Opportunities and Challenges for Student-Faculty Collaborative Research in Small Predominantly Undergraduate Institutions: A Case Study

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Abstract

Student-faculty collaborative research at predominantly undergraduate institutions not only enriches the experience of both professors and students, but also provides unique opportunities for curricular and institutional transformation. This study explores the opportunities for and challenges of conducting research in a small-sized non-PhD granting college. A qualitative methodology is employed, including literature review, purposeful participant interviews, observations, surveys, self-reflection, and data analysis. Primary benefits and prevalent obstacles of conducting research for students, faculty, and the institution were identified. The results indicate that small predominantly undergraduate institutions are well positioned to develop distinguished research programs. However, a combination of student recruitment, faculty development, and administrative challenges hinder developing a more vibrant student-faculty collaborative research in these institutions. The paper is concluded with a list of suggestions for practical policy changes, necessary infrastructure additions, and non-monetary incentives that can boost research and scholarship activities in small colleges.

Keywords

Primarily Undergraduate Institutions (PUIs), Undergraduate Research, opportunities and challenges of research, teaching-intensive institutions

Introduction

The scientific community places increasing importance on research performed at Primarily Undergraduate Institutions (PUIs). The call for research expansion in these traditionally teaching-focused institutions stems from the belief that automation and artificial intelligence will soon replace the skills that have conventionally been taught in higher education institutions. According to a 2017 report from the Pew Research Center, ("The Future of Jobs and Training"): "Multiple studies have documented that massive numbers of jobs are at risk as programmed devices – many of them smart, autonomous systems – continue their march into workplaces. Workers of the future will learn to deeply cultivate and exploit creativity, collaborative activity, abstract and systems thinking, complex communication and the ability to thrive in diverse environments."[1]. Student involvement in research will equip students with the skills that will allow them to thrive in the future job market: collaboration, communication, content, critical thinking, creativity, and confidence. In fact, many PUIs have already adopted a teacher-scholar model in which faculty are required to actively engage with research in their respective fields of study, to remain updated with the rapid developments in science and technology and to provide unique benefits to their students[2,3]. However, the

research activity in Primarily Undergraduate Institutions (PUIs) has remained limited [4, 5]. Faculty in PUIs find it challenging to remain research active due to teaching and service obligations and having access to fewer resources[4], and the institutions have not yet managed to find fair, appropriate ways to value mentoring of undergraduate research in the tenure and promotion process[6].

This study explores the opportunities and challenges for conducting research in PUIs. Specifically, the aims of this study are:

1. To identify faculty perspective on the current research activity in PUIs.
2. To establish a prioritized list of opportunities and challenges for conducting student-faculty collaborative research in PUIs.
3. To determine the factors that affect faculty willingness to conduct more research.

Methodology and Case Description

A case study-based qualitative methodology, including literature review, purposeful participant interviews, observations, surveys, self-reflection, and data analysis was employed to achieve the research objectives (Figure 1). The case studied is the School of Engineering (SOE) of The Citadel, The Military College of South Carolina. The SOE has a total of 595 undergraduate students and 98 graduate students and includes four departments: Civil, Environmental, and Construction Engineering, Electrical Engineering, Mechanical Engineering, and Engineering Leadership and Program Management. The SOE has 35 full time faculty including nine professors, nine associate professors, fourteen assistant professors, one full time instructor, one visiting professor, and one full time adjunct professor (who is also a lab technician). Table 2 shows the composition of the faculty at The Citadel SOE. Current faculty assignment includes 60% teaching, 20% service, and 20% research. Only one full time graduate research assistant currently works at the SOE. While tenure promotion policy at The SOE varies among different programs and is rather subjective, as a general policy faculty are expected to have a minimum of two research activities per year. Example acceptable research products include publishing peer reviewed journal articles or conference papers, submitting research proposals, writing codes, standards, and textbooks, and other high impact research activities.
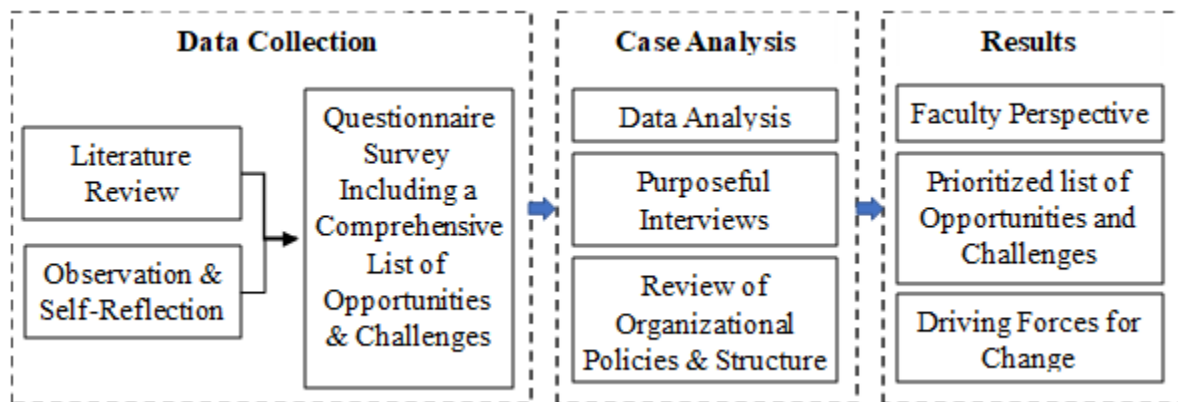

