Reflections on the Messiness of Initiating a Systematic Literature Review on Broadening Participation in Engineering and Computer Science

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Abstract— **The rigorous, structured, and transparent review of literature on a particular topic can lead to promising insights about research directions, practical solutions, and potential policies. While the Systematic Literature Review (SLR) is a well-established methodology, it is rarely used in the field of engineering education. Though the use of the term "systematic" suggests a clear-cut process and there are resources available to describe the major steps of the method, the initial steps of a SLR are inherently messy—i.e., they heavily rely on the researcher's judgement and decision-making. Unfortunately, the messiness embedded in these steps is rarely discussed or described in existing resources. In this study, we reflect on the "messiness" of initiating a SLR on broadening participation in engineering and computer science. Informed by two existing approaches to reflection, we used the STAARA (Situation-Task-Affect-Action-Result-Aftermath) framework to reflect on the ways in which we resolved important decisions associated with one overarching situation and several corresponding tasks, affects, actions; the aftermath is also discussed. This paper includes insights from our experience that can help other researchers navigate the initial steps of a SLR.**

Keywords— systematic review; research methods; broadening participation; reflection

I. INTRODUCTION

Systematic Literature Review (SLR) is a research method for reviewing literature in a clear and methodical manner. Among other benefits, a SLR provides an opportunity to synthesize and highlight the current state of scholarship around a topic, and can be used to identify gaps in past research before determining next steps [1, 2, 3]. SLR requires researchers follow a prescribed process, which is often completed in partnership with a trained librarian familiar with the field, creating a transparent and reliable process that other researchers can replicate [1]. This research method dates back over a century, and its popularity has grown as researchers continue to use the approach to bring clarity to ambiguous areas of study [4]. Few studies in engineering education employ the SLR methodology. One example of this method being used in the field of engineering education was Borrego and colleagues producing an SLR on the use of the SLR method in the field [1]. In this study, a SLR is used as part of a study on broadening participation in engineering and computer science [e.g., 5, 6].

Like other research methods, the details of the procedures necessary to complete a SLR vary from project to project. Thus, we began our study by reviewing the literature to understand the various ways SLR have been conducted. We relied on two main sources of information on how to execute the SLR [1, 4]. First, Borrego and colleagues [1] provide an overarching framework for how to approach a SLR. They suggest that the SLR procedures be organized into two major groupings: the first group includes procedures focused on the selection of relevant studies; and the second group includes procedures focused on the pulling out the necessary information from said studies. Second, instructions from [4] supplemented these insights with more specific methods.

In short, a SLR includes 5 major steps [7]: 1) Formulate Guiding Research Questions and Corresponding Inclusion Criteria; 2) Find and Catalogue Sources; 3) Critique and Appraise Quality of Selected Literature; 4) Synthesize Insights; and, 5) Address Bias, Validity, and Reliability Concerns. In this paper, we present a conceptual framework for reflection and use it to reflect on the messiness associated with the first two of the five major steps in a SLR for a project focused on broadening the participation of African Americans in engineering and computer science. The rest of this paper is organized as follows: First, we provide an overview of the study and the rationale for conducting a SLR. Next, we, present the framework we used to guide the reflection on the "messiness" we faced during the initial steps of the SLR. Then we present the reflection itself. Lastly, we discuss the results and implications for others interested in conducting a SLR.

This study serves as a concrete example of how we enacted the SLR method and navigated the messiness of initial steps to reach a point of clarity. Future researchers engaged in a SLR will find this reflection useful because it presents a transparent account of the research process that is often omitted in literature. When researchers publish the results of a SLR, the decision-making process that happens in between the planning of the SLR and its initiation is lost and, oftentimes, readers only see the finished product. However, process is important when it comes to creating high quality research—the more information researchers have to help them make decisions along the way, the better the likelihood that high quality research will result from it. Furthermore, reflection accounts like the one presented herein are particularly valuable for

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methods that are rarely used in engineering education—like the SLR method.

