Changes in Student Perceptions of Course-Based Service Learning at Large Scale: EPICS at 23 Years Old

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EPICS at 23 Years Old

Abstract
The EPICS Program, founded at Purdue University in 1995, has grown where it is engaging more than 1100 students per year collaborating with more than 50 local and global community organizations. The EPICS program has experienced a more rapid phase of growth in recent years, doubling the enrollment from 292 in the spring of 2010 to 603 in the fall of 2017 and over 700 in 2018. This phase of growth included shifts in the composition of teams, as more first and second year students enrolled in the design teams and in the course administration to accommodate the larger enrollment. The program has evaluated many dimensions throughout its history including the student experience through formative and summative student evaluations. An analysis of the self-reported student evaluations shows a high level of consistency based on the student reported overall experience and learning. This data is consistent with other data gathered from the program including surveys and interviews from graduates and student reflections. The consistency of the evaluations offers evidence that the scaling of the program and the changes to accommodate the scale has retained the core EPICS experience.

Introduction

Engineering education seeks to fill the need for more engineers while deepening the educational experience to equip graduates to succeed in the diverse global economy. Educating students to thrive in their careers with the technological, societal, cultural and environmental complexities they will face requires new approaches. Modern discussions in engineering education consider adding required time to graduation to add time into the packed curriculum to address these issues. Extended time to graduation is fraught with problems in today’s reality of the high cost of education and political pressures especially with state supported institutions. An alternative is to consider new pedagogical approaches that can add efficiencies into the curriculum where students can learn and gain experiences that will carry them successfully into their careers and lives after graduation. Such approaches are often referred to as high impact pedagogies [1].

The American Association of Colleges and Universities classifies service-learning as a “high impact pedagogy” [2]. While the roots of service-learning, also called community engaged learning, date back to the 1860’s with the Morrill Act and the 1920’s with the work of John Dewey, curricular integration took root in the U.S. in the 1970’s. In the 1990’s there was a significant increase in the adoption of the pedagogy within many disciplines in higher education.
Research has shown that service-learning, can have benefits on student persistence [4-12], learning of core disciplinary knowledge and the broader skills needed in today’s global economy across many disciplines [13-18].

Engineering has been slower to adopt service-learning. During the explosion in other fields in the 1990’s, there were a relatively small number of successful examples emerging in different engineering disciplines [19, 20]. The last two decades has seen a growing number of successful programs in engineering and computing [21-26]. Research has shown that engineering-based service-learning can influence student retention [27-29], diversity of the engineering student population [30-32] and learning the broad set of skills needed for today’s engineers [32-37]. The ASEE Community Engagement Division is a benchmark of the recognition of the pedagogy within the engineering education community.

While significant progress has been made, skepticism and barriers remain. In the in the 2014 ASEE report [38], deans noted that that service-learning was not widely implemented nor was it considered important to their colleges. Nearly two thirds of the administrators believed it was not practiced at their own institution and did not deem it important enough to change.

To impact the broader engineering education community, diverse service-learning models must be implemented, assessed and disseminated. Individual or small groups of faculty conduct most of the active models with relatively small numbers of students. Surveying the 2018 ASEE Community Engagement Division’s papers on the practice shows that the vast majority of programs, courses or experiences are relatively small [39-47]. The diversity of models should include those that can scale and demonstrate efficiency for large and medium sized programs.

Successful models that have scaled include the ambitious Service-Learning Integrated throughout a College of Engineering (SLICE) program at UMass Lowell. Their approach integrated engagement into multiple engineering courses as projects and assignments that complimented the existing course across all of the engineering disciplines [48, 49]. The University of Toronto implemented one of the largest first-year service-learning courses [50]. The EPICS (Engineering Projects in Community Service) Program, at Purdue University scaled to over 600 students per semester and disseminated to many other campuses. [25, 33]

Data on programs, especially as they are scaled, is critical to demonstrating impact to help make the case to faculty and administrators on the benefits and potential in engineering. Data can take many forms including evaluations of student products, interviews and observations and feedback from alumni reflecting back on their experience after graduation. Self-reported student evaluation and reflections on learning are other forms of data captured in many classrooms.

