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# Achieving student outcomes with service-learning in Mechanics of Materials


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# Achieving student outcomes with service-learning in Mechanics of Materials


## Abstract

The implementation of experiential learning opportunities in undergraduate courses provides students an alternative hands-on learning methodology that can supplement the traditional lecture-style approach. A service-learning model was used in an undergraduate Mechanics of Materials course in the form of a semester-long project. The first implementation (Cohort 1) involved partnering with UT Arlington's College of Engineering and participating in the bi-annual Engineering Saturday event. This event is a K-12 outreach program, which invites children from local K-12 schools and exposes them to science, technology, engineering, and math (STEM) activities. Students designed a demonstration activity and presentation, met regularly with the instructor to receive guidance on the activity design, and completed preflection and reflection assignments while preparing the activity and after the event. The second implementation (Cohort 2) of the project involved a partnership with the City of Arlington Parks and Recreation department to assess the city's 96 public parks that serve its residents. Students organized meetings with the community partner, designed an asset tool rubric, performed park site visits, and completed preflection and reflection assignments to log their observations.

The objectives in both cohorts were built on reinforcing concepts, like axial loading, torsion, fatigue, stress concentrations, and column buckling. Thus, the assignments and experiences were designed for students to apply engineering design to meet specific needs with consideration of public safety and social or environmental factors, consider the impact of their work in larger contexts, and learn to work effectively in a team (ABET outcomes 2 and 4-5). The effectiveness of the service-learning model was assessed by analyzing student preflection and reflection responses and comparing the student's performance in the course to a control group of students that did not participate in the project. The qualitative results from preflection and reflection responses show a strong indication that the service-learning projects had a positive impact on social awareness, self-identity, and engineering purpose. The community partners were not formally queried, but anecdotally they both provided positive feedback and a willingness to work together again. The performance results were significant in Cohort 1, showing a 10-point improvement in an exam for the students that participated in the service-learning project compared to students who elected to complete a case study project.


## Introduction

The goal of an educator is to discover and develop innovative approaches to increase student engagement and student learning. This pursuit must have purpose (e.g., teach course content) and be designed to meet specific goals (e.g., learning outcomes). Service-learning is a pedagogy that fosters these concepts and goes further to bring relevance to course content by identifying specific community needs and developing a project or entire curriculum to meet those needs [1]-[2]. The end product results in a healthy collaboration between the university and community at large. Another key aspect about service-learning is the opportunity for reflection and educating students about the importance of reflection in the overall educational experience [1]-[3].

Service-learning applies well to an engineering curriculum, which comprises students that predominantly learn-by-doing. The creation of engineering projects in community service (EPICS) paved the way for a service-learning model in elective interdisciplinary courses [4]. Additional examples of service-learning projects and courses, including elective, capstone, and core courses across more than 30 universities can be found in the literature, and is strong evidence that it works [5]-[7]. The Accrediting Board for Engineering and Technology (ABET) standardizes the requirements for engineering courses and service-learning is setup well to meet some of those requirements [8]. For example, the Solid Mechanics course (also known as Mechanics of Materials) taught within the Mechanical and Aerospace Department at The University of Texas at Arlington (UTA) highly supports ABET outcomes 1 and 7. These outcomes cover a students' ability to identify and solve complex engineering problems and apply their knowledge. However, by incorporating a service-learning project in the course that also supports ABET outcomes 2 and 4-5, adds value to the student learning experience. Namely, the students apply engineering design to meet specific needs with consideration of public safety and social or environmental factors, consider the impact of their work in larger contexts, and learn to work effectively in a team.

The result creates an improved delivery of course content that will positively impact how a student learns and the skills they develop as engineers. A service-learning project naturally groups students together, each having different skill sets, and forces them to think and work together to solve technical and/or human problems [9]. So, one positive impact is in student's interpersonal development and teamwork skills, as identified by multiple, large studies [10]-[11]. The authors in [10] note that students learn how to be a leader and self-report a growth in their leadership ability. Students are further able to connect what they are learning from the theoretical content in the classroom to personal experience in performing the service-learning activities. They develop a deeper understanding of the content, are more curious, and enhance their critical thinking ability [10]-[11]. Another positive outcome from service-learning projects is the increased awareness to cultural issues. While students may possess different cultural beliefs and values, service-learning seems to increase students' desire to promote peace and human development [12]. Students become more sensitive to cultural issues and experience a heightened level of social responsibility [13]. These developed soft skills have the potential to extend to areas outside their academic experiences, like their career choices, participation in service after college, or commitment to activism [10].

While the experience component is critical to a service-learning project, this experience does not necessarily result in learning [14]. The ability for students to recognize the meaning of their experience and personal development is enabled through preflection and reflection activities. Preflection is the idea of preparing students to think about their biases and establish their expectations before going into the service-learning experience. It helps to enrich the reflection process by having students examine their values and assumptions [15]. Reflection is a meta-cognitive technique that helps guide students to think about what they learned. The methods for performing the reflection include a journal, experiential research paper, case study, directed readings, and class presentation. When the reflection component is designed effectively, students are empowered to apply their skills to other areas of study and to self-regulate themselves as learners [16]-[17].