II. Overview of the Larger Project

To assist the reader with understanding of the nature of this particular SLR, we provide an overview of the larger project in which it is situated. The larger project is focused on efforts to broaden the participation of African Americans in engineering and computer science. Beginning in the early 1970s, the field of engineering began to focus on broadening participation [7]. As a result, scholars—including researchers and practitioners—have spent over 40 years producing a substantial body of literature on this topic. Unfortunately, despite continued efforts to broaden participation, we have seen a decline in the proportion of African Americans earning engineering degrees [8, 9, 10]; a similar disparity exists in computer science, which is often housed in engineering [9]. This suggests that there is a gap between research and practice.

Thus, the goal of the larger project is to develop a conceptual model that more accurately depicts the relationship between research and practice in the context of broadening participation, and to outline a national agenda for coordinating the efforts of different stakeholders committed to this effort, particularly as it relates to African Americans in engineering and computer science. To achieve this goal, the larger project is organized into three phases designed to gather knowledge about the association between research and practice though incorporating existing literature and the perspectives of scholars engaged in this topic. Phase I includes conducting a SLR and Phase II includes conducting interviews with researchers and practitioners engaged in this topic across four junctures (i.e., K-12, undergraduate education, graduate education, and the workforce). The project concludes with a Delphi study during Phase III.

The focus of this paper is on how we initiated Phase I. While the 'S' in SLR implies a relatively straightforward process, we encountered important yet messy decision-making points as we performed the initial steps of a SLR. By "messy", we mean instances where a lack of clarity, ambiguity, or difficulty required disentangling before the prescribed steps outlined in the SLR resources [1, 4] could be completed.

III. Purpose and Research Questions

In writing this paper, our purpose is to offer researchers a transparent and concrete example of navigating the initial steps a SLR. To address this purpose, we use the following research questions to frame our process for the reader:

(1) *What judgement-laden (i.e., "messy") decisions did we encounter while initiating a SLR on broadening the participation of African Americans in engineering and computer science?*
(2) *How did we approach those decisions?*
(3) *What resulted from our approach?*

To answer these questions, we offer a reflection about our decisions and decision-making process to help readers who may confront similar instances of messiness as they initiate their own SLR on a similarly messy topic.

IV. Method of Reflection

Reflection is a process for exploring the meaning of experiences and the implications of said experiences for future actions [11, 12]. This process can occur before, during, or after an experience. In this paper, we use reflection as a tool to dissect the anatomy of our decision-making process during our use of the SLR method. More specifically, we use a framework to guide our reflections on decisions we faced during the initial steps of the SLR as well as how these decisions influenced subsequent steps. This approach facilitates transparency around the challenging situations we faced and the decisions we made along the way.

To meet the specific needs of this paper, we adapted and merged elements from two reflection frameworks and combined them to create a more suitable method of reflection. The reflection framework we made contains elements of the Situation-Affect-Interpretation-Decision (SAID) reflection model and the Situation-Task-Action-Result (STAR) interview framework. Fosmire and Radcliffe [13] used the SAID model to elicit reflections from students during their design process. Similarly, [14] described the STAR framework as a technique for eliciting interview responses. The STAR framework is commonly used as a heuristic when responding to behavioral questions during interviews (e.g., *Tell me about a time when you had to demonstrate leadership*). Use of the STAR framework ensures that the response includes the situation, task, action, and result. To leverage advantageous elements from each, we used elements from both STAR and SAID to develop the *STAARA Framework of Reflection.* STAARA is an acronym for the six major elements of the proposed reflection process: Situation, Tasks, Affect, Action, Results, and Aftermath.

Each component of the STAARA Framework of Reflection corresponds to a reflection question that people can ask themselves (or as we asked ourselves). They are: 1) *Situation*: What is high-level problem that you faced? 2) *Tasks*: What tasks do you we need to complete to resolve the problem? 3) *Affect*: What is your response to the implications of each task? 4) *Action*: What, specifically, do you need to do to in order to resolve the problem? 5) *Result*: After completing the action, what was the outcome of taking action? 6) *Aftermath*: What did you learn as a result of the actions you took? During the initial steps of the SLR, we answered each of these questions using recorded memos and other planning documents. We also kept an audit trail to record topics and decisions made during our weekly team meetings for the larger project.

