International Journal of Engineering Education Vol. 32, No. 4, pp. 1732–1741, 2016
Printed in Great Britain

0949-149X/91 $3.00+0.00

Using Service-Learning to Improve the Engagement of Industrial Engineering Students*

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Students in an undergraduate ergonomics course within the Industrial Engineering Department participated in a service-learning project. While working with a local sweet potato farm, student teams evaluated packaging operations at the farm and developed both ergonomics and operations improvements. At the conclusion of the course, students (n = 45) completed a survey on their perceptions of the project and its influence on learning outcomes, community engagement, and student development. More than 90% of the students reported that the project helped them learn course topics better than a traditional course method. The transfer students (transferred from a junior college or other university) especially found service-learning as an effective tool to better understand the course topics by having practical experience. Positive responses to the project were significantly higher in female students and students who had parents with an engineering background. Students with prior volunteer experience also had more favorable perceptions of the service-learning project than those who did not volunteer.

Keywords: service-learning; student engagement; community partnership

1. Introduction

1.1 Service-learning pedagogy

Higher education institutions across the United States connect college students with community partners for the betterment of local and global communities [1]. This service manifests as either direct community service or participatory community service through the pedagogy of service-learning. While there are a variety of definitions for service-learning, researchers agree that service-learning is linked to an academic credit course in which college students participate in meaningful community service that addresses an identified community need. Ideally, students must also reflect on the service in order to meet course objectives and gain deeper understanding of the academic discipline, and to develop an increased awareness of civic responsibility and personal learning [2–4]. Their technical expertise and organized teamwork provides significant benefit to the community through successful projects [5]. Further, service-learning combines these four elements: community engagement, critical reflection, reciprocity, and public dissemination of the efforts created through the service-learning partnership [6, 7].

Kuh [8] identified service-learning as a high-impact practice. Student participation in high impact practices has been shown to impact the level of effort invested in an academic course. These practices provide methods by which students participate in "active, challenging, learning experiences, experience diversity, interact with faculty and peers about substantive matters, receive more frequent feedback, and discover the relevance of their learning through real-world experiences" [5, p. 11]. Further, service-learning provides college students with venues in which to address and solve real-world problems [9, 10]. Service-learning participation has been shown to have positive cognitive and academic effects on undergraduate students [11], including increases in their writing, critical thinking, interpersonal and professional skills [12–15]; impact on their social and emotional development [16]; feeling better prepared to serve as active citizens in their future communities [17, 18]; gaining motivation to meet the learning goals of their academic coursework and persisting to graduation [19–23].

Both urban and rural areas employ the service-learning pedagogy. Rural service-learning is distinct from the traditional as the need for projects and the ability to find community partners creates both challenges and opportunities [24]. Faculty must think outside of the box in terms of the partnerships that are developed. For example, in a traditional service-learning project non-profit agencies often serve as community partners; however, in a rural setting, such agencies may not always be available [25].

Many rural service-learning projects provide opportunities to work more intensely with commu-

* Accepted 5 March 2016.

nity members. For example, when faculties choose to connect with the Extension Service in any of the 76 land-grant universities in the United States, the Extension Service provides access to university Extension Agents. These agents have an intimate understanding of their community members. Such pre-developed relationships create opportunities for faculty to become "insiders" in the community and develop service-learning projects that focus on identified county or city needs [26]. Moreover, "integrating university service-learning courses with Extension programs can be an effective model [for] creating and implementing community development initiatives" [27, n.p.]. Therefore, the Extension Service can prove to be a great resource [28].

1.2 Service-learning and engineering education

Service-learning has been implemented in a variety of academic disciplines, including the fields of Nursing, Architecture, and Engineering [17, 29–30]. In 1995, Purdue University developed the Engineering Projects in Community Service (EPICS) model; cited as the earliest national model for service-learning in engineering, this model is now being implemented in more than 20 universities around the world [27, 31]. Soon after that, Tsang [32] and Ritter-Smith and Saltmarsh [33] compiled literature reviews about service-learning practices across the disciplines of engineering, including pedagogy and learning outcomes. Recently, Lima and Oakes [27] developed a comprehensive text entitled, *Service-Learning: Engineering in Your Community*, which provides engineering instructors with templates for designing and developing service-learning in the engineering curriculum.