In the next section, the details of the service-learning projects as they were applied to a Mechanics of Materials course are presented. Then, the results from student responses to preflection and reflection questions and the impact on academic performance are summarized and discussed. The paper ends by drawing conclusions about the reasons why service-learning should be a normal part the undergraduate engineering curriculum and suggestions for improvement in future work are provided.

## Service-learning in Mechanics of Materials

The Center for Service-Learning at UTA offers faculty from any discipline the resources and support needed to implement service-learning components in their courses. Each spring and fall semester, a cohort of 12 faculty are selected and awarded a stipend to attend informational seminars about the history, theory, and practice of service-learning. Participation from the engineering college was historically low compared to other colleges. However, as a lecturer in the Mechanical and Aerospace Engineering (MAE) department, the opportunity to develop a service-learning component for Mechanics of Materials was offered and supported by the Center for Service-Learning.

### *Project description*

Mechanics of Materials is a pre-professional course in the MAE department and typically taken by both mechanical and aerospace engineering students in their 2nd year. The service-learning component in the present work was developed in the form of a project and assigned to students for course credit. The project was implemented in the spring 2018 semester for one section (Cohort 1) and in the fall 2018 semester for two sections (Cohort 2). In total, 12 students participated in Cohort 1 and 28 students in Cohort 2.

The project for Cohort 1 was focused on understanding and demonstrating the basic theory of column design. The focus for Cohort 2 was expanded to challenge students in the design, assessment, and understanding of engineering structures subjected to static loads. For both cohorts, the semester-long projects required students to complete a pre-flection, design activity, and reflection assignments, including a final presentation. The lecture content was synchronized with specific milestones in the project to allow students to connect their learning directly with the application of their knowledge and understanding. Namely, the following student outcomes were defined for the projects:

- Students will learn how to work with a team to achieve a common goal.
- Students will improve their interpersonal and public-speaking skills.
- Students gain academic credit while serving the community and better understand the relevance of their academic coursework.

### *Identifying a community partner*

The collaboration with a community agency is paramount to the creation of a student-community partnership for the promotion of civic responsibility and sense of community. Most importantly, the service-learning project is designed to meet community needs with the help of diverse student backgrounds who also benefit from the experience. Engineering Saturday seeks student volunteer groups willing to conduct 90-minute activity sessions throughout the day and deliver exciting content to the eager and enthusiastic attendees (i.e., K-12 students). This set up a great opportunity for Cohort 1 to demonstrate ductility, torsion, and the basic theory of column design while using a service-learning framework to document their experience.

In Cohort 2, the City of Arlington Parks and Recreation department was willing to partner with us to meet their needs. This was a great partnership because it offered a broader scope of a project that would expose students to a diverse set of engineering problems. Specifically, the City of Arlington needed help assessing the integrity and safety of all its structures and recreational equipment (i.e., park "assets") across the 96 city parks that serve its residents.

**Performing the service-learning project**

The students in Cohort 1 were split into 3 groups of 4 team members. Each group was given the task of creating a short slideshow presentation (10-15 minutes) on the topics of ductility, torsion, and basic column design. A key component to the presentation was that it had to include a hands-on column design activity (45-60 minutes) for children to complete. Figure 1 shows the activities designed and demonstrated by one of the student groups in Cohort 1.