In this reflection, we provide our answers to each of the STAARA questions with respect to the areas of messiness we encountered in our SLR. We reflect by first describing the overarching situation, and then describing the three tasks we realized we needed to perform to resolve the problem posed during the situation. For each task, we describe our affect in response to the task, the action we pursued, and the results of said action. We then describe the consequence of completing all three tasks in the aftermath. The organization of the reflection process is depicted in Figure 1 below. The Reflection subsections follow the flow depicted by the arrows (i.e. $S \rightarrow T_1 \rightarrow Af_1 \rightarrow \ldots \rightarrow Ac_3 \rightarrow R_3 \rightarrow A$.)

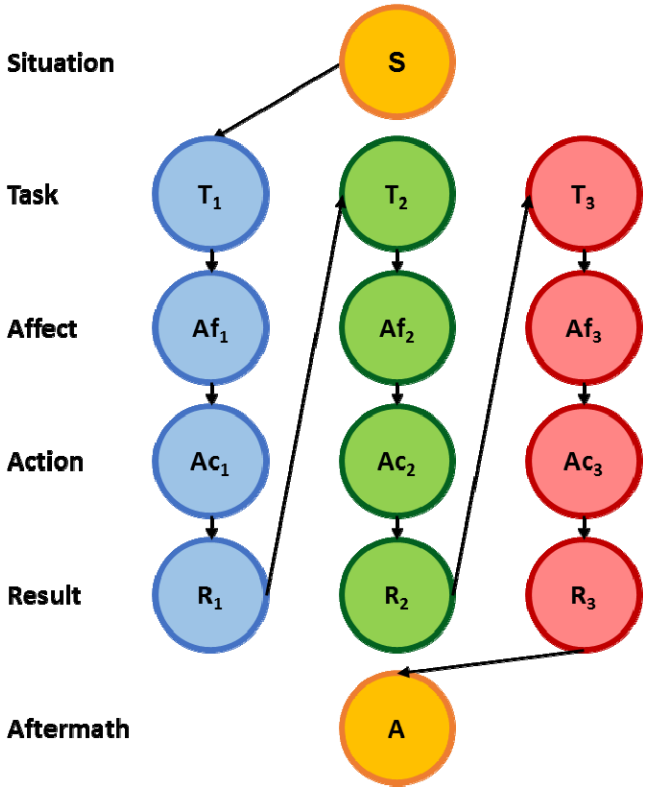

Fig. 1. Depiction of the reflection process based on the STAARA framework. The process began as one overarching **S**ituation that required three **T**asks to resolve. Each task had an **A**ffect, **A**ction and **R**esult. Upon completion of each task, we report on the overarching Aftermath.

V. Reflection

Situation: The Process of Selecting Relevant Studies

In this reflection, we concentrate on the process of selecting relevant studies. As previously stated, the first two major steps in conducting a SLR are to: 1) Formulate Guiding Research Questions and Corresponding Inclusion Criteria; and 2) Find and Catalogue Sources. Combined, this involves setting the inclusion criteria and finding sources. We concentrate on the selection process because the associated decisions determine the sources from which researchers will extract data before synthesizing insights. Therefore, it is imperative that researchers use foresight in their method of selection of studies to ensure they get the information they want to answer their research question.

We broke up the selection process into a series of three tasks requiring boundary work. Boundary work, defined by [15], is the process of argument that people make that effectively maps something as valid in contrast to something else as invalid. The three tasks that we needed to complete are outlined in the SLR process by [4]: (1) defining the publication date range (e.g., 1966-1991); (2) defining search strings; and (3) defining databases from which to conduct searches. It is worth noting that while the tasks are presented sequentially, the discussions surrounding them happened simultaneous. To do the boundary work necessary to complete each task, we engaged in an iterative and recursive group mediated process that required adjusting boundaries within the context of the social processes that dictate how and when knowledge around broadening participation had been generated, as well as how it has been organized for research. In terms of our project, boundary work was done by grounding our arguments around the social processes important to the generation of broadening participation knowledge.

Each of these tasks were completed in concert with the project librarian—who provided options on possible ways to proceed with each task. As a group, we weighed the pros and cons of certain options based on the consequences that certain choices would have on the resulting literature. Based on these pros and cons, we reached a consensus and proceeded with the implementation of each option. In the following sections, we discuss each of these tasks in further detail.