Faculties are implementing service-learning projects across the disciplines of engineering and throughout a range of engineering coursework, including courses for first-year students as well as graduate level courses [34]. In 2010, the American Society for Engineering Education (ASEE) established the Community Engagement division to better address the needs of this growing field of study. The Accreditation Board of Engineering and Technology (ABET), the organization which certifies the quality of education received in engineering, has also established guidelines that service-learning can easily address [35, 36].

Academic engineering programs conduct service-learning projects both locally and globally. Lima and Oakes [27] highlight service-learning engineering projects from a variety of higher education institutions around the United States (e.g. Pennsylvania State University, University of Massachusetts at Lowell, Georgia Tech, Ohio State University), engineering majors (e.g. Civil Engineering, Chemical Engineering, and Industrial and Systems Engineering), and different levels of student learners (e.g. freshman, seniors). These projects are only a few examples of the continuing growth and impact of service-learning pedagogy on the field of engineering.

Globally, Engineers Without Borders USA [37] involves more than 13,000 members who "support community-driven development programs worldwide through partnerships that design and implement sustainable engineering projects, while creating transformative experiences that enrich global perspectives and create responsible leaders" [37, n.p.]. EWB-USA involves chapters at higher education institutions as well as faculty members gathering students to participate in service-learning trips. Moreover, faculties can develop their service-learning projects internationally to better the education of their students.

2. Course integration

2.1 Course summary

In partnership with the Center for the Advancement of Service-Learning Excellence (CASLE), service-learning was integrated into an Industrial Ergonomics course taught in the Industrial and Systems Engineering (ISE) department at a University. The course is a junior level course and enrollment in the section was 48 students. The course is required for graduation for undergraduate industrial engineering students. The topics taught in the course include work measurement, physical ergonomics, and cognitive ergonomics. The course learning objectives were as follows:

- Utilize problem-solving tools to select areas for improvement, collect and analyze data related to those areas, and develop solution strategies in work environments.
- Analyze, design/re-design ergonomically correct workplaces using ergonomic principles of motion economy, anthropometry, manual material handling, and workstation design.
- Understand the principles of performance rating and allowances and apply them to time study in order to develop standard times.
- Apply work sampling to determine utilization, allowances, and standard times.
- Understand the impact of work task design on work and operator performance.
- Understand human capacities and limitations and apply that information to the design, development, and evaluation of systems.

This class was an "S" designated course implying that during the course, students apply the industrial

ergonomics knowledge and skills they learn to a meaningful community service project. A service-learning course differs from a traditional project-based course in four ways: the project topic emphasizes community engagement, critical reflection, enhanced educational opportunities, and tangible benefits to community partners that might not be possible otherwise. While service-learning has been implemented in a variety of universities and courses, it is relatively uncommon at our university, particularly in engineering. This course was the first engineering course to receive the "S" designation.

2.2 Service-learning project objectives

Students partnered with a sweet potato farm. Operations at the farm include planting, harvesting, storing, sorting, packaging, and shipping of sweet potatoes. The students were placed into 10 different teams; two teams were assigned to each of the five focus areas for the project: product loading and cleaning, single-wrapping sweet potato packaging, bagging of sweet potatoes, box assembly, and box labeling and packaging. Student teams toured the farm facilities, developed a project plan, collected data for their operation area, and designed operations and ergonomics improvements for their area. Students were required to provide at least one operations improvement and one ergonomics improvement. Students completed reflection activities including journals and in-class discussions. Information that the students provided to the community partner required accuracy so that their work could be implemented by the community partner.