Figure 1. The Research Process

Table 1. Full Time Faculty at The Citadel School of Engineering

Department	Professors	Associate Professors	Assistant Professors	Instructor/visiting Professors	Adjunct
Civil, Environmental, and Construction	3	5	6	1	1
Mechanical Engineering	2	1	6	1	-
Electrical Engineering	4	2	1	-	-
Engineering Leadership and Program Management	-	1	1	-	-
Total	9	9	14	2	1

Literature Review

A review of the literature was conducted to identify a comprehensive list of the faculty, student, institution, and infrastructure opportunities and challenges for conducting student-faculty collaborative research in PUIs. Table 2 summarizes the findings from the literature. The outcomes of the literature were used along with a few challenges that the authors personally experienced to create an online survey of faculty opinion about the primary benefits and prevalent obstacles of conducting research.

Questionnaire Survey

The questionnaire included three sections: a. descriptive information about the respondent including affiliation and academic rank, b. questions about the importance of various opportunities and challenges on faculty interest to conduct student-faculty collaborative research; and c. faculty perception of the current research policies at SOE. The survey was electronically sent to all 35 full time faculty of SOE and 27 completed surveys were received indicating 77% faculty response rate. Table 3 summarizes the characteristics of respondents.

Table 2. List of Opportunities and Challenges for Research in PUIs based on the Literature

	Opportunities	Challenges
Faculty	Promotion, Self-Development, Reputation among scientific community, Keeping update in research topics, Motivation, Rewarding feeling of mentoring students, New knowledge and new outlooks that improve classroom performance[5]	Balancing mentoring time and teaching loads, Finding the right student, Funding Issues, Departmental Research Atmosphere, Colleagues' Research Collaboration Relationship, Stress and Pressure[3,5,10,14]
Student	Self-motivation and self-directed learning, Gain real-world engineering experience, Increased confidence, Learn lab techniques, Work independently, Interpreting experimental results, and understanding how knowledge is gained/constructed, Improved oral and written communication skills, Teamwork, Ability to understand primary literature, Better job opportunities and familiarity with the tools, equipment, and processes for solving engineering problems, Enhancing resumes, Contributing knowledge and impacting the world[7,8,9,10,11,12,13]	Lacking maturity , Inherent lack of knowledge that undergraduates have, Lack of experience, Lack of time, The mentor-student challenge comprised the level of engagement between the advisor and student, advisor availability, and student interest in the topic, personal issues in the student's lives such as financial issues, motivation/commitment, Financial and time constraints, Balancing research time and course schedules, Finding an available research opportunity, Colleagues' Academic Capacity[3,5,6,7,8,15,16,17,18]
Institution	Increased visibility in the scientific community, Reputation[2,12]	Lack of research materials and workshops to help foster a student's computer literacy, Organizational structure: Staff training on recruiting research assistants, Tenure and Promotion constraints and policies[15]
Infrastructure	Providing lab spaces, equipment, and educational resources through research grants.	Information Technology, Research Discussion Spaces, Research or Experiment Facilities on Campus, Paper Book and Journal Resources, Digital Book and Journal Resources, Research Software and Coding Resources, High tech laboratories on Campus, Availability of books, instruments and machines, Lack of Undergraduate Research Office that provides small stipends for the students to travel and present research[3,5,12,18]

Table 3. Affiliation and Academic Rank of the Respondents

| Department	Number of Responses	Response Rate (%)	Academic Rank	Number of Responses	Response Rate (%)
Civil, Environmental, and Construction	15	94%	Professor	8	89%
Mechanical Engineering	6	60%	Associate Professor	6	67%
Electrical Engineering	4	57%	Assistant Professor	12	86%
Engineering Leadership and Program Management	2	100%	Instructure/Visiting Professor	0	0%
			Adjunct	1	100%

Results

This section presents a summary of the findings of this study.