Task 1: Defining Publication Date Range

One major area of messiness we encountered was the bounding of the publication date range. The messiness within establishing a date range was related to identifying a range that was justified based on the goal of the project and history of scholarship in this area. As we learned, answering the question of how far one looks back depends both on the results of the database search as well as on a strong understanding of the historical process through which a particular area of scholarship has been produced.

Affect 1

Initially, we set an arbitrary publication date range of 25 years. However, the librarian encouraged us to develop a stronger rationale for the publication range. One possible boundary for the date range we considered was the date range given by the search results itself. At one point, the librarian informed us that dates could stretch back as far back as 1952. The implication of choosing the range solely on the resulting database search included the possibility of wasting project resources reviewing articles that are not closely aligned with the types of articles we wanted to obtain. After assessing the implication, we decided that having a sound rationale for a pre-conceived range would enhance the possibility of finding relevant articles, and would enhance the efficiency of the project.

Action 1

We decided that the best way to set a date range would be to study the publication range of the data that resulted from the search and to relate the results of the search to important events that influenced the production of research. We analyzed the

frequency of the publication dates of articles to identify areas of sustained density of publications. We identified that there was a large drop off in density of publication before the year 1975. We also brainstormed possible events that had major consequences on participation (or efforts to broaden participation) in engineering and computer science. Examples of this include the advent of changes in national events and policy (e.g., Civil Rights Movement from 1954-1968 [16]; Bollinger I and II Supreme Court decisions in 2001 and 2002 [17]) and the development of co-curricular and extracurricular programs with African Americans engineers as its focus (e.g. National Society of Black Engineers started at Purdue University in 1975) [7].

Result 1

Fig. 2 below shows the generation of research from one 5-year period to the next since 1975. As the graph illustrates, in every 5-year period of 1975-2014, publication output increased, indicating that interest in the research area has yet to peak. We eventually agreed on a publication date inclusion criteria of years 1975 to present (i.e., 2017) using the results about frequency of publications to inform our decision. We chose 1975 as a starting point because not only does it fit with the nature of the density of publications collected by the search; it corresponds well with important events surrounding the growth of research related to broadening participation. Close to 1975, federal agencies began funding programs aimed at broadening the participation of African Americans [7]. Furthermore, organizations dedicated to broadening participation were established during this time (e.g., National Society of Black Engineers, National Action Council for Minorities in Engineering) [7]. Needless to say, we chose the present as an end date because scholarship around broadening the participation of African Americans in engineering and computer science still continues.

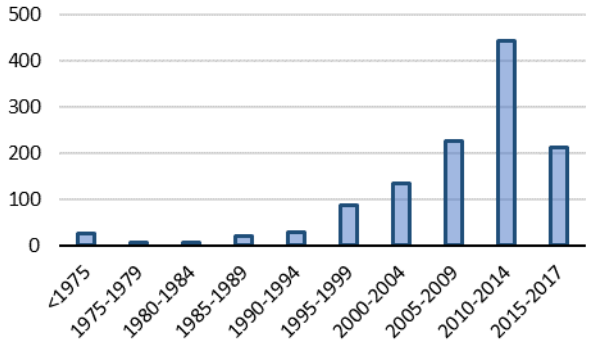

Fig. 2. Frequency of articles in search results published before and after 1975.

Task 2: Defining Disciplinary and Juncture Search Strings

Another area of messiness occurred when defining the search strings. The search strings (i.e., search terms and operands) needed to ensure that the search results would yield mostly relevant articles and filter out irrelevant articles. The messiness within defining the search string related to the idiosyncrasies of different search databases with varied search designs. We also needed to incorporate the broad taxonomy of keywords that researchers use when classifying their own work. For example, engineering education researchers Finelli and Borrego [18] developed a keyword taxonomy for engineering education research. To resolve the messiness of generating the search string, we underwent an iterative boundary work process to define and test different strings until the desired results were achieved.