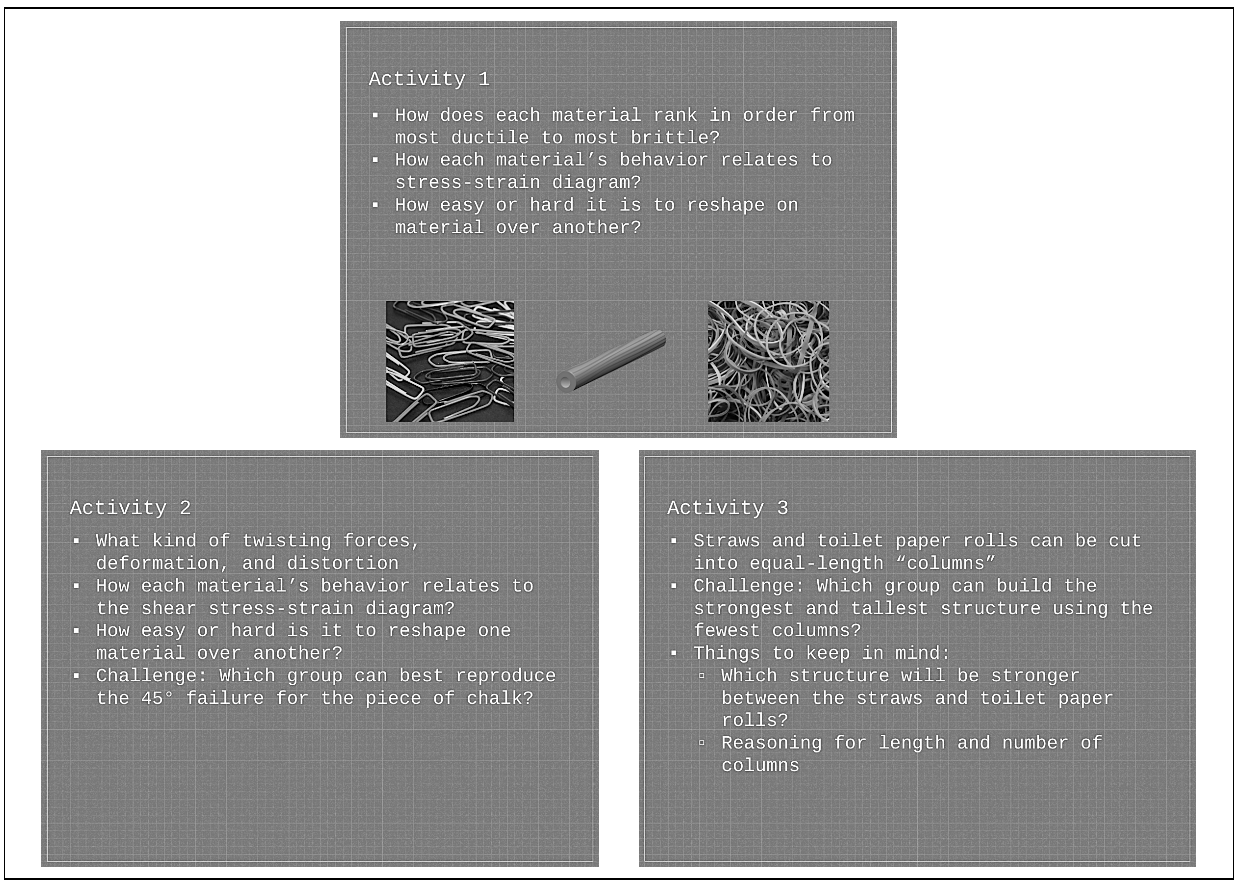


Figure 1. Three activities designed and planned by one of the groups in Cohort 1.

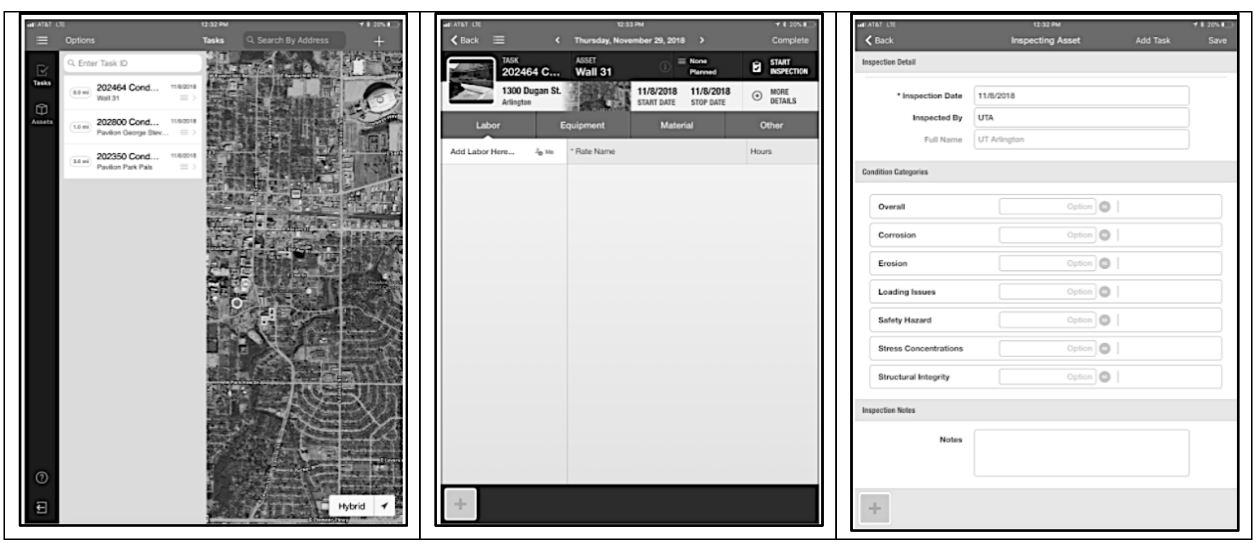
The questions in each activity were aimed to promote productive discussions and provide the cohort students a structure they could follow. In some cases, the activities included props like rubber bands, paperclips, toothpicks, and structural nails to demonstrate ductility concepts for different materials. Similarly, chalk was used for torsion and plastic straws for column design.

