WIP - Retention of women in engineering professoriate : A Systematic Review

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Abstract

This work in progress is a mixed-methods systematic review that addresses the gap in literature specific to the conversation around how the engineering professoriate retains women in the field. The National Analysis of Diversity in Science and Engineering Faculties at Research Universities has shown that there is a significant underrepresentation of women faculty within the field of science and engineering. In this work-in-progress paper we report on a mixed-methods systematic review of literature conducted to explore the retention of women in the engineering professoriate.

Keywords: faculty, women in STEM, professoriate, mixed methods systematic review

Background

'The National Analysis of Diversity in Science and Engineering Faculties at Research Universities' has shown that there is a significant underrepresentation of women faculty within the field of science and engineering [1]. Although the number of women earning PhDs in science and engineering has increased, the number of faculty members has not increased as much. This impacts the number of faculty members who can serve as role models and mentors to undergraduate and graduate students in engineering. Hence, similar to studies focused on female student retention in engineering, which is being extensively studied, there is a need to explore the recruitment and retention of female faculty within this profession, as they too faced various kinds of challenges within and outside their department. Consequently, this adversely affects the retention of female students in engineering [2]. Hence, similar to studies focused on female student retention in engineering, which is being extensively studied, there is a need in exploring the recruitment and retention of female faculty within this profession, as they too faced various kinds of challenges within and outside their department [3].

To start exploring this topic, we are utilizing a systematic review to better understand literature on women in the engineering professoriate and their retention. Specifically, we aim to explore where scholarship is being shared or disseminated, what was the primary motivation behind these research studies, and what solutions are being discussed in literature. A mixed-methods systematic review was seen as most appropriate to answer these questions, since we were interested not only in the numbers which a more quantitative approach would have yielded but also wanted to understand more deeply the rationale for the conversation surrounding women in the engineering professoriate - or lack thereof. Heyvaert, Maes and Onghena [4] state that while

conducting systematic reviews, mixed syntheses, as compared to "un-mixed syntheses," may provide "more complete, concrete, and nuanced answers" to complex research questions.

Method

This review follows steps described in exemplary articles describing systematic reviews conducted using mixed methods (e.g., [5]–[8]). The first step in data collection was to identify inclusion criteria. An inclusion criterion describes the type of primary articles included in the review, and is often directed by the purpose and research questions for the research syntheses [9]. Inclusion is driven by the research questions guiding the study. For the purpose of this systematic review, the inclusion criteria were:

- Date: 2017 or later
- Discuss women in the engineering professoriate in relation to either retention or persistence or both, as explicitly stated in their abstract.

Using these inclusion criteria, we then collected and critically appraised articles from the EBSCOHost: Education Research Complete and Engineering Village (Figure 1). We created a spreadsheet for the articles in this review and extracted information related to these articles such as Year of Publication, Author affiliation, Universities described, etc. From this analysis, we aim to identify the foci of current discussions regarding retention, persistence, and the representation of women in the engineering professoriate. We used an adaptation of the Search-Screen-Appraise methodology promulgated by Borrego, et al [9]. Figure 1, adapted from Borrego, et al. [9] provides a visual representation of the steps in my data collection process, and the number of articles filtered at each step. Thus, upon limiting the search to papers published from 2017 or later, we ensured that these papers were recently published (within the last five years). The initial search returned a total of *N=191* papers (Figure 1), including journal articles and conference papers. Preliminary analysis included removal of duplicates, which yielded *N=113* papers.

We conducted searches on Education Research through EBSCOHost and Engineering Village using the following keywords:
- Women Faculty
- Retention
- Engineering

We then proceeded with the screening process, which entailed reviewing abstracts and making decisions to include papers using the following criteria:
- Discussed women in the engineering professoriate
- Study and/or discussion included retention, persistence, or both
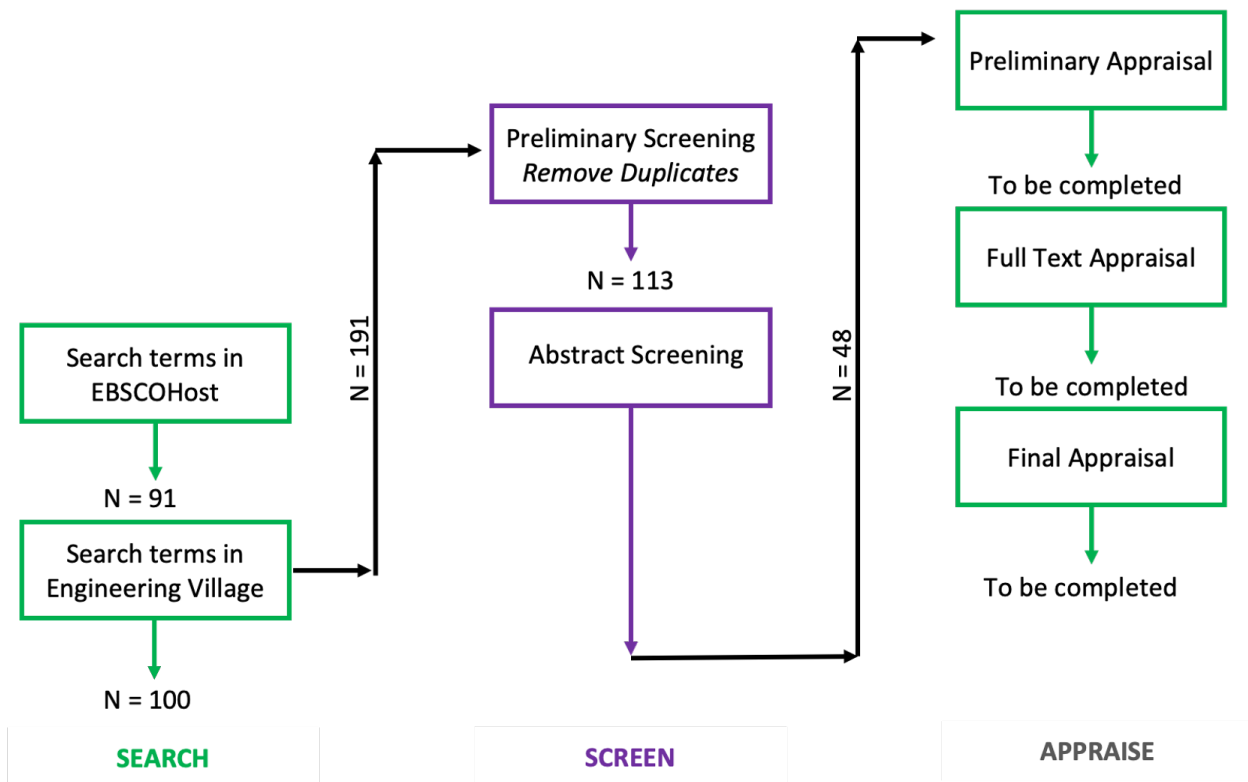
Figure 1. Systematic Review Process