The partnership between the academic course and agricultural partner is unique to this service-learning project. Many of our students aren't regularly exposed to the agricultural economy within our region. This project allowed students to expand their horizons and explore areas of the region they had known about previously. This benefit would likely be true at many international institutions as well. Allowing students to explore the common regional economic thrust areas, outside of the student's primary discipline, is enlightening for the students.

At the beginning of the project, students were given project details including information on deliverables due throughout the duration of the project. The project was worth 30% of the course grade, and included five deliverables: reflective journal (10%), project plan (20%), technical project report (30%), project showcase (15%), and dissemination product (25%).

3. Methods

3.1 Survey instrument/procedure

The survey was composed of Likert scale and open-ended questions. The survey contained five sections: demographics (8 questions), career and personal (6 questions), community engagement (7 questions), ergonomics and service-learning (5 ques-

Table 1. Demographic information

Demographic information ($N = 45$)			**Number of Students**
Gender	Male		40
	Female		5
Classification	Freshman		0
	Sophomore		0
	Junior		19
	Senior		26
Cumulative GPA	4.00		1
	3.50–3.99		5
	3.00–3.49		15
	2.50–2.99		15
	2.00–2.49		8
	Below 2.00		1
Family's educational background	Parents attended college	Yes	36
		No	9
Parent's engineering background	Parents graduated from engineering discipline	Yes	6
		No	39
Student status	Transferred Student	Yes	13
		No	32
Frequency of volunteer activity	Frequently		4
	Sometimes		22
	Rarely		12
	Never		7

Table 2. Descriptive statistics for the responses on career and personal information

	Percentages of responses ($N = 45$)				
Career and personal information	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
SL was beneficial to training as engineer	47	53	0	0	0
SL helped strengthen teamwork skill	47	47	4	0	2
SL helped strengthen analytical skill	35	63	2	0	0
SL did not strengthen communication skill	5	0	11	64	20
SL helped strengthen technical writing skill	2	54	42	2	0
SL team did not work well together	7	7	11	44	31

SL: Service-learning.

tions), and open-ended questions (5 questions). These questions addressed student experiences with the service-learning project regarding working with the community as well as how it impacted their learning of course material. Several questions throughout the survey were constructed to reverse the scale to ensure participants were reading the questions. Students were asked to participate in the survey voluntarily after completing their service-learning projects. The link to the online survey was provided and students first gave their consent to allow the survey to be used for education purposes.

3.2 Participants

Participants were students enrolled in the Industrial Ergonomics course. Of the undergraduate students who completed the project, 47 of 48 completed the survey, and 45 survey responses were complete and usable. The class was composed of junior and senior industrial engineering students. Table 1 includes the results of the demographics section of the survey.

3.3 Statistical analysis

The survey responses (Strongly Agree, Agree, Neutral, Strongly Disagree, and Disagree) for all the questions were analyzed by estimating the percentages of responses on each category. These descriptive statistics were helpful in understanding the students' interest and preference towards service-learning. Further statistical analyses were performed to identify the influence of different demographic characteristics on service-learning experiences. For those analyses, the independent variables were gender, classification, cumulative GPA, family's educational background, Parent's engineering background, student status: transfer student (yes/no), and frequency of volunteer activity. These responses can be defined as ordinal and independent. Therefore, non-parametric statistical analyses were conducted to find the expected association. The Mann-Whitney U-test was used for the independent variables with 2 levels, and the Kruskal-Wallis χ^2-test was used for other cases. All these non-parametric statistical analyses were performed using SPSS (version 21.0) and the results were considered as significant at 95 percent confidence interval ($\alpha = 0.05$).

4. Results

4.1 Descriptive statistics

Descriptive statistics for the responses about career and personal information are shown in Table 2. This section yielded similarities for most of the responses. All of the students (100%) agreed that the service-learning project was beneficial to their training as engineers. Most students agreed that their teamwork (94%), analytical (98%), commu-

Table 3. Descriptive statistics for the responses on community engagement

	Percentages of responses ($N = 45$)				
Community engagement	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
SL developed responsibility to community	11	40	40	9	0
SL brought students close to community	4	47	40	9	0
SL made proactive in community services	7	51	38	4	0
SL helped to apply engineering skills	47	51	0	2	0
SL didn't make difference providing service	0	7	11	62	20
SL educated about University's extension service	16	60	20	4	0
Students understand purpose of CASLE	20	62	16	2	0

SL: Service-Learning.
CASLE: Center for the Advancement of Service-Learning Excellence.