Affect 2

Initially, a group of keywords were identified by the research team, and supplemented through feedback from other researchers who work in the field of science, technology, engineering, and mathematics (STEM) education whose work primarily focuses on underrepresented minorities. This initial list was quite broad and we considered grouping terms by juncture (e.g., K-12, college students, graduate students, and workplace). We also thought it might be useful to have some examples of articles that fit our relevance criteria on-hand such that we could use them to perform a preliminary check to see if our results were yielding the types of articles we hoped to find; these are commonly referred to as "sentinel articles." In addition to offering keywords, we asked researchers to offer sentinel articles as well.

Action 2

To establish the validity of the search terms, fourteen sentinel articles were used as a baseline for evaluating our search strings. The librarian reviewed the sentinel articles to expand and supplement the original list of keywords. However, she found that the original set of keywords returned less than half of the defined set of sentinel articles needed to validate the search. When searches did return the sentinel articles, the number of total articles was over 2000—many of which seemed irrelevant to the study, based on a quick skim of the titles. We noticed that the term "black" was one of main keywords associated with irrelevant articles. As a result, the librarian made several adjustments to the search string to maximize the completeness of the search while decreasing the number of irrelevant articles.

To create a more effective search string, the librarian re-organized the original keywords into several groups based on concepts. More specifically, the original set of keywords were classified as motivation or persistence; bias or discrimination; African American or black; and STEM, engineering, or computer science. While the original strategy resulted in search results that contained about half of the sentinel articles, the original set was grouped in a way that made it difficult for search engines to locate some of the sentinel articles. The librarian originally grouped the terms for motivation or persistence AND the bias or discrimination language, expecting both to be present. However, after further review of the results, she found that the Boolean operand "AND" limited the search results. The search string used words that included both a positive (i.e. motivation or persistence) and negative framework (i.e. bias or discrimination) of the experience of African Americans in the STEM fields—which is unlikely in a single paper. Thus, the search string Boolean argument was refined by using OR when using those concepts together. This significantly broadened the search results; the majority of the

sentinel articles showed up in the search results after doing this.

While it was good to see an increase in the number of relevant articles, we also wanted to decrease the number of irrelevant articles. To do so, the librarian applied additional limits within the context of each database. The grouping corresponding to African American or black search terms was limited to search in the subject, title, and abstract fields of the records to help remove any results where the terms may appear in other fields, like in the journal title, but not anywhere else in a record. Similarly, the STEM, engineering, or computer science group of terms was also limited to the subject, title, and abstract fields of the records to remove all occurrences of the terms being found in author affiliations.

Result 2

Table I includes an example of how we ultimately defined the search string for one of the databases.

TABLE I. SEARCH STRING EXAMPLE.

Database Name	Final Search String
Ebsco search interface (Education Source, PsycINFO) Search limits - all searches without field codes were searched without selecting a field code. The default setting of "select a field (optional)" was used.	((bias OR discrimination OR multicultural* OR inclusiv* OR racism OR prejudice) OR (motivation OR attainment OR achievement OR aspiration OR persist* OR retention)) AND (AB STEM OR SU STEM OR TI STEM) AND ((((AB STEM OR SU STEM OR TI STEM) OR (AB engineer* OR SU engineer* OR TI engineer) OR (AB "computer science" OR SU "computer science" OR TI "computer science"))))

Task 3: Defining Database Inclusion

One last area of messiness we encountered was deciding which databases to use. We needed databases that were subject appropriate, included the sentinel articles, and provided several types of scholarship (e.g., conference papers, journal articles, and theses or dissertations). Initially, the research team's pragmatism, excluding the librarian, considered only including some scholarship types. As we reviewed more information about how to carefully execute the methods associated with a SLR, we learned that exclusion of publication types would create publication bias, which would affect the validity of the findings [4]. Thus, figuring out how to include a robust set of articles from many publication sources required creating an argument that made sense with respect to the project goals.

Affect 3

The non-librarians of the research team were influenced early on by the potential for a large number of articles identified through preliminary data base searchers. (It is worth noting that "large" is relative to our experience. For the researchers, a data set including hundreds of articles was out of the ordinary; for the librarian, this was not as surprising as she previously encountered searches with much larger data sets). The large numbers sparked discussion among the researchers about ways to reduce this amount without losing the types of scholarship we were interested in and while staying true to the method. To avoid publication bias, we ultimately decided not to specify the publication types (and thus, we included all publication types included in the database).