Data Analysis

To analyze the papers collected, we first conducted a deductive analysis by reading all paper titles and abstracts and identifying content relevant to our research questions and search criteria. With these criteria in mind, to ensure quality, at least two authors read the titles and abstracts of each article and removed those that clearly did not meet the criteria. We also documented in Microsoft Excel our rationale behind the decision to include or exclude specific papers in order to ensure transparency and trustworthiness [10] of the systematic review. The characteristics of the analyzed papers are described in the next section.

Results

Preliminary results from analyzing the 48 papers included in our review highlight three findings that can be used to form recommendations for the engineering education community. These findings are based on the themes captured from the ongoing conversation on this topic in literature: (1) Research on the retention of women in the engineering professoriate is backed by grants and funding opportunities to study the topic, (2) Research on this topic is disseminated widely although journal scholarship is not limited to popular engineering education publishing venues, conference scholarship comprised primarily those popular in the field, and (3) The

concern is global and expressed similarly across departments and discipline, however, contexts focus on describing specific departments or disciplines.

(1) Research on the retention of women in the engineering professoriate is backed by grants and funding opportunities to study the topic

A key similarity across the studies was that most of them mentioned being backed by a grant or award funding from an institution that promotes advancement of women in STEM. For example, the ADVANCE: Organizational Change for Gender Equity in STEM Academic Professions (ADVANCE) grant has allowed institutions to explore such topics as building a more supportive climate for women faculty in engineering [11] and barriers to career advancement and success among women faculty in engineering [12].

(2) Research on this topic is disseminated widely although journal scholarship is not limited to popular engineering education publishing venues, conference scholarship comprised primarily those popular in the field.

Our process yielded a total of 48 papers spread across a variety of publication avenues including peer-reviewed journals and conference proceedings. A good percentage of accepted papers after the screening were published in the Proceedings of the American Society for Engineering Education (ASEE) Annual Conference and Exposition (39.58%) and in the Frontiers in Education (FIE) Conference (12.5%). The studies published as journal articles spanned five different journals, with one journal representing about 5% of the studies: Journal of Diversity in Higher Education. Only one engineering-education specific journal was found in the list: International Journal of Engineering Education, which published the paper describing the *factors affecting women's persistence in chemical engineering*. This finding highlights the need for researchers to publish more in the engineering education specific journals, since the readership of these journals are the administrators and educators who are the key audience for this scholarship.

(3) The concern is global and expressed similarly across departments and disciplines, however, contexts focus on describing specific departments or disciplines.

A number of the papers included after the screening process described programs and research efforts at specific institutions and departments, such as the University of Southern California [13]; Purdue University [14]; and geotechnical engineering [15]. All of these papers highlight the same concern of identifying barriers to success among women faculty in STEMm as well as recruitment, retention, career advancement, and opportunities to assume leadership roles for women in the engineering professoriate. This is probably due in part to funding opportunities that specifically support institution-based programs, strategies, and initiatives on broadening participation in the STEM professoriate.

Next Steps

The next step for analysis will involve appraisal, which is divided into three cycles: preliminary, full text, and final [9]. Specifically, we will continue to answer the following research questions:

1. What proportion of literature discusses the retention of women in the engineering professoriate?
2. What is the current state of diversity and representation, and how does it vary based on university type?
3. What are the barriers already identified in literature for retaining women in the engineering professoriate?

For all these phases, we will categorize the 48 included articles based on relevance to our three overarching research questions. This process will include the development of a coding scheme for review and analysis, and will yield a codebook that will document patterns and themes that emerged from analysis. The codification of the reviewed papers will be provided in a future publication.

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