Table 4. Descriptive statistics for the responses on Ergonomics and SL knowledge

	Percentages of responses ($N = 45$)				
Ergonomics and service-learning	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Students deepened interest in the course	27	64	7	2	0
SL helped learning Industrial Ergonomics	40	56	4	0	0
SL provided additional knowledge than traditional course	23	70	7	0	0
Students would not prefer to have SL project	2	0	31	54	13
All Students should complete a SL project	25	62	9	2	2

SL: Service-Learning.

nication (84%) and technical writing skills (56%) became stronger after the completion of the project. Most (75%) students were pleased with how well their team worked together.

Responses related to community engagement, presented in Table 3, showed some divergences in responses among the students. All responses regarding the influence of service-learning project on community engagement had the highest percentage of students choosing "agree"; however, many students chose "neutral" regarding their feelings on how the project connected them to their community.

The survey responses related to the ergonomics and service-learning are summarized in Table 4. This summary shows that more than 90% of students agreed that the service-learning project deepened their interest in the course topics, helped them learning Industrial Ergonomics, and achieving more knowledge than from a traditional course offering. Most students agreed that they would prefer to complete another service-learning project (67%) and felt that all students should complete one before graduation (87%).

4.2 Student feedback

The majority of the feedback from students regarding the service-learning project as a whole was positive. Sample student comments include:

> *"I absolutely loved this project. I am fortunate enough to have a relatively broad range of work experience and this was really great. To see things that are easy to view as just "the way people have to work," and to think to yourself that you can improve that. Being able to recognize that Ergonomic shortcomings happen in every single work place, and know what you can do to fix them and make people's lives better, it was really a great experience. I have always loved ISE; however, classes like this really help refresh your mindset and really push you to improve as a person and student, especially as a senior."*

> *"The reflective journals helped keep me from procrastinating as did the project plan. The technical report and dissemination product acted to measure my understanding of ergonomics and how I can apply what I learned in the class. The showcases allowed me to display my working knowledge of ergonomics in the since that I had to explain what I had done to others."*

In addition, categorical analysis showed that 52% of students felt that they spent the expected amount of time or less to complete the project, 34% felt they spent more than expected, and 13% didn't specify more or less when asked about time spent on the project.

4.3 Inferential statistics

Statistical analyses showed that of the seven demographic information, service-learning did not show any association with classifications, GPA level, and family's educational background. The remaining demographics displayed a relationship with the influence of service-learning project based on some of their responses. Table 5 includes the results of statistical analyses showing significant differences in responses based on different demographic groups.

Additional statistical analyses were conducted to display the significant associations between the demographics and survey questions to investigate the relationship between demographics and service-learning (see Table 6). When considering whether the service given in the service-learning project made a difference, the responses were significantly different among male and female participants and also for the participants having a parent with an engineering background. The majority of the participants from confirmed that the project made a difference. However, male participants and participants not having a parent with an engineering background responded less positively to that change.

Having a parent with an engineering background exerted influence on the service-learning based on responses to whether students' interest increased in the course materials through that service-learning project. Both groups of this demographic characteristic thought that service-learning deepened their interest in the subject matter of the course. In response to that question, 83.3% of students whose parents have an engineering background agreed that the project deepened their interest in

Table 5. Test statistics for significant difference in responses based on different demographic groups