Faculty Perception of Current Amount of Research

Faculty split over the need for conducting more research at SOE (Figure 2). While 37% of respondents agree or strongly agree that more research should be conducted, about 26% disagree or strongly disagree that more research is needed. The remaining 37% were neutral about this question. Interestingly, mid-career faculty put greatest emphasis on research with 67% of Associate Professors agree or strongly agree that more research is needed at SOE. On the other hand, only 1 out of 8 respondents with the rank of full professor agreed that more research is needed. Additionally, strong feelings of faculty about the mission of SOE was most notable in this research. For example, one faculty member stated that "The Citadel is a teaching institution, and high impact research was not what I agreed to when I agreed to come on as a faculty." On the other hand, another faculty member was hoping for "Course relief. Some hook to help attract and retain top students." So that they can have more productive research program. Another finding of this study was that more than half of the faculty members (55.5%) would be willing to conduct more research in exchange for teaching load reduction (Figure 3)

1. There should be more research done in the School of Engineering at The Citadel.
27 responses
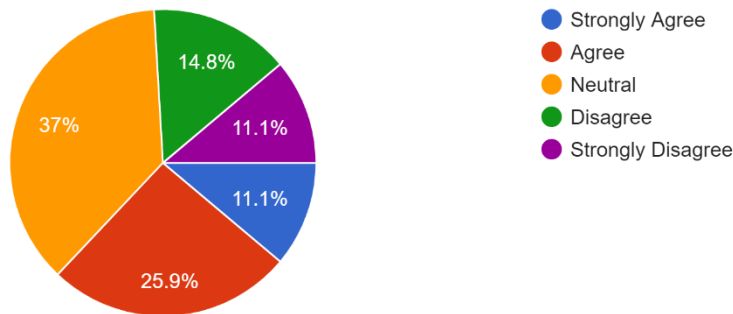
Figure 2: Respondents perception of current research quantity at SOE

2. You would be interested in doing more research in exchange for teaching load reduction.
27 responses
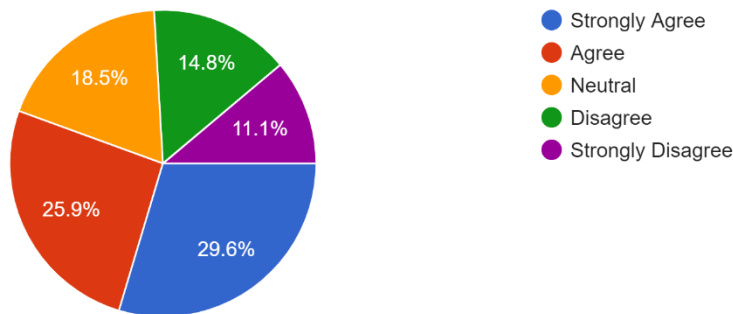
Figure 3: Faculty willingness to conduct more research given lower teaching load

Opportunities and Challenges

Relative importance indices were calculated for the research opportunities and challenges. As shown in Table 4, top 3 opportunities that faculty see in conducting research are to help students' academic experience, providing them with opportunities to gain real-world engineering experience, and improve their oral and written skills. On the other hand, findings the right student and balancing mentoring time and teaching time are the most significant challenges that faculty face to enhance collaborative student-faculty research.

Table 4: Relative Importance Index of Opportunities and Challenges

Rank	Opportunities	RII	Rank	Challenges	RII
1	Positive impact on a student's academic experience, self-motivation, self-directed learning and confidence:	4.11	1	Finding the right student:	4.19
2	Helping students to gain real-world engineering experience:	3.93	2	Balancing mentoring time and teaching loads:	4.00
3	Helping students to improve their oral and written communication skills, teamwork, and ability to understand primary literature:	3.74	3	Departmental Research Atmosphere, Colleagues' Research Collaboration Relationship:	3.67
4	Keeping updated in research topics:	3.70	4	Funding Issues:	3.37
5	Contributing knowledge and impacting the world:	3.70	5	Organizational Policies on research (such as tenure/promotion requirements):	3.33
6	Enhancing resume for both professor and student:	3.67	6	Dealing with Stress and Pressure:	3.30
7	Being promoted:	3.56	7	Availability of high-tech laboratories, Research or Experiment Facilities (instruments and machines) on Campus:	3.26
8	Enhancing Self Development:	3.56	8	Availability of Information Technology, Research Software and Coding Resources on Campus:	3.15
9	Better job opportunities for students:	3.56	9	Access to journal articles, paper book, and other digital research resources:	3.07
10	Gaining a good reputation among scientific community:	3.52	10	Availability of research training and workshops on Campus:	2.33
11	Improving visibility and reputation of your institution in the scientific community through presentations and publications:	3.44	11	Lack of opportunity to showcase your research on Campus:	2.19
12	Earning summer salary from research:	3.37			
13	Opportunity to travel and present your research:	3.11			

Conclusion

There seems to be a split of idea about necessity of conducting more research at PUIs, with a group of faculty members believing that too much research may distract teaching institutions from their primary mission of educating undergraduate students, while another group thinks research is an essential tool for effective training of students for the future world. Further research is needed to explore how each of the various engineering disciplines may be affected by expanding collaborative student-faculty research opportunities, and what discipline-specific challenges and opportunities exist. In future, we will broaden the scope of our research to engineering programs in other PUIs as well as non-engineering disciplines.

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