Work In Progress: The Impact of Project-Based Service Learning on Students' Professional Identities and Career Readiness

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Dr. Huihui Wang, is an assistant professor and the Chair of the Engineering Department at JU. JU is a private, undergraduate liberal arts institution in northeast Florida. Within our College of Arts & Sciences, the STEM disciplines continually draw the largest student enrollment numbers. In 2015, the Engineering Department transitioned from its 30 year history as an engineering dual degree program to a four year on-site program. The former program was affiliated with seven well-known universities including Columbia University, the University of Florida, and the Georgia Institute of Technology. JU opted to establish the onsite engineering program based on students' needs and interests as identified through feedback from the previous dual degree program. This four-year program can confer a BS degree in mechanical engineering or electrical engineering. The new engineering department has added two more faculty positions, put $200,000 towards upgrading equipment and facilities, increased retention rates and increased internship opportunities (Dr. Wang has supervised several interns). As a member of ASME, ASEE, IEEE, Florida Engineering Society (FES), and an advisor of NSPE JU Chapter, she actively participates in conferences, workshops and professional activities.

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WIP: The Impact of Project Based Service Learning on Students' Professional Identities and Career Readiness

1. Introduction

Project based service-learning (PBSL), as an innovative pedagogy and strategy, has been integrated into engineering education through curricular, co-curricular and extra-curricular activities in many universities to improve engineering education with many favorable impacts on students [1-10]. There is evidence that PBSL has a positive influence on student learning outcomes, as well as on an institution's recruitment, retention, and graduation rates such as EPICS (Engineering Projects in Community Service, started at Purdue University and now a national program), SLICE (Service-Learning Integrated throughout a College of Engineering) at University of Massachusetts Lowell, and the Global Perspective Program at Worcester Polytechnic Institute [3]. Researchers from four different institutions—Michigan Technological University, Tufts University, University of Colorado Boulder, and James Madison University conducted a longitudinal study to measure the impacts of service learning on engineering students' learning using five indicators, i.e. self-efficacy, motivation and retention, engineer identity, attitudes on learning, cultural competency and mental health [4]. Other universities or institutions also have either service learning programs or participate in the national program EWB (Engineers Without Borders) to engage students' learning and increase their civic engagement [1-14]. However, little research appears to have been conducted to understand possible correlations between PBSL and the formation of a student's professional identities, and how it will better prepare them to formally enter their chosen careers.

To address the existing gap in research regarding PBSL impacts, we are attempting to qualitatively explore the following two research questions in this WIP paper.

1) What are the impacts of different types of PBSL on formalizing an engineer's professional identities especially at Jacksonville University (JU), a Predominantly Undergraduate Institution (PUI) Liberal Arts (LIA) university?

2) What are the impacts of PBSL on students' career readiness (The definition of career readiness and how it will be measured are explained further in Section 2 and 3)?

In this project, four PBSL activities were designed and three of them were implemented. Four PBSL activities are described in section 4.

2. Theoretical Framework

Under the competitive social context, it is reasonable to educate engineering students to formalize their professional identities aligning with their careers as early as possible. In this project, we focus on exploring impacts of PBSL on engineering students' professional identities, and on their career readiness through the lens of social identity theories, the social cognitive career theory (SCCT) [15] combining with vocational choice and personality type theories. Studies to explore engineering career pathways mainly focused on two aspects: student career plan/choices, and early career paths after graduation [16-21]. In this project, we define career readiness consisting of two parts—academic readiness and career knowledge. We will give special attention to indicators of academic readiness and career knowledge which includes demonstrated career interests, choice goals, and choice actions according to the study in [22, 23] and SCCT theory. We select Woofound career readiness assessment tool as the assumptions of this study correlate with the preference and trait theories supporting each tool [24]. The Woofound uses data provided by the United States Department of Labor to determine personality traits that lead to success in the 1,100+ careers that we match through within the Traitify

application. This data has been gathered through interviews, surveys and extensive research into the fields to which we are matching [25].

3. Research Method

In this project, a mixture of qualitative and quantitative evaluation methods will be used based on the research methods listed in [26-29]. This paper however, focuses on the qualitative exploratory study of the impact of PBSL on engineering students' professional identities and career readiness since we are at the very beginning stage of this project. The team conducted first round, one-on-one interviews (qualitative) to become acquainted with participants' perspectives that will enable us to explore the impacts of PBSL on students' multiple identities (research question1). To better explore career readiness (research question 2). Woofound surveys were used to get the baseline data of their career knowledge for further study.