The students in Cohort 2 were formed into groups of 3-4 team members. A total of 8 groups were formed among the 28 students that participated in the project. Each group was tasked with designing an asset tool rubric to assess the condition of park assets, attending a kick-off meeting with the community partner, scheduling 2-3 park site visits to photograph and assess the park assets, and preparing a slideshow presentation (10-15 minutes). Table 1 shows a sample rubric provided to students as a guide for assessing a bridge asset at a park.

Table 1. Sample asset tool rubric provided to students.

| Bridges | Category 1 | Category 2 | Category 3 | Category 4 | Category 5 |
|---|---|---|---|---|---|
| Poor | | | | | |
| Uncertain | | | | | |
| Fair | | | | | |
| Good | | | | | |
| Excellent | | | | | |

The idea was to establish a Likert-style scale (e.g., from poor to excellent) to rate the condition of category. The categories were meant to be asset-specific conditions, such as corrosion, loading issues, and safety hazards. The rubrics created from all 8 groups were combined and consolidated to form one comprehensive rubric that all groups agreed on. The complete design of the asset tool rubric is provided in the Appendix section. This finalized rubric was used by each group to assess the condition of park assets for each park site visit. The park asset data was recorded with ArcGIS software (see Fig. 2) using an iPad provided by Arlington Parks & Recreation. The data included the park location, inspection code (i.e., name of the asset), description of the asset condition, and pictures of the asset.




(a) (b) (c)

Figure 2. ArcGIS software used to record asset data. (a) Satellite map view. (b) Asset location details. (c) Data entry screen.

Figure 3 shows two examples of park assets, namely a walkway bridge and a wall, that the students evaluated during their park site visits. Students reported that the bridge was suffering from decayed wood in some areas of the walkway, which posed a safety concern. Students further noted that the wall structure showed signs of erosion and possibly corrosion form the underlying metal structure. In other cases, students documented examples of the primary deformation modes: axial, torsion, and bending. Students were not asked to complete any mathematical analysis or calculations regarding their observations. However, it was important for students to witness these mechanical defects, failures, and deformation modes in real-world engineering structures and connect them to course content. These experiences ultimately provide students with a broad societal and global context, offering them a different perspective when they perform engineering analysis in the classroom.

|  |  |
|---|---|
| Location: Clarence Foster Park<br>Inspection Code: Bridge 4306 | Location: Clarence Foster Park<br>Inspection Code: Wall 46 |

Figure 3. Walkway bridge and wall structure photos taken by students during the park site visits.

**Results and discussion**

The student responses to the preflection and reflection questions are analyzed here. The questions asked for each cohort are listed in tables as a reference. Preflection and reflection questions were assessed to uncover biases, beliefs, motivations, and challenges that students possessed. In some cases, specific preflection and reflection questions are analyzed together to qualify the changes in student perceptions about self-identity and the community before and after their participation. A quantitative analysis is performed to understand the impact of the service-learning project on a student's academic performance.

***Preflection and reflection experiences (Cohort 1)***

All groups were given feedback on their presentation and activity before the actual day of the event to ensure the quality of their work. Each student was asked to complete a preflection and reflection assignment that were structured in the form of a journal with directed questions. Table 2 lists the set of preflection and reflection questions.

Preflection question 1 (i.e., Q1) was a qualifier to check student understanding about service-learning, so it was not analyzed. Student motivations in preflection Q2 and attitudes in Q6 were predominantly positive:

- *"I felt it would be a good opportunity…"*
- *"…[I can] get more involved with the school."*
- *"…I'm excited to hopefully inspire the students."*

Table 2. Preflection and reflection questions for Cohort 1.

| | **Questions** |
|---|---|
| **Preflection** | 1. In your own words and understanding, what is Service-Learning?<br>2. What motivated you to participate in this Service-Learning project? Was it because it involved Engineering Saturday, the extra credit or were there other circumstances?<br>3. What do you expect to learn about yourself from your participation?<br>4. What do you expect to learn about the community from your participation?<br>5. What level of impact do you think your participation will have on the community?<br>6. Please express any other thoughts, attitudes, or feelings about the Service-Learning project. |
| **Reflection** | 1. What did you learn about yourself from your participation?<br>2. What did you learn about the community from your participation?<br>3. Is there a specific example where you observed the impact you were making on the kids in attendance? Describe it.<br>4. Is there a specific challenge that you encountered during the event and how did you overcome it?<br>5. Optional: Find a friend outside of class and share your service-learning experience with them. How did it feel? |

So, students seemed to approach the service-learning project with an open mind and genuine sense of personal interest. A comparison was made between preflection Q3-Q4 and reflection Q1-Q2, which were aimed at self-identity and community outlook. Student responses at the preflection stage appeared enthusiastic about their skills and optimistic about the community. For example, students mentioned public speaking, teaching, and answering questions as skills they expected to learn. At the reflection stage, students were surprised that their interpersonal skills were stronger than they thought, while recognizing that they lacked development in other areas:

- *"I found out how confident I was while interacting with young people and how comfortable I was explaining to them advance engineering concepts."*
- *"That I work well with teammates and completing task at hand."*
- *"I learned that I still need to work on my public speaking…"*

Some students were shocked to learn how little community involvement existed. It was interesting to observe that a few students gained a sense of civic responsibility, "…there still should be more of an effort put towards early education." Preflection Q5 and reflection Q3-Q4 were also compared, examining community impact and challenges faced. Students initially expressed that their involvement in the service-learning project would have a deep impact with the ability to motivate young children to pursue engineering in college. In retrospect, this idea was affirmed with some students noting the transferability of skills helped them in the project.

