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Methods for Conducting a Scoping Literature Review on Institutional Culture and Transformational Change in Engineering Education

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Work In Progress: A Scoping Literature Review on Institutional Culture and Transformational Change in Engineering Education

Abstract

This work in progress details the methods used to conduct a scoping literature review (ScR) on the current state of the literature concerning institutional culture and transformational change in engineering education. The purpose of this study is to investigate the intersection between institutional culture and evidence-based practices for transformational change in engineering education. As this has yet to be mapped adequately in the engineering education literature, the research team expanded the search to the broader body of STEM literature on higher education institutions in the U.S. The completed study will identify current trends, theories, and potential gaps in the literature.

Keywords: scoping review, institutional culture, theories of change, transformational change

1. Introduction

Institutions offering engineering programs often implement generalized change strategies, but these strategies tend to have little impact on institutional culture. Since the late 1980s, Tierney has argued that institutions with similar missions and curricula can have different outcomes based on how their identities are communicated to internal and external constituents and the perceptions held by these groups [1]. The results of such changes, however, may be confined to a specific area of the institution, or the institutional environment may not be responsive to the changes implemented [2]. Faculty and administrators must implement intentional and continuous change strategies to address complex institutional challenges [3]. Intentional change requires a deliberate course of action, while continuous change requires responsiveness to stakeholders and the external environment [3]. Instead of using generalized strategies, engineering education institutions should assess their specific environment and context from a cultural perspective. This will allow for a more personalized approach and determine the best actions toward change.

In this publication, culture refers to *"shared systems of meaning and practice emerging from collective learning and taught to a group's newcomers as the correct way to think and behave"[4, p. 2]*. An institutions' culture is influenced by external factors (i.e., demographic, economic, political) and internal social dynamic of its stakeholders (i.e., history, values, processes) [1]. For transformational change to occur in this context, the changes implemented must be intentional, deep, and pervasive so they can change select underlying assumptions, institutional behaviors, processes, and products, therefore altering the institutional culture [3].

2. Methodology

The emergence of engineering education research as a new form of inquiry in the early 2000s has made evidence-based practices crucial to inform decision-making for practitioners and leaders. To conduct a preliminary examination of the potential size and scope of available research literature, a Scoping Review (ScR) is essential [5], [6]. The primary purpose of an ScR is to identify the nature and extent of research evidence and describe the state of the literature in a

specific area without using formal quality examination in the inclusion or exclusion criteria [6]. An ScR may also indicate whether conducting a systematic review would be appropriate [7].

2.1 The Scoping Review Protocol. During the initial phase of the ScR, the research team must be critically reflective of the process, re-visiting prior stages to ensure that the final review meets the project's desired scope and research questions. The research team currently consists of an engineering librarian, two literature reviewers, and one content expert. Arksey and O'Malley's methodology informed the development of the scoping review protocol utilized in this publication [7]. As shown in Figure 1, the proposed protocol includes five ScR stages: (1) identify the research questions, (2) identify relevant studies, (3) select relevant studies, (4) chart the data, and (5) collate, summarize, and report. The engineering librarian, who specializes in systematic reviews and engineering education, aided in the refinement of this protocol.

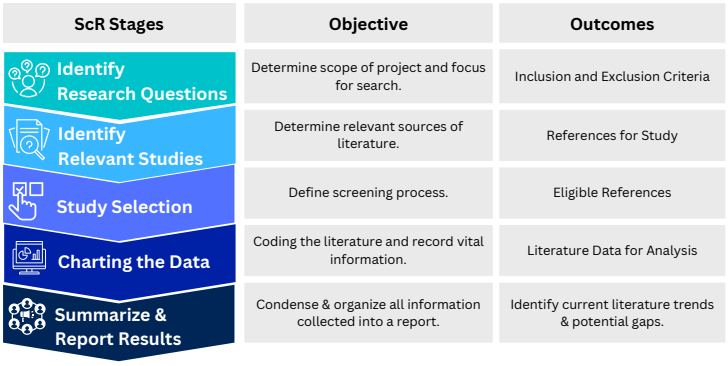

Figure 1. Five Stages of a Scoping Literature Review

(1) Identify the Research Questions

What is the current literature landscape about institutional culture and transformational change at engineering institutions of higher education in the U.S.?

(2) Identify Relevant Studies

From the research question and aim of the study, three main inclusion criteria were created: (1) the literature must discuss both organizational culture and transformational change, (2) the discussion of transformational change must describe the institution where the change happened, and (3) the literature must emphasize the agents of transformational change. Additional inclusion and exclusion criteria were created as a collaboration between the librarian and the other research team members. These criteria are summarized in Tables 1 and 2.