We used an ethnographic approach to interview engineering students in three PBSL activities. Ethnographic interviewing (qualitative research) involves an evolving process of prompting participants tell us what's going on, gathering terms and concepts from their perspectives. Since we want to explain participants' perspectives on their identities as engineering students, we cannot give the words/vocabulary to the participants that describe what they are doing--they must do that. The first round interviews focused on very general questions about participants' experiences as students in the engineering program. As we analyze transcripts we will refine our understandings of participants' identity-oriented language and explore connections to our research objectives. Domain analysis entails cross-checking amongst the investigators and the participants regarding accurate labeling of categories of terms in the domains that were used by participants. This analysis will reveal the meanings and understandings of the participants about issues of identity and career readiness in the unique ways they explain them.

4. Design and Implement PBSL Activities

The four PBSL activities are as follows:

1) "I am an instructor in a STEM class": At the moment of the writing, we are still discussing with a local high school for details. We plan to conduct this activity in fall 2017.

2) "Design customized food barrels for a food pantry": This project challenges sophomores to work on a project that is not strictly designed (assumptions, contexts, etc.) but has a concrete end goal. Through communication with employees at the local food pantry, 16 students in 8 teams interacted with them at each step of their projects such as design, development, and test phases to maintain constant goal alignment. This activity is being implemented into the Technical Communications course this semester. Each team writes self-reflection journals every two weeks and presents the progress of their projects. By the end of this semester, the food pantry staff will be invited to join students' final presentations and give feedback to students on their projects as well as their service learning.

3) "Understand and improve the water quality in the St. Johns river": This project allowed 13 students in 4 teams to start thinking of larger scale community issues. It required juniors to conduct research of designing systems to monitor water quality in our local waterways. They visited local water treatment plants to learn the fundamentals of water analysis and then designed, developed, and tested their monitoring system by collaborating with JU Marine Science Research Institute (MSRI). They also met with water plant engineers and administrators

throughout the project to get feedback. This project was incorporated as part of the course Introduction to Mechatronics last semester.

4) "FIRST (For Inspiration and Recognition of Science and Technology) Robotics Coach Program": Pairs of senior engineering students led teams of middle and/or high school students to participate in a seasonal FIRST robotic contest last semester. The senior pairs met with their team trainees at least 30 hours last semester to guide students to design and build robots for the competition. This activity will be implemented into a service learning course which will be counted as a technical elective course.

5. Data Collections

Semi-structured interviews (each interview took about one hour) were conducted for the purpose of establishing protocols upon which themes in the data were revealed. Data from interviews will be a source for the follow-up surveys and subsequent interviews.

5.1 Participants

Four engineering students were interviewed. The choice of students considered the diversity of their race, gender, and grade year. Their demographic information is listed in Table 1. Those four students who were interviewed took Woofound surveys too.

Table 1 Demographic Information of Interviewees

Student	Race/Ethnicity	Gender	Grade	Notes
A	Hispanic, Latino	F	Senior	Participated in PBSL 4, NROTC program (Naval Reserve officers Training Corps)
B	Black	M	Sophomore	Participated in PBSL 4, Veteran
C	Hispanic	M	Junior	Participated in PBSL 2
D	White	M	Senior	Participated in PBSL 3

5.2 Procedure

Our data collection procedure was approved by JU research board (JU IRB: 2016-042). Before each interview and Woofound survey, each participant signed a consent form agree that they allow us to present their results without identification information. This consent form was reviewed and approved by our IRB too. Each interview was digital recorded and transcription were coded to dig out interviewees' vocabulary and concept terms. All interview results are maintained in an electronic database protected by password on our department network. Woofound is an online survey at JU career resource center (CRC). Results of Woofound are password protected on our CRC network.

6. Findings and Analysis

6.1 Interview

During the first round interviews, we divided our students and faculty (two professors from engineering department, one professor from education and one professor from social science) into two groups. Each group has two professors and two students. In each group, one professor from outside the engineering field will be briefing the consent form so that there would be no coercion applied on students. We started asking general questions about their identities and then went to the question of impacts of PBSL on their identities. As the interviewing process continues, we will explore and document how participants' define and explain their perspectives

on identity, getting more specific and detailed with each interview. We will share our understandings of what participants say, using their own words, then confirm that what we understand about those works is accurate.

1. Give me a sense of what it is like to be a student like you in the engineering major.
2. Describe the typical student in your major in terms of what kind of people tend to be in your classes.
3. Is there a variety of types of people who choose your major?
4. What are the words you use to describe yourself to people who are also in college, but not in your major?
5. Tell me about how doing PBSL in your major has affected you personally, especially in the way you describe yourself to others.

We summarized four domains based on the interviews and transcription as follows. Due to the page limit, we only excerpt what they said corresponding to domain 4 which gives us preliminary data related with question 1.

Domain 1: What it's like to be in the program—relationships amongst students

Domain 2: What type/s of people are like to be in the program—people types

Domain 3: What type/s of people are like to be in the program—type/s of yourself

Domain 4: What impacts of PBSL on you are—changes of your personality or identity

Student A participated in PBSL 4 activities and she described her experience as a volunteer in elementary school robotics team as follows:

Interviewer: "When you think about that in the context of how you describe yourself. Where there any ways that you could see things like the hardworking, being helpful and unselfish as part of your robotics work. Is there a connection there at all?"