- *"I hope to be able to show what engineering really is to the students and be able to convince a few students to pursue engineering."*
- *"I actually noticed some of the girls writing notes…which surprised me that they were paying that close attention and were that interested in the topic."*
- *"As a tutor I had developed techniques of breaking down complexity into more abstract concepts. I believe I was able to resolve the fear of kids of engineering being complex and difficult by breaking down complex concepts and relating them to real life observable phenomena."*

***Preflection and reflection experiences (Cohort 2)***

Each student was asked to complete a preflection and reflection assignment, similar to Cohort 1. The questions were also structured in the form of a journal with directed questions. The slide-show presentation served the additional purpose of being a reflection component. Each team member was also asked to evaluate themselves and their team members based on input, time management, interpersonal skills, and evidence of contribution. Table 3 lists the set of pre-flection and reflection questions.

Table 3. Preflection and reflection questions for Cohort 2.

| | **Questions** |
|---|---|
| **Preflection** | 1. In your own words and understanding, what is Service-Learning?<br>2. What motivated you to participate in this Service-Learning project? Was it because it involved the City of Arlington? Was it the extra credit? And/or were there other circumstances?<br>3. What do you expect to learn about yourself from your participation?<br>4. What do you expect to learn about the community from your participation?<br>5. What level of impact do you think your participation will have on the community?<br>6. Please express any other thoughts, attitudes, or feelings about the Service-Learning project. |
| **Reflection** | 1. What did you learn about Service-Learning that you didn't know before this project?<br>2. How can you use, modify, or apply service-learning to other areas (i.e. school, work, etc.)?<br>3. What did you learn about yourself from the first participation experience?<br>4. What did you learn about the community from the first participation experience?<br>5. Is there a specific example where you observed that impact you were making on the community? |

Preflection and reflection Q1 were compared to examine the misconceptions students had about service-learning. Students noted that they were unaware that they would have to use teamwork and problem-solving skills. Some felt that they gained experience that would be useful when they enter the workforce.

- *"...required more collaborative work with teammates."*
- *"...helped me to learn more about practical problems."*
- *"...gained experience from the practical problem. It helped us to think differently and become more prepared for future work."*

The initial motivations in preflection Q2 for participation in the project were cautiously optimistic from a few students. They felt that the opportunity was unique and unlike any kind of learning that they had been exposed to other than the textbook in the classroom. But, most students were positive and felt that the project would provide valuable real world, hands-on experience. These students also showed that they were less motivated by the extra credit opportunity. If compared to reflection Q2, there was confirmation from several students that felt they could apply their skills from the service-learning project to other areas due to the "…transfer [of] knowledge in problem solving." Thus, this was an indication of deeper understanding since students were able to connect their learning to personal experience.

The level of learning about self-identity and the community was compared across preflection and reflection Q3-Q4. Some students expressed a shift to a more external view of things, whereas initially they had only considered themselves. Others hoped to and later observed a personal growth with their soft skills.

- *"Learn how practical problem solving different from knowledge from the book and gain experience from practical problem solving."*
- *"I expect to learn more about how I function on a team…"*
- *"…[the] inspection of assets also leads me to think of the need of the community."*
- *"I learned…that I work well on a team and am able to help find roles for most or all of the available team members."*

Before the project, students were genuinely interested in understanding the community needs and whether the park assets were useful to them. Some students didn't feel like many of the parks and their assets were being used. However, students after the project mentioned that they were highly surprised by their observations. Student responses demonstrated an increase in cultural sensitivity, public awareness, and social responsibility.

- *"Learn the demand and request from the community. It helps to know what the community wants and needs."*
- *"I expect to learn more about how the community utilizes their parks as well as how the community treats the infrastructure at those parks."*
- *"The community needs more help from the service than expected. The safety and convenience…can help the community to satisfy their needs."*
- *"I learned that the community really does use the Arlington parks to their fullest potential. In every park we visited there were many people running, biking, hiking, or simply enjoying the amenities. This is one of the reasons why what we helped to do…is very important."*

A final comparison was made between preflection and reflection Q5. This question considered the student's perspective about the impact on the community from their participation. Students expressed mixed thoughts about their level of impact before the project. For example, some students felt that the community would appreciate their involvement, while other students were not convinced that they would make a significant impact. Upon reflection, their participation in the project had a profound impact on their outlook toward the community and their sense of social responsibility. A few students realized that without the efforts of this service-learning project or similar community initiatives, the condition of public services could lack the attention they need to remain in good order.