The types of scholarship we could gather from databases included peer-reviewed journal articles, conference papers, op-eds written in periodicals, and deposited theses. However, figuring out how to include these different types of scholarship required finding out which databases to query. For instance, choosing to include conference papers that touched on topics related to broadening participation meant we would need to include databases that indexed the conference proceedings for subject appropriate articles. This is just one of many examples associated with determining which databases to query.

Action 3

We identified and categorized prospective databases based on subject appropriateness and accepted all publication types. It should be noted that we did not select any databases that solely index dissertations, theses, or conference proceedings.

Result 3

In Table II below, we summarize the databases, the types of scholarship, and subjects they indexed.

TABLE II. DATABASES USED IN SLR.

Database Name	Publication Type(s)	Subject(s)
Education Source, PsycINFO (EBSCO search interface)	Journal articles, conference papers, books, book reviews, educational tests (Education Source), dissertations (PsycINFO)	Education publications (general and STEM), both practice and research. Psychology, including educational psychology, behavioral science, and mental health.
Compendex, INSPEC (Engineering Village search interface)	Journal articles, conference papers, book chapters, dissertations, technical reports, book reviews	Compendex covers all fields of engineering. INSPEC covers physics, electric and electronics engineering, computer and control engineering, and some information technology. Both indexes also include some STEM education, particularly in engineering.

VI. AFTERMATH

Our decisions concerning publication date, search string definition, and database inclusion led to a new situation where we retrieved more than 1,200 articles. On one hand, the resulting set of articles included what we wanted—the sentinel articles we defined as the types of articles we wanted the search to included were present in the search. On the other hand, this meant that additional work was needed before proceeding to the information gathering stage.

While engaging in the initial steps of the SLR, we also realized that there are other types of reviews that we could

consider. More specifically, we came across an article that summarizes 14 types of reviews [19]. Among the options, the mapping review/systematic map seemed well-aligned with one of the research question we are the most curious about (i.e., an understanding of the state of scholarship on this topic). In short, a systematic map is described as a "map out and categorize existing literature from which to commission further reviews and/or primary research by identifying gaps in research literature" [19, p. 94].

The article also summarizes the methods details based on the search, appraisal, synthesis, and analysis. The search requires completeness of searching determined by time/scope constraints; this is the same as what is required for a SLR. There is no formal quality assessment; this is unlike what happens in step 3 of the SLR. The synthesis may be graphical and tabular; and the analysis characterizes the quantity and quality of the literature (e.g. based on study design and other key features). Oftentimes, it helps identify the need for primary or secondary research in an area.

In light of this, we are now conducting a systematic map and SLR simultaneously. The way this is operationalized is through coding each of the 1,200 articles at two stages. The first stage involves determining if the article fits the inclusion/exclusion criteria (as defined by the three questions aforementioned).

Articles that meet the inclusion criteria are coded based on the details of the study. More specifically, after three rounds of inter-rater reliability checks, we settled on a codebook that includes the three relevance criteria and codes associated with the publication year, disciplinary focus (i.e., engineering, computer science, STEM), juncture (e.g., K-12, undergraduate education, across junctures), participant demographic details (if applicable), study type (e.g., overview of an intervention, evaluation, research), and research methods (if applicable).

We are currently reviewing the set of 1,200 items for inclusion/exclusion before getting to the final set of data that would be used for data extraction (i.e., step 3 of the SLR). In short, we are reviewing the title and abstracts of each article to answer the following questions:

1. Is the study focused on education or the STEM workforce?
2. Is the article focused on engineering, computer science (or STEM if the focus is on K-12 experiences or issues)?
3. Is the article focused on issues or experiences of African Americans or some aspect of the variety of topics associated with broadening participation?

Articles that were marked "Yes" for each of these questions will be included in the final data set. Based on the current status of the review, we estimate that approximately half of the 1,200 articles will be included in the set of data that will be used for the data extraction. Once the coding is complete, we will disseminate the systematic map and pursue the next step of the SLR (i.e., Critique and Appraise the Quality of the Literature).