These criteria guided the search for existing literature in the following online databases: Compendex (Engineering Village), INSPEC (Engineering Village), ERIC (ProQuest),

Central Inclusion Criteria	Working Definition	Synonyms
Institutional culture	institutional norms; typical associations and expectations in a given institution	organizational culture
Cultural change	shifting paradigms and/or perspectives as related to culture	change in culture
Transformational change	change aims to modify not only practices, but outcomes, thereby disrupting the status quo	transforming change, transformation, systemic change
Engineering education	the discipline involved in problem-based teaching and learning; it integrates knowledge and practices from the sciences, economics, language, and creative arts	
Higher education	Education beyond the secondary (high school) level	college, university, post-secondary school/ education, tertiary school/education, third-level school/education

Table 1: Central Inclusion Criteria.

Additional Criteria	Working Definition	Implementation
Publication type	Article or conference publication	Database search restriction
Written in English	Publication available in the English language	Database search restriction
US institutions	Institutions of higher education (college, university, etc.) located in the United States	Location was determined by reviewers during screening
Publications from the 21st century	Dates ranging from January 1, 2000 to the date of the search	Publication date was determined by reviewers during screening

Table 2: Additional Criteria.

Education Database (ProQuest), Scopus, and Web of Science. These six databases were selected as they often include publications relevant to engineering education. Individual document repositories, like ASEE PEER, were not searched directly as their search functionality does not support the same level of search query refinement as more extensive literature databases. Additionally, after verification by the librarian, most of the publications found in ASEE PEER are included in the selected databases, thereby providing a more robust search option while avoiding the exclusion of relevant articles.

As shown in Figure 2, the librarian and research team created a general search query based on the selected inclusion and exclusion criteria. As each database has its own specialized search syntax, the general search query was translated into a database-specific search strategy to ensure that the query remained the same across databases. Each database was searched individually, and results were exported to a citation manager (Zotero) in preparation for the Study Selection stage.

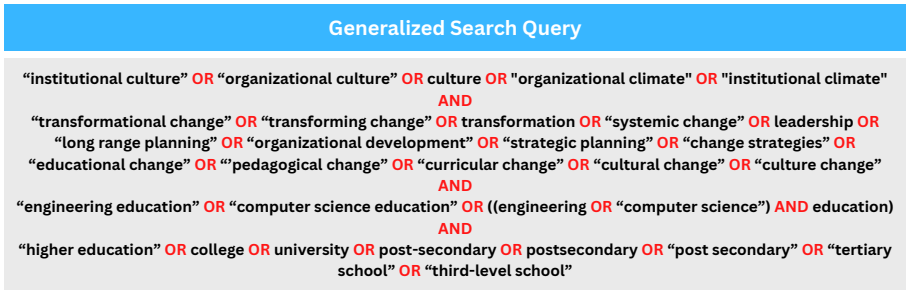

Figure 2: Generalized Search Query

(3) Study Selection

The Study Selection phase typically involves three screening cycles: Title Screening, Abstract Screening, and Full-Text Screening. Before each screening cycle, the inclusion and exclusion criteria were revisited, revised, and agreed upon by the research team. This screening process was performed iteratively, allowing for critical reflection at each stage to drive the resulting findings by the reviewers in consultation with the content expert. To standardize study selection among the research team, a Screening Tool was developed using the inclusion and exclusion criteria. This tool took the form of a dichotomous questionnaire to help the reviewers determine if a publication was eligible for inclusion.

After the Screening Tool was tested and refined by the research team, the librarian uploaded the publications identified during the previous stage to Covidence, a cloud-based systematic literature review management platform available online at https://www.covidence.org/, for screening [8]. Due to the way that Covidence displays publication data, Title and Abstract Screening were done at the same time. Two reviewers were randomly assigned publications to screen utilizing the platform. Once the reviewers voted, the content expert was able to view conflicts (where one reviewer voted yes and the other voted no) and serve as a tiebreaker to decide whether to include a given publication.

3. Results and Conclusions

3.1 Database Search. The librarian conducted the database searches on October 10, 2022, which resulted in 1,435 publications using the inclusion and exclusion criteria summarized in Tables 1 and 2. The results of this search are summarized in Table 3 (on the following page), with results

broken down by database, interface, and number of publications found, including duplicates. After duplicate removal, there were a total of 984 publications remaining. These publications were then moved into Covidence for phase (3) Study Selection.

Database	Interface	Results (N)
Education Database	ProQuest	108
ERIC	ProQuest	165
Compendex	Engineering Village	448
INSPEC	Engineering Village	293
SCOPUS	SCOPUS	355
Web of Science	Web of Science	66

Table 3: Results of the Database Search.