- *"The community would be pleasant from the participation of college involving the safety and needs…"*
- *"I am not sure of the full impact that this project will have on the community."*
- *"Our team have observed the wall from one park has terrible condition…If no one has accomplished inspection, the problem would be remained."*

***Impact of the S-L project on student performance***

A comparison of exam 3 grades for Cohort 1 was performed. Exam 3, unlike the previous exams, was administered within a week after the service-learning project was completed. The final exam was not considered since exemptions were granted for high achieving students, which included many students that participated in the service-learning project. The exam 3 results, presented in Fig. 4, were split into three groups: S-L project, case study, and no project. The S-L project group were Cohort 1 students (12 total), the case study group (10 total) were given a column design project assignment, and the no project group (32 total) chose to do neither S-L nor case study project.

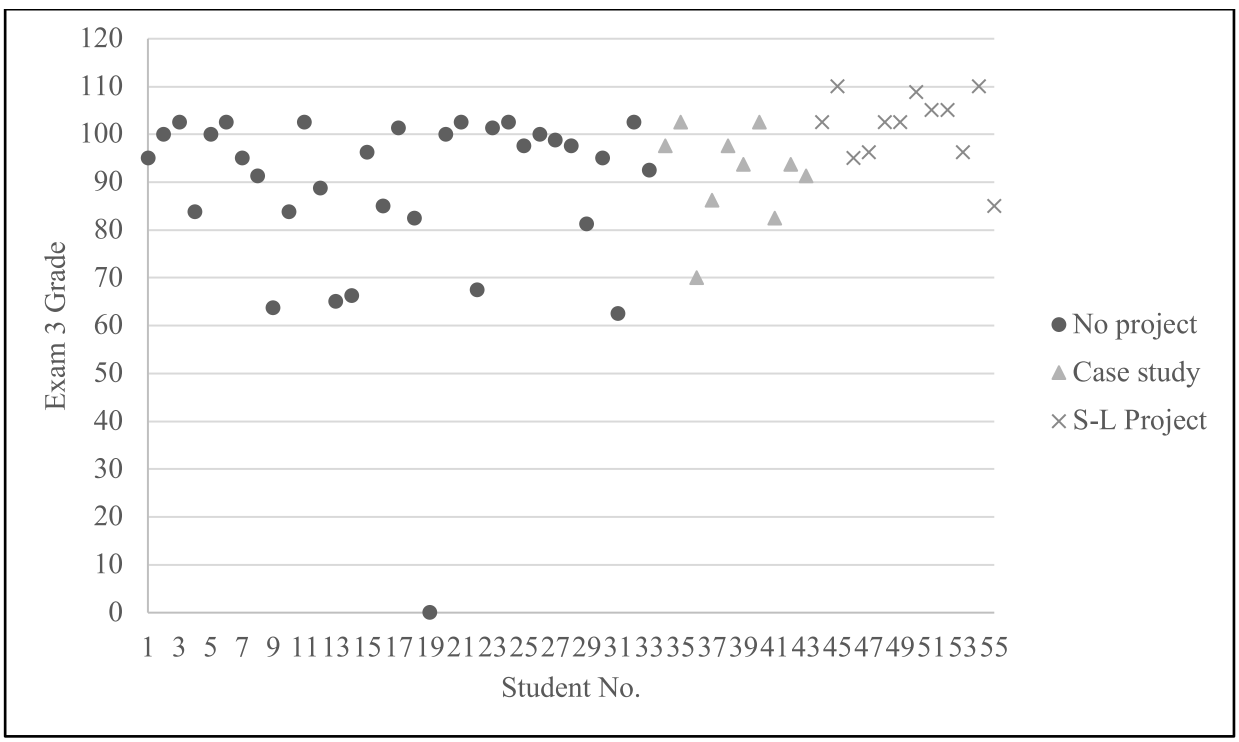



Figure 4. Comparison of service-learning project on exam 3 performance for Cohort 1.

The average for the case study group 91.8 was higher than the no project group 88.1, while the S-L project group performed significantly better than those two groups with an average 101.6 out of a 110 total points. The results also show that S-L project students were more likely to perform better in exam 3 with the lowest score being 85, whereas it was 70 for the case study group and five students scoring between 62-67 (excluding the 0 for the student that did not attend the exam). However, the true impact of the S-L project on student performance is inconclusive since it should be expected that high achieving students would perform well on Exam 3 with or without the S-L project. So, a deeper analysis was conducted on the group of S-L students to consider their homework and quiz averages to distinguish between the high and low achieving students. Figure 5 shows that at least two low achieving students (students 49 and 50) participated in the S-L project. A low achieving student was identified as having a homework and quiz average that were both 70 or below.

