institutional or organizational structures including promotion and tenure processes, conflicts with other institutional priorities such as research, and faculty who stand in opposition to change.

Despite the belief change happens slowly, attempted improvements in engineering education are occurring constantly; the majority of interviewees could identify one or more efforts to improve engineering education they were or had been involved with directly, and knew of others on campus. However visible symbols of engineering education research—specific workshops, journal articles, reports—do not often directly appear in conversations about change. Exceptions to this are high profile national reports such as *The Engineer of 2020* among dean-level and above administrators and programs/efforts for which funding is available (e.g. RED [12] or

KEEN [13]) among a wider range of participants. Rather preliminary evidence indicates that information on EER flows through a combination of informal networks and conversations around high profile national initiatives which serve as beacons or catalysts for local change. The networks consist of interested faculty, local EER experts, and formal programs or initiatives (including faculty development) on- and off-campus. Using the preliminary framework of direct and indirect symbols indirect knowledge of EER seems to be much more prevalent.

Another preliminary finding is that symbols, knowledge, and artifacts related to EER seem to have more impact when they are used both at higher administrative levels such as deans and provosts (top-down) and by faculty who can undertake EER-related projects (bottom-up). Faculty spoke of the value of administrators who were supportive and could facilitate and resource projects. Administrators valued faculty who generated ideas to improve the institution and were capable of following through on those efforts.

Overall, the initial impressions arising from the preliminary dataset are that results from EER are used to support local needs more than to answer to, or address, national initiatives. Often national initiatives such as Engineering Grand Challenges [14] are appropriated to address local issues. These local issues typically are initiated by top-down and bottom-up partnerships in attempts to build an institutional or program identity. Examples include hands-on learning, entrepreneurship, or global programs. The goal of such programs is primarily to distinguish an institution is some way rather than to directly improve the education of engineering students. Individuals who are knowledgeable about EER often serve as catalysts for such efforts, seeding ideas into these efforts. Despite ABET's stated intent to stimulate innovation, accreditation is not seen as a means to distinguish an institution (unlike programs like EPICS [15] or NAE's Grand Challenges [14]), but rather as a way to preserve quality and encourage internal reflection on curricular issues. In the data analyzed so far ABET seems mostly disconnected from EER.

On the second research question—how the issues viewed by administrators align with priorities of the EER community—the overlap is large in some areas and smaller in others. Again interest in EER seems to be framed through a lens of local campus initiatives such as diversity, making, or entrepreneurship. EER artifacts and symbols enter conversations through faculty engaged in networks around such specific issues of local interest. With the exception of diversity and broadening participation there is often a mismatch between the local issues that are seen as important by administrators and what is often published and discussed in EER conferences and publications. Two issues raised fairly often by administrators often in the preliminary data set are the cost and accessibility of engineering programs and how to help faculty deal with rapid growth of knowledge in engineering disciplines.

Limitations

There are several significant limitations to this study and any conclusions are highly tentative given the limited data examined to-date. In other words do not take these preliminary results as suggestions for action or further research. From the symbolic interaction perspective the study focuses broadly on data available through interviews of a large number of individuals who occupy different niches in the engineering education ecosystem. More in-depth ethnographic observation of interactions was not performed and the use of semi-structured interviews may not

fully capture the ways that EER informs change. Feedback is sought on how to better understand "invisible channels" through which EER findings may find their way into administrative decisions as well as other means by which EER influences governance processes other than through established administrative channels. Additionally the framing of the interviews around issues of governance generally and ABET more specifically may limit participants from thinking broadly about the use of EER outside of these contexts. Similarly for the second research question a serious effort to capture the many issues identified broadly in engineering education community has not yet been made, so comparisons currently are limited. However planned future use of consensus reports to identify issues should enable *ad hoc* judgements of how EER is achieving policy impacts and identification of relevant concerns expressed by administrators.

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