3.2 Title and Abstract Screening. The first round of screening in the study selection (third) stage of the ScR protocol was conducted by utilizing the Screening Tool. After resolving conflicts, 790 publications were found to be irrelevant and thus were excluded, leaving 194 publications for the Full-Text Screening. The reasons for exclusion are summarized in Table 4. Please note that publications may have been excluded for more than one reason, thus the numbers shown in this table exceed the total number of excluded publications. For this screening, there was 92% agreement (calculation: (906 ÷ 984) × 100 = 92%) between reviewers. This high level of reviewer agreement shows that the research team's initial reflection meetings were successful for this screening phase [9].

Reason for Exclusion	Records Excluded (N)
Publication was written in a language other than English	115
Publication date was before 2000	68
Not a study (e.g. review paper, workshop, correction, or erratum)	171
Study was located outside the US	447
Study did not involve an institution of higher education	313
Study did not involve engineering or a related subject	71
Study did not include a sample of college-aged students, faculty, or staff	89
No results collected, or no intervention took place	142

Table 4: Exclusions by Reason.

The 78 conflicts were addressed through a conflict resolution meeting mediated by the content expert. Most conflicts stemmed from a simple yet unanticipated issue: abstracts were non-specific regarding the country in which the study took place. Mitigating this issue required reviewers to take additional steps to confirm study locations (one reviewer took these extra steps while the other did not, thus leading to a "yes" vote and a "no" vote respectively). How the location question is presented to reviewers in subsequent Screening Tools will thus require significant revision moving forward to ensure that false negatives do not arise later in the screening process.

The next greatest cause of disagreement between reviewers was whether a study was engineering-related or not, as certain topics that were clearly engineering-related to some may not seem engineering-related to others. This issue seems to have arisen due to the reviewers having different backgrounds and thus varying ideas of what constitutes as engineering. For example, one abstract discussed climate change, which was not immediately recognized as related to engineering. The content expert clarified the matter during conflict resolution, and it was quickly corrected.

A partial PRISMA flowchart (Figure 3, on the following page) was created to summarize the current state of the ScR. PRISMA stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses. It is an evidence-based minimum set of items for reporting in systematic

reviews and meta-analyses in the form of a flow diagram [10]–[12]. Note that for the purposes of the flowchart, database results are consolidated under the interface used: Compendex and INSPEC under Engineering Village; and ERIC and Education Database under ProQuest.

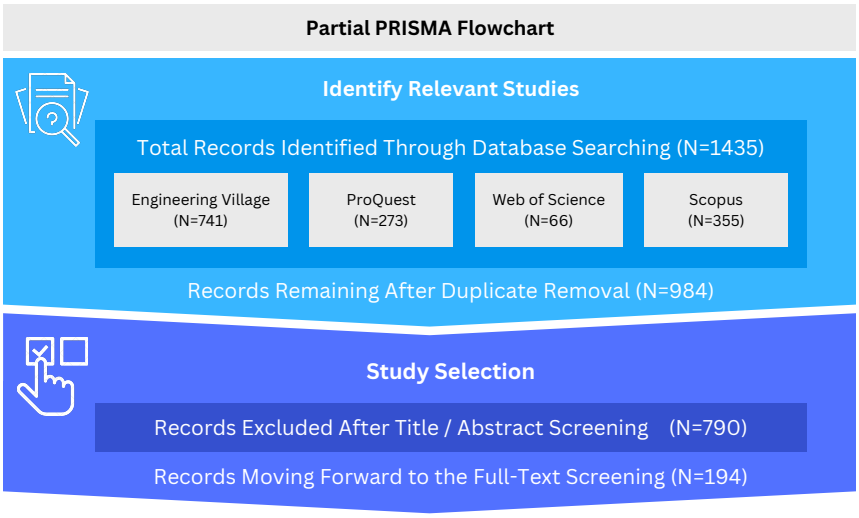

Figure 3: Partial PRISMA Flowchart of the WIP Scoping Review.

3.3 Future Work

The next step of the ScR will be the Full-Text Screening of the remaining 194 publications. Before screening can begin, the team will meet to review and revise the current Inclusion and Exclusion criteria to ensure that everyone agrees on what should be included. A Full-Text Screening Tool will be developed and tested against a small subset of publications to simplify the decision-making process. The Full-Text Screening will be conducted using Covidence as done previously for the Abstract and Title Screening wherein the reviewers are randomly assigned publications to review, and the content expert can resolve any conflicts that may arise.

Once the Study Selection stage has been completed, the research team will progress to stage (4) Chart the Data and, finally, stage (5) Collate, Summarize, and Report. When this process is complete, the research team will publish their findings, including an analysis of the literature that highlights the prominent themes, theories, and potential gaps that may be found. This future publication is expected to unite disparate lines of research on institutional culture and transformational change, challenge the assumptions in the field, and change the way engineering education views transformational change.

4. Acknowledgements

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