Board 53: Engagement in Practice: Strengthening Student's STEM Identity Through Service

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I. INTRODUCTION

Volunteering offers participants the opportunity to develop their social network and connection with the local community. Volunteering can make adolescents more adept at connecting with social groups outside of their norm [1], increase their civic engagement [1], and increase their academic aptitude [2]. When community service is integrated into a school's curriculum, it has been found to increase students' enjoyment of learning, academic motivation, and performance [2-3]. In adults, reports have shown that volunteering improves physical and mental health, boosts self-esteem, and increases overall happiness [4]. Students who support community engagement initiatives such as volunteering related to their discipline, gain applicable experience and advocate for their careers [5].

Service learning is one type of community service in which projects are assigned within a student's curriculum [6]. Within the fields of Science, Technology, Engineering, and Mathematics (STEM), [7] research has been conducted on how to improve student retention and academic performance through this type of service [7-8]. The retention and completion of STEM major degrees need a balance of activities such as service learning, volunteering, and organization involvement through their four-year institutions [9]. While there are many studies on service learning and its impact on STEM, there are fewer studies done that focus specifically on the effects of volunteering in STEM activities. This paper looks at the effects of students volunteering in STEM activities outside of their own interests and time, as opposed to service learning. Two factors that will be studied in this research are students' sense of STEM identity [10] and STEM efficacy [11]; both of which suggest a student will be successful in a STEM career. These factors are defined under psychologist Albert Bandura's theory of self-efficacy, which states a person with a strong sense of efficacy will overcome challenges and achieve higher accomplishments [12]. STEM identity is the ability for one to recognize themselves as a STEM professional [13]. Since social factors such as race, age, and gender can affect individuals' STEM identity [14], these factors will also be evaluated within the research. For example, undergraduate Latina students in engineering programs who face challenges related to both their race and gender, struggle to feel validated and don't envision themselves transitioning into the workforce [14]. STEM efficacy is the belief and attitude in one's ability to succeed in STEM [15]. For instance, undergraduate students who participated in STEM-related activities such as mentoring and research reported an increased confidence in their ability to achieve their career goals as well as a stronger sense of overall self-efficacy [16].

There is a need to encourage more students to pursue STEM as it has been shown that there is a shortage of STEM workers in the United States. The number of people working in STEM ranges from 5% to 20% of all U.S. employees [17]. Furthermore, because approximately 19.4 million jobs require experience upon entering the position, up to 2 million job posts will remain unfilled [6]. Public colleges and universities make difficult decisions regarding the funding of student programs, support services, staffing, and intervention programs that increase the enrollment and success of underrepresented students in STEM [18]. Recognizing the need to improve student

retention in STEM, institutions have taken multiple approaches to adopting new frameworks to improve students' STEM identity and efficacy. Our approach is to assess the impacts of STEM volunteering on STEM identity and STEM efficacy.

The authors of this paper have developed methods that include partnering with local community organizations to design STEM-related volunteering opportunities for students. They hypothesize volunteering will increase the students' STEM identity and STEM efficacy, and this impact is dependent on the length and recurrence of the service provided.

II. METHODS

The overall design of the project is shown in Figure 1. We partnered with organizations to design three types of volunteering activities. Volunteering activities are classified as short-term, medium-term, or long-term based on the length of the activities. We recruited participants from Wilbur Wright College's engineering program to volunteer, and we assessed their STEM identity and STEM efficacy before and after the service.

Figure 1. *Overall Experimental Design*

A. 3-Types of Volunteering Activities

The terms for volunteering are shown in Table 1. We collaborated with multiple community partners and local student organizations at Wright College to design short-term, medium-term, and long-term STEM-related volunteering activities. The terms are defined by the length of service. Short-term activities are limited from hours to a day. These activities include Science Fair judging and volunteers serving as ambassadors at STEM open houses and other short-term partner activities. Medium-term activities last days to weeks. Medium-term activities include volunteering during Engineering Week, which offers high school students the opportunity of hands-on activities, and participation with other community partners. Long-term activities last from months to a semester. Long-term activities include peer mentoring, tutoring, and programmatic long-term volunteering at partner institutions.

Volunteer Term	Short-Term (Hours to 1 Day)	Medium-Term (Up to 2 Weeks)	Long-Term (Months to Semesters)
Service Activities	- Science Fair Judging - Open House Volunteer	- Engineering Week Volunteer - Discovery Partners Institute (DPI)	- Tutoring - Mentoring - Project Exploration (PE)

Table 1 *The term durations of the different volunteering service activities*

B. Implementation and Assessment

Volunteers are recruited from the Engineering Program cohort at Wright College and were given options for volunteering activities. Several short-term and medium-term volunteering events have been executed. Various long-term activities are in progress or currently in developmental stages. Before and after the service, STEM volunteers were asked to answer a Likert Scale survey [19] regarding their STEM identity and STEM efficacy. We used Bandura's toolbox to design the self-efficacy and identity survey questions [12]. In the surveys, volunteers were also asked about the number of times that they had previously volunteered. We will use the Brinkerhoff Success Case Method [20] to select volunteers as interview participants to better assess the volunteering experience. These interview questions will use the Appreciative Inquiry Method (AI) [21] to understand what has made the volunteering experience successful.

III. PRELIMINARY RESULTS AND DISCUSSION

We implemented four (4) short-term activities, one (1) medium-term, and two (2) long-term activities which are in progress. To date, we have a total of fifty-five (55) participants from the short-term activities, one (1) medium-term, and one (1) long-term activity. Medium-term and long-term activity outcomes are not currently reported here.