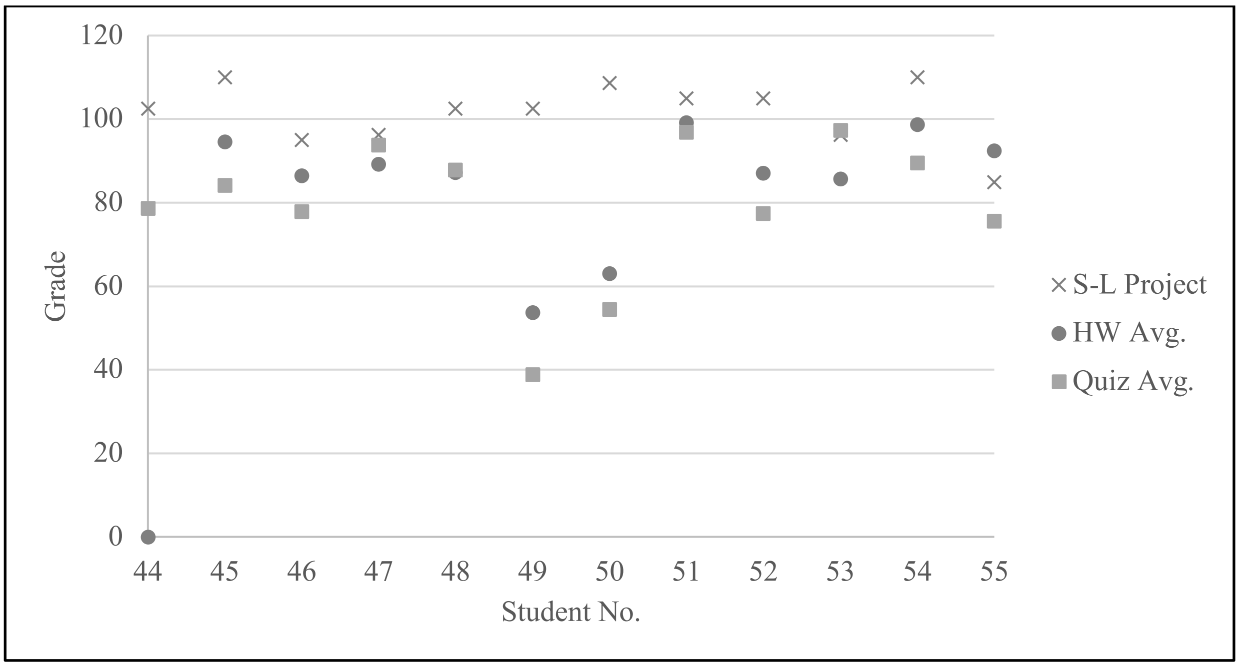



Figure 5. Impact of service-learning project on exam 3 performance for Cohort 1 between high achievers and low achievers.

Thus, there is some evidence that the S-L project had a positive impact on student performance, especially for low achieving students. These results support the use of activities, like project-based learning and service-learning, in undergraduate engineering courses. Even though the S-L project group only consisted of 22% of the class size, the results are profound. Especially when one must consider the impact on student perspective and soft skill development that is not explicitly quantified by the results in Figs. 4-5. A quantitative analysis on student performance of Cohort 2 was not performed due to partial loss of student data. While this analysis could not be completed, the results were anecdotally positive in favor of students that participated in the service-learning project.

## Conclusions and future work

This work implemented a service-learning framework in an undergraduate Mechanics of Materials course. The purpose was to investigate the level of achievement with regards to student outcomes and impact on academic performance. The service-learning projects in Cohorts 1 and 2 were designed for students to: apply engineering design to meet specific needs with consideration of public safety and social or environmental factors, consider the impact of their work in larger contexts, and learn to work effectively in a team (ABET outcomes 2, 4-5). The analysis of student responses to preflection and reflection questions for both cohorts qualitatively showed that the service-learning projects had a positive impact on social awareness, self-identity, and engineering purpose.

The quantitative analysis of an exam for Cohort 1 showed a significant improvement on student performance for students involved in the S-L project compared to students that did not participate. Even though high achieving students were more likely to participate and score better in the exam, further analysis of the low achieving students revealed that they benefited the most. Future work should consider motivating low achieving students to get involved or require participation in order to maximize the performance improvement for the students that need it the most. Also, since the case study project group showed a minor improvement on student performance compared to the no project group, the results support the use of project-based and service-learning activities in the undergraduate engineering curriculum. In Cohort 2, there were many personal discoveries and development of soft skills expressed by students. So, more work could be done to explore the potential impact that service-learning has on student performance as they progress into their professional courses.