VII. Discussion

The purpose of this paper was to offer researchers a transparent and concrete example of navigating the initial steps of SLR. In the discussion we answer the original research questions rewritten below.

(1) *What judgement-laden (i.e., "messy") decisions did we encounter while initiating a SLR on broadening the participation of African Americans in engineering and computer science?*

The overall situation (i.e., the process of selecting relevant studies) resulted in three judgement-laden tasks: defining publication date range, defining disciplinary and judgment search strings, and defining which databases to include.

(2) *How did we approach those decisions?*

The different tasks each required an informed set of decision-making based on knowledge about the ways knowledge has been constructed regarding the broadening participation. Several practices helped the research team navigate this messy process – closely working with a subject-relevant project librarian, maturing our understanding of different types of systematic reviews, and engaging fellow researchers.

We thought that the most important practice towards the development of a successful search strategy was the continuous incorporation of the project librarian from the outset of the project. While a librarian's participation is mandated as part of any SLR, the role(s) of a librarian are largely up to the research team itself to define [20]. We recommend that researchers incorporate a subject relevant librarian into the development of the search strategy if possible. [20] described the importance of the librarian in the development of a successful search strategy, and furthermore, [21] specified the importance of a subject specific librarian. We selected a librarian with extensive experience working within engineering education because of our research topic. We recommend that researchers similarly tailor their librarian search around their experience.

Along with treating the SLR as a fluid process, researchers should also be knowledgeable of other types of reviews. SLR is one type of systematic review with its own set of strengths and weaknesses and other systematic reviews can be more appropriate than SLR at a given time [19]. For example, had we been aware of other types of reviews, we would have considered ways they would have helped us review the large number of articles we retrieved. Furthermore, we would have avoided discussions about excluding publication types in fear that we would have too many articles to review. Researchers should be knowledgeable about other types of systematic reviews along with the SLR to help assuage issues, like retrieving a large number of articles that we experienced.

Another useful practice was the early engagement of other researchers familiar with the topic. Petticrew and Roberts [4] listed the importance of expert input in progressing the SLR. Based on our experience, we one area where expert input was especially needed was in the identification of sentinel articles. To find sentinel articles, we contacted researchers through the team's social network to help identify a strong set of sentinel articles. We contacted colleagues working in the area of

broadening participation and queried them for articles they thought were relevant to the study. The incorporation of knowledge from our social networks greatly expanded the set of sentinel articles, and as a result, our overall ability to locate relevant articles.

Lastly, researchers should use the search process as an opportunity to learn about the social construction of knowledge with respect to their topic, and initiate the search process as soon as possible to allow for ample time to validate the search results. Both Borrego et al. as well as Petticrew and Roberts [1, 4] wrote that the manner in which knowledge has been created surrounding a research topic is important towards creating a successful search strategy. In our study, the messiness related to creating a successful search string also taught us about the complicated nature of our search topic. For example, some researchers have thought of broadening participation as a problem of attracting students, while others have looked at it from the perspective of discrimination and bias. These contradictory research perspectives illustrate the varied and complicated nature of research in the field of broadening participation, but also manifested in difficulties in creating the actual search string. A more successful search resulted when the librarian created a search sting that accounted for the complicated nature of broadening participation research. Hence, we want to forewarn other researchers with complicated topics that difficulties in their searches may be related to competing schools of thought among scholars doing research on the topic.

(3) *What resulted from our approach?*

Our approach led to the identification of ~1200 articles and our decision to complete a mapping review prior to deciding which articles to include in the remainder of the SLR. We are now in a much better position to proceed with the next steps of this project thanks to this intermediate step.

VIII. Conclusion & Implications

Improving our conception of an SLR as a research methodology, as opposed to merely a research product, was an important part of our process. While there are basic tenants of an SLR, these tenants are supposed to be used as guides to facilitate completion, not thoughtless instructions that take researchers from start to finish. As a result, researchers must decide how to enact the tenants of the SLR. Our advice to readers who choose to complete an SLR is to approach tasks with a flexible outlook, mindful that the next step in the process may go differently than originally planned. This is a normal part of the SLR process, just as it would be with any other research methodology. Researchers should be mindful of other types of reviews that may be help with the inherent messiness of the SLR process.

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