Demographic information	Question	Test statistics and *p*-values
Gender	Service provided through service-learning project made a difference	M-W: U= 31.50 p = 0.004
Parent's engineering background	Service provided through service-learning project made a difference	M-W: U= 60.00 p = 0.022
	Students deepened interest in the course	M-W: U= 64.50 p = 0.039
Student status	SL provided additional knowledge compared to traditional course	M-W: U= 124.00 p = 0.013
Frequency of volunteer activity	SL did not strengthen communication skill	K-W: χ^2 (2) =9.45 p = 0.024
	SL made students more proactive in community services	K-W: χ^2 (2) =8.27 p = 0.041
	SL helped to apply engineering skills in community services	K-W: χ^2 (2) = 8.17 p = 0.043
	Students would not prefer to complete SL project for any course	K-W: χ^2 (2) = 8.52 p = 0.036

M-W: Mann-Whitney test.
K-W: Kruskal-Wallis test.

Table 6. Influence of different demographic groups on responses to the survey questions

			Percentages of responses		
Question	Demographic	Sample Size	Agree or strongly agree	Neutral	Disagree or strongly disagree
Service provided through service-learning project made a difference	Gender	Male (40)	10.0	12.5	77.5
		Female (5)	0.0	0.0	100.0
	Effect of parent's engineering background	Yes (5)	0.0	0.0	100.0
		No (40)	10.0	12.5	77.5
SL deepened interest in the course	Effect of parent's engineering background	Yes (5)	83.3	0.0	16.7
		No (40)	92.5	7.5	0.0
SL provided additional knowledge compared to traditional course	Student Status (Transferred student)	Yes (12)	100.0	0.0	0.0
		No (31)	90.3	9.7	0.0
SL did not strengthen communication skill	Frequency of volunteer activity	Frequently (4)	0.0	0.0	100.0
		Sometimes (21)	4.8	4.8	90.4
		Rarely (13)	15.4	7.7	76.9
		Never (7)	14.2	42.9	42.9
SL made students more proactive in community services	Frequency of volunteer activity	Frequently (4)	50.0	25.0	25.0
		Sometimes (21)	78.2	21.8	0.0
		Rarely (13)	38.5	61.5	0.0
		Never (7)	42.9	42.9	14.2
SL helped to apply engineering skills in community services	Frequency of volunteer activity	Frequently (4)	75.0	0.0	25.0
		Sometimes (21)	100.0	0.0	0.0
		Rarely (13)	100.0	0.0	0.0
		Never (7)	100.0	0.0	0.0
Students would not prefer to complete another SL project for any course	Frequency of volunteer activity	Frequently (4)	0.0	50.0	50.0
		Sometimes (21)	0.0	13.0	87.0
		Rarely (13)	0.0	46.2	53.8
		Never (7)	42.9	42.9	14.2

SL: Service-Learning.

course topics, compared to 92.5% of those whose parents do not have an engineering background.

Student status (i.e. transfer or otherwise) has a significant influence subjected to the ergonomics and service-learning knowledge section of the survey. All of the transfer students (transferred from a junior college or other university) agreed that the service-learning project helped them to achieve additional knowledge in this course compared to a traditional course, while the non-transfer

students agreed less to that statement (9.7% of the non-transfer students responded impartially).

Table 6 shows that survey questions from all three sections (career and personal information, community engagement, and ergonomics and service-learning) found volunteer activity being associated with service-learning project experiences. Students who reported volunteering frequently or sometimes, confirmed that their communication skills became stronger through this project. On the other hand, the students who rarely or never perform volunteer activity responded less in favor of this communication skill development. Students exhibit variability in responses for the survey question of becoming more proactive in community services through service-learning projects. Only 50% of the frequent volunteers and 42.9% students, who never did volunteers work, responded positively about this statement whereas those who carry out volunteer activities "sometimes", were more supportive (78.2%) to this. For the students who volunteer rarely (61.5%), most of the responses were impartial along with 42.9% neutral responses from students never doing volunteer work. Looking at the statement that service-learning can develop engineering application skills, the students who were less connected to volunteer activity showed 100% agreed response while only 75% of the frequent volunteers and 53.8% rare volunteers showed their support. The findings exhibit that excluding the students who never carry out volunteer activities, no other level of volunteerism among the students were disinclined to complete another service-learning project.