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## Appendix

The asset tool rubric below was used to assess bridges, light poles, retaining walls, pavilions (or other standup structures), and docks (near water sources). For each asset type, a list of condition categories (e.g., corrosion, erosion, loading issues, etc.) were identified.

| Bridges | Corrosion (including fasteners, nails, joints, brackets) | Erosion (e.g., rot, wear, infestation) | Loading Issues (e.g., deflection, deformation, bending) | Safety hazard (e.g., handrails, stairs) | Stress concentrations (e.g., holes, cavities, cracks, warping) | Structural integrity (e.g., columns, supports, trusses, frame) | Image |
|---|---|---|---|---|---|---|---|
| 1-Poor/High Priority | | | | | | | |
| 2-Uncertain | | | | | | | |
| 3-Fair/Medium Priority | | | | | | | |
| 4-Good | | | | | | | |
| 5-Excellent/ Low Priority | | | | | | | |

<u>NOTES</u>:

- Material Condition: Verify that the materials used are still in working condition. Check for water damage, rusting, cracks or other defects.
- Structural Integrity: Check for holes, surface material (slippery, smooth) and leveling problems that might develop.
- Support Condition: Check for visual and structural deficiencies. How does it respond to loads?
- Cosmetic Condition: Check for signs of wear due to natural or human wear and paint condition.
- Handrail Condition: Overall condition of handrails: Missing pieces, water damage, rust, etc.

| Light Poles | Corrosion (including fasteners, nails, joints, brackets) | Erosion (e.g., rot, wear, infestation) | Loading Issues (e.g., deflection, deformation, bending) | Luminosity | Safety hazard (e.g., electrical, wiring, covers) | Stress concentrations (e.g., holes, cavities, cracks, warping) | Structural integrity (e.g., base, supports) | Image |
|---|---|---|---|---|---|---|---|---|
| 1-Poor/High Priority | | | | | | | | |
| 2-Uncertain | | | | | | | | |
| 3-Fair/Medium Priority | | | | | | | | |
| 4-Good | | | | | | | | |
| 5-Excellent/ Low Priority | | | | | | | | |

<u>NOTES</u>:

- Material Condition: Any signs of rust, corrosion or wood chipping.
- Support Condition: What is the condition of the bolts and the base of the light pole?
- Structural Integrity: Check for bent poles, light bulb covers, missing pieces.
- Cosmetic Status: Check for graffiti, scratches, and missing paint.
- Electrical State: Visually analyze for any exposed wires, missing light bulbs or low light intensity.

| Retaining Walls | Erosion (e.g., rot, wear, infestation) | Stress concentrations (e.g., holes, cavities, cracks, warping) | Corrosion (including fasteners, nails, joints, brackets) | Structural integrity (e.g., standing angle, wall, supports, frame) | Image |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 1-Poor/High Priority | | | | | |
| 2-Uncertain | | | | | |
| 3-Fair/Medium Priority | | | | | |
| 4-Good | | | | | |
| 5-Excellent/ Low Priority | | | | | |

NOTES:

- Material Condition: Any signs of rust, corrosion, or wood chipping.
- Support Condition: Check the state of studs, buttresses, or other wall support structures.
- Structural Integrity: Does the wall contain all the bricks or blocks as originally designed.
- Standing Angle: Determine if the angle at which the wall is standing poses a collapsing hazard.
- Bulging: Spots in which the wall is not following the standing angle.

| Pavilions (other standup structures) | Corrosion (including fasteners, nails, joints, brackets) | Erosion (e.g., rot, wear, infestation) | Structural integrity (e.g., columns, supports, trusses, frame) | Floor/roof condition (e.g., holes, cracks, warping) | Furniture integrity (e.g., chairs, tables, trash cans, fountains) | Safety hazard (e.g., electrical, sanitation, water leaks) | Image |
|---|---|---|---|---|---|---|---|
| 1-Poor/High Priority | | | | | | | |
| 2-Uncertain | | | | | | | |
| 3-Fair/Medium Priority | | | | | | | |
| 4-Good | | | | | | | |
| 5-Excellent/ Low Priority | | | | | | | |

NOTES:

- Material Condition: Any signs of rust, corrosion, or wood chipping
- Support Condition: Current condition of the supports holding the structure.
- Structural Integrity: Comprehensive review of the entire pavilion/standing structure.
- Cosmetic Condition: Check for graffiti, scratches, and missing paint.
- Roof Condition: Overall roof condition, missing tiles, supports, or any damages to the beams.

| Docks (near water sources) | Corrosion (including fasteners, nails, joints, brackets) | Erosion (e.g., rot, wear, infestation) | Loading Issues (e.g., deflection, deformation, bending) | Safety hazard (e.g., handrails, sanitation, clearances, water leaks) | Stress concentrations (e.g., holes, cavities, cracks, warping) | Structural integrity (e.g., columns, supports, trusses, piers) | Image |
|---|---|---|---|---|---|---|---|
| 1-Poor/High Priority | | | | | | | |
| 2-Uncertain | | | | | | | |
| 3-Fair/Medium Priority | | | | | | | |
| 4-Good | | | | | | | |
| 5-Excellent/ Low Priority | | | | | | | |

NOTES:

- Material Condition: Any signs of rust, corrosion, or wood chipping caused by the water.
- Structural Integrity: Extensive look at the overall dock.
- Support Condition: General state of the supports holding the dock.
- Cosmetic Condition: Check for graffiti, scratches, and missing paint.
- Water Clearance: Analyze the limits on the clearance of the water level on the dock.