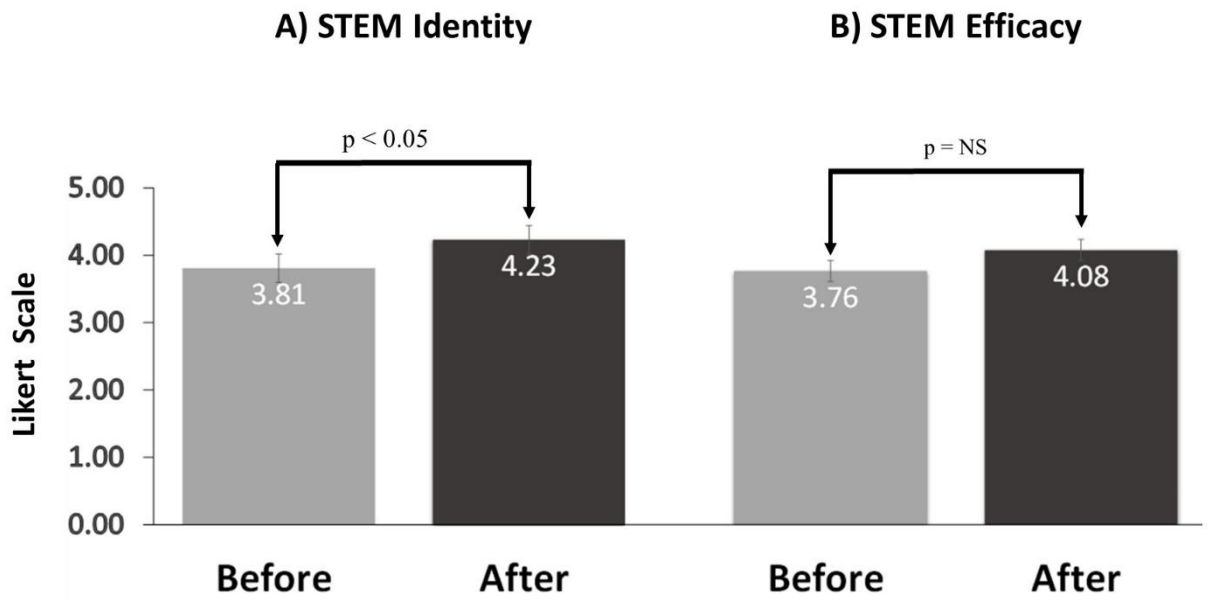

Figure 2. Impact of the Short-Term volunteering activities on student's A) STEM Identity and B) STEM Efficacy

A) STEM Identity and B) STEM Efficacy

Figure 2 shows the impact of short-term STEM volunteering on A) STEM Identity and B) STEM Efficacy. Although our results are preliminary, the short-term STEM volunteering showed a significant increase in students' STEM Identity after volunteering, 3.81 to 4.23 ($P \leq 0.05$), before and after respectively. The short-term volunteering activity, however, did not significantly

increase students' STEM Efficacy, 3.76 to 4.08 (P = 0.13), before and after. This can be attributed to not having enough volunteers or responses. We speculate, however, that the results were influenced by the short time duration. The length of time may not have been sufficient to impact a student's STEM Efficacy. We will compare this with the results of the long-term and medium-term activities once they conclude.

The medium-term and long-term activity results are not shown because of a very small number of participants. Thus far, only one (1) medium-term volunteering event has been completed. Several medium-term and long-term volunteering projects are ongoing.

C) Demographics

A part of the survey asked for the volunteers' demographic information and GPA. The volunteer's academic performance will be correlated with their STEM efficacy in the future. While our sample size is still small, most volunteers were first-year engineering students with the majority of volunteers being male (58%), Hispanic (50%), and 31% of the volunteers having a 4.0 GPA.

In addition, participants were also asked about their interest in continuing to volunteer. Ninety-six percent (96% - 53 out of 55) indicated they are interested in volunteering again as presented in Figure 3.

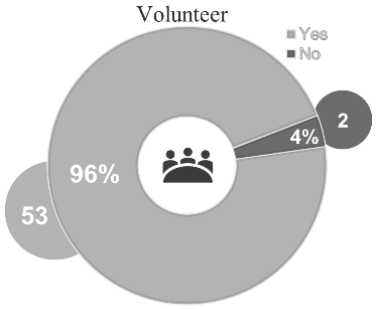

Figure 3 *Summary of Participants interest in future volunteering opportunities*

The preliminary results from the initial short-term and medium-term (results not shown) events support our hypothesis that volunteering in STEM-related activity increases one's STEM identity and STEM efficacy. Although Figure 2.B shows that there is no significant difference in the volunteers' STEM efficacy before and after the short-term volunteering activities, our results are very preliminary. We will increase the number of events and increase the number of volunteers. We also hypothesize that the duration of volunteering activities has an impact on STEM Efficacy. In the future, we will assess the impact of cumulative, repeated, and multiple short-term volunteering activities, compared with medium and long-term activities. Additionally, our results showed that most students would be willing to volunteer again in future opportunities. It is possible that the students who participated in our research had an initial sense of identity within STEM and volunteering further strengthened this identity. This finding aligns with previous research that suggests more socially integrated people are more likely to volunteer [22].

IV. FUTURE WORKS

It is necessary to increase the number of short-term, medium-term, and long-term activities and to increase the number of volunteers in all terms. In addition, we will explore the reason why 4% of our short-term participants do not want to volunteer. We will explore motivating factors that cause students to return to volunteering as we will need these participants. We will also enhance our recruiting strategies and assess what prevents students from volunteering. We will continue to expand our data size and we will continue to collaborate with more local community partners and student organizations within Wright College to organize volunteering opportunities. With more activities and larger data size, we will compare the impact of all terms on the STEM identity and STEM efficacy of volunteers.

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