Student A: "Definitely. I also think that I tend to **overload my plate**. That is just my specific personality. I like to **take on every task available, I don't like missing opportunities**. So, that was a **volunteer opportunity that I thought would be really interesting**, especially I like working with that age group of kids."

Student B immediately spoke out "**hands-on experiences**" of **technologies and teaching**. He said that he did not know how large such a FIRST robotic program was regionally and nationally and how influential it was before he joined the team as a coach. He said he was **pretty happy** that our university was a partner of such a program so that they had a chance of participating in **PBSL 4 activities**.

Student C talked a lot about the project of PBSL2 in technology details. He quite **enjoyed the research training** through this project. This PBSL2 definitely **strengthened his 3D modeling and printing knowledge and skills**.

Student D worked on PBSL 3 and thought that it was an **interesting and rewarding** problem. He was **happy to have the opportunity to work on different types** of problems as an engineering student. He is also **double majoring in sustainability** and he commented on the how of studying **these two majors helped him to approach the problem**.

6.2 Woofound Surveys

To provide additional insight into students' career readiness, the four students, who were interviewed, also completed the Woofound surveys. The following table summarizes their results. Woofound usually lists top two out of seven categories of personality traits for each person as well as two career matches. Numbers in the table mean percentages of their personality traits.

Table 2 A summary of four students' Woofound Surveys

Students	Student A	Student B	Student C	Student D
Action-Taker	**89.37**	**100**	**93.95**	79.45
Analyzer	71.1	98.91	86.26	83.28
Inventor	60.26	97.62	46.48	**87.12**
Mentor	78.09	**99.32**	73.79	77.41
Naturalist	87.07	90.08	83.33	**92.91**
Planner	82.6	97.2	88.08	76.53
Visionary	**89.28**	89.93	**92.26**	79.43
Career Match 1	Training & Development Managers	Animal Scientist	Directors, Religious Activities & Education	Zoologists and Wildlife Biologists
Career Match 2	Judges, Magistrate Judges & Magistrates	Multimedia Artists & Animators	Geoscientists	Physics Teachers, Postsecondary

From their results, three of four students are action takers. Results make sense if we consider trainings of engineering majors and their backgrounds. Engineers are problems solvers and they definitely need to take actions to solve problems not just talk. Student D is planning to be an entrepreneur of a hydro plant farm after he graduates. That is why his top two traits are Inventor and Naturalist. The PBSL activities are trainings to strengthen their personality traits. Student B spent most time on coaching kids of FIRST robotic programs. Such an experience helped him to formalize or strengthen his mentoring personality trait. So it was not a surprise to see he was a mentor. Student A and C are both leaders of different student organizations so that they have strong visionary traits. Career matches list all possible potentially matching jobs for them. Some students did not realize some of them before taking such a survey. But when reviewing their results of personality traits and experiences they had, they claimed that it was pretty reasonable.

7. Summary and Future Work

This WIP paper introduces three PBSL activities conducted in our engineering department one PBSL activity we plan to conduct in the near future. The ethnography-based interviews were given to four students with different demographic and academic backgrounds. This is just very first round interviews and Woofound surveys. We form four domains as we interview and transcribe. Building domains guides our study, and helps us to construct follow-up interview questions based on what we see in the domains. Results just give us baseline data for both interviews and Woofound. We are cautious to conclude anything at this stage.

One of four students is a female student in our NROTC program. Her answers about her identities are different from other three male students. It will be interesting to explore more how the gender as well as the special program such as NROTC program, or student athlete program (about 25% of engineering students are student athletes) influence their perspectives about their identities and career readiness. Another one of four students is a veteran. Definitely his answers tell us that the military experiences influence his views about his own identities, our program and his choice of participating in one of PBSL activities. We will pay attention to veteran students' perspectives about impacts of PBSL since the percentage of veteran students is about 10% in our

department. The data of very first round interviews gives us directions and hints about follow-up interviews and survey questions. In addition, the results of Woofoud surveys give us the baseline to track their changes of their identities in the future. Two of interviewees will graduate this year so we will track their changes of identities and careers after they graduate on one hand; on the other hand, we will choose another three or four interviewees. Surveys of impacts of PBSL on their identities and career readiness (i.e. career knowledge part. The academic readiness will be assessed through student outcomes) will be designed and given to all students who will participate in PBSL activities to answer our research question 1 and 2 respectively.

The PUI/LIA universities typically have a high ratio students who are U.S. residents, many of whom will pursue professional careers and advanced degrees after receiving their B.S. degrees. Successful completion of this series of projects will better prepare students for their careers, strengthen relationships between local community organizations and our institution, and help produce excellent, civically-minded next generation STEM workforce.

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