5. Discussion

5.1 Descriptive statistics

The survey on career and personal information included the questions based on several skills developed by the service-learning project. The descriptive statistics on the responses for those survey questions (see Table 2) showed that most of the students were supportive regarding this issue. The project helped the students to experience working in a real-world environment and use their theoretical knowledge achieved from the course work in solving real problems. The students enjoyed working as real engineers, achieved practical experience and knowledge to identify a problem, learned to work with constraints, and got trained to find a proper way to provide a solution to any problem. Therefore, the students confirmed the importance of service-learning in various skill development (Communication, analytical, teamworking, technical writing) and found it as an effective tool for training as engineers. Similar findings are available from many previous studies [11, 38, 39].

The descriptive statistics in Table 3 showed that students were positive about the importance of service-learning for increasing interest on community engagement. These findings can be supported by other research on similar arena [40, 41]. The successful completion of the project with an insightful outcome made the students confident about their ability to make changes in community services. As a consequence, they might have wanted to apply their knowledge and experience achieved from the Industrial Ergonomics course to help people in their community.

The third part of the survey was related to the knowledge achieved from the Industrial Ergonomics course accompanying a service-learning project. Students responded positively for their increased interest in course topics and better understanding of the subject compared to any traditional course offering (only course-work without any service-learning project). Their preference of including service-learning in the graduate study could be the result of great research experience they earned through this project. This finding reveals the necessity of inclusion of service-learning in the courses where knowledge from course materials can be applied in real-life to solve a problem and to serve better the community.

5.2 Student feedback

Critical feedback provided by the students often included the location of a community partner. Many students preferred the community partner to be closer in location to the University so that they could see more directly the impact of their work on the community. The project indicated overall positive attitudes. Students felt that the project was a challenge and a great experience as well. It provided a unique opportunity for them to learn the coursework, while also allowing them to complete a project that benefitted the community.

5.3 Inferential statistics

The non-parametric statistical analyses sought to determine how different demographics of the students influenced the service-learning project experience. In regards to the benefits students gain for their training as engineers, they answered survey questions significantly different based on gender, who did and did not have parents in engineering, who was and was not transfer student, and on the frequency of volunteer activities in the community. The analyses showed that 100% female students were confident that the service provided through the project made a difference while males were less supportive to this statement. The males might have

seen more options for improvement than the females and were less positive about the increased quality of the service. Based on his extensive research on cultural dimensions, Hofstede's [42] argued that gender can influence the perception and behaviors. Another study found that males are more competitive in their discourse than females [43]. These supportive findings can explain the influence of gender on the responses regarding the increased quality of provided service through a service-learning project.

On the same question, 100% students with parents from engineering disciplines provided their positive opinion. They might be able to see more clearly the advantages that a service-learning project could provide due to the knowledge of their parent's experiences as engineers. Students with parents who do not have engineering backgrounds might not be as aware of the benefits the service-learning project could provide not only to their learning experience, but also to their development as future engineers. However, such students confirmed more positively that service-learning project deepened their interest on the course materials. The project's successful outcome, and their positive contribution in a community service using the course knowledge, might have significantly changed their perception of engineering. Research has identified that while choosing career, students are influenced by their parent's occupation [44, 45]. Therefore, those who have parents from engineering discipline may already have their interest in engineering and the service-learning experience did not make any significant change deepening their interest in course materials.

The ergonomics and service-learning portion of the survey questioned how the project influenced the students' perceived learning in the course materials. The responses were different among the groups of students based on whether they were transfer student or not. Students who were transferred might have been more interested and involved in the project, allowing them to gain more related knowledge of course topics with its completion. It was easier for them to practice the knowledge in the real world to understand its application properly. Whereas the non-transfer students might have already had a basic understanding of the course topics from their previous course experiences and, as such, were not as influenced.

When examining whether the service-learning project influenced students strengthen their communication skill, large percentages of positive responses from most of the volunteers (frequent or sometimes) explained that the project guided the students (frequent volunteers) to defeat their fright of proper communication and provide the students with an organized and structured way to connect to them to the community. Similar results were found from many previous studies [46, 47]. The students who rarely or never did any volunteer work, a large percentage of neutral response for them were obvious. These students hardly communicated with someone regarding any volunteer work. Therefore, they were not able to perceive the improvement in their communication skill as confidently as the other types of volunteer (frequent or sometimes) did.

Looking at the association between students' frequency of volunteer works and their will to be more proactive in the community services, students who volunteer sometimes responded most positively confirming that this project influenced them to be more involved in the community services. Frequent volunteers along with the students who never did volunteer work were also positive but not to a great extent. Service-learning might not be able to make a noticeable change in the attitude of these extreme levels of volunteers regarding the community services. However, the large percentages of neutral responses from the students doing volunteer work rarely were unusual and expressed their state of being confused about their stand. They might want to be involved more, nevertheless, considering other possible factors (time, personality, availability of services in their community), they were not interested to become more proactive.

Additionally, the survey question regarding students seeing how engineering can be applied to their community also sparked an interest with this demographic (frequency of volunteer activity) of students. The majority of the students' at all volunteer levels saw positively that the project helped them to apply their engineering skill to the community services. It is likely that students who currently volunteer may now see a broader range of opportunities to volunteer, especially now that they are more aware of how they can apply the skills learned from their engineering coursework. In this regard, the project might facilitate other levels of volunteers.

5.4 Project implications

The success of the service-learning project had a number of direct and indirect implications. For those directly involved in the project, there were numerous benefits. As reported above, student response was overwhelmingly positive. The service-learning project allowed students to attain both educational outcomes and a stronger connection to their community. The community partner also benefited directly through the recommendations provided to improve operations at their company.

From a faculty perspective, the project allowed for a renewed passion for the application of the material to new domain areas. Finally, from a faculty perspective, the application of course material to a community problem allowed for renewed interest and passion in a traditional topic area.

The service-learning project had implications for not only those directly involved with the project, but others as well. The state extension service used the project as a way to demonstrate effective academic-extension partnerships. The state sweet potato council educated farmers statewide regarding ergonomic interventions that were recommended by the students. Throughout the academic unit and the university campus, the project helped to demonstrate that a community service-learning project could be successful while maintaining academic rigor. The project helped to increase buy-in from various academic constituents across campus.

In order to improve the chance of project success, a few small considerations can be made during project implementation. First, students should be encouraged to invest in the project. This is not a financial investment, but rather an investment of time, energy, and ideas. When the students take a sense of ownership on the project, the quality of their output is improved. Second, students should be encouraged to think big. While many community partners have constraints on their problem, students should explore creative ways to work within those constraints. Finally, the faculty member should emphasize the importance of engineers providing service throughout the course, not just related to the service-learning project, helping students develop an altruistic mindset about their profession.

6. Conclusion

This study was focused to determine the influence of service-learning on students' skill development, their training as engineers, and the improvement in course offering and on the increased preference for community services. 48 students were asked to response on a survey and 45 responses were analyzed. When reviewing the survey responses as a whole, students had an overwhelmingly positive experience with this project. They were exposed to community service through this service-learning project in a different way than they have seen or done before. Students learned how they can apply what they learn in their engineering courses to their community. Many students, especially those who volunteer more, reported to have received more benefits from the project. These students already enjoy giving back to the community and were able to learn how they can give back in even more ways, particularly through their engineering knowledge. Students felt that the project benefitted their development as future engineers and gave them real-world experience that exposed them to what they would be doing after graduation. This project benefitted not only the students, but also the community.

The study had a very small sample size for some levels of the demographic groups while performing the inferential statistical analyses. In addition, this research only considered the qualitative responses to demonstrate its findings. In future, studies can include some additional independent variables, such as personality type, race, and age. A study comparing the grades of the students for a course accompanied by a service-learning project with the same course offered in a traditional way would be able to reveal the influence of service-learning based on quantitative finding.

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