This paper examines student evaluation and self-reported learning over 23 years as one community-engagement program has grown significantly. Where there are clearly limits to the self-reported data, it does offer an insight into the student experience. The paper analyzes the student evaluation data over a period of 23 years and specifically examines how the student
perceptions have changed over time. The main question driving the study is how the student self-reported experience changed as the program has grown from a small beginning of 40 students to over 600 students per semester. During this time, the program has changed significantly to accommodate the large number of students and part of the program evaluation is how this has affected the lived student experience.

It is important to note that this is one part of the overall program assessment and recognize the limits of self-reported data alone. This data will be correlated with other streams of data from previous and future studies. It should also be mentioned that the program balances the student outcomes with the community outcomes and impacts. Parallel studies are being conducted with the program’s community partners to assess the impact on the community and the quality of the partnerships developed with the program. This paper focuses on the plethora of self-reported student evaluation data over 23 years.

Program Overview

The EPICS Program was initiated in the School of Electrical and Computer Engineering at Purdue University in 1995 [51]. The program has grown steadily in size and breadth to where it is recognized as an independent academic program within the College of Engineering with dedicated laboratories. The program has experienced growth over the 23 years as shown in Figure 1. In the recent years, the growth rate has been very rapid and necessitated changes in the operation of the program, as previously described [52]. In the Fall semester of 2018, over 700 were enrolled and engaged in more than 150 projects with 57 community partners. While the program began within ECE exclusively, it has become explicitly multidisciplinary with an
average of about 40 majors participating in a typical year, and it includes students in their first-year through their fourth or final year. Each department, or school, determines how EPICS counts in their curriculum. These agreements are the results from conversations across campus with separate faculty curriculum committees. For all of the engineering disciplines at Purdue University, EPICS courses will satisfy at least a technical elective (some require students to have third or fourth year standing) and capstone for four disciplines. The curricular structure allows students to participate over multiple semesters or even years which supports long-term, reciprocal community partnerships. The long-term student participation allows for project development over multiple semesters or years and allows projects in EPICS to address complex and compelling needs in the local or global community.

EPICS teams, or course sections, consist of 8-25 students and are student led with a faculty or industry mentor, called an advisor. Graduate student teaching assistants support the advisors and each one supports 3-4 sections providing a mechanism for consistency across teams. Each team or course section comprises multiple sub-teams, each one of which supports a single design project. A typical project team comprises 4-5 students. Once a project is delivered, a new project is then identified by students under the guidance of their faculty mentor(s) and community partner(s). Example projects include designing assistive technology for people with disabilities, developing database software for human services agencies, and developing energy-efficient and affordable housing solutions, as described in more detail in previous publications [25]

Assessment Methods in EPICS

Two core values guide the overall philosophy of EPICS. First, it seeks to provide an educational experience that will prepare students for professional practice. Second, it seeks to meet compelling human, environmental or community needs. The assessment processes are integrated into the curriculum and designed to create artifacts that can be assessed. A key concept is to utilize and assess authentic project artifacts (papers, reports, notebooks, blogs, reflections, etc.) that also demonstrate student learning and achievement. Whenever possible, the assessments are integrated into processes and activities that advance learning, prepare students for their profession, and add value to the development of the community-based design project. [53].

These principles are employed along four dimensions of the program: 1) individual student learning and grading, 2) team and project assessment, 3) community impact, and 4) program assessment. Companion papers described these dimensions further [25,33,52,53].

The program’ assessment includes evaluations from students and their perceptions of their learning and their experience. This analysis focuses on the individual student evaluations collected through summative, anonymous course evaluations. The program has administered a consistent set of questions over extended periods of the program integrated into the common evaluation scheme employed by the university. The long duration of the same evaluations offers the opportunity to explore the impact of the program’s changes to the student experience. While
there are clearly limits to the self-reported student data, it does offer insights into the lived student experience during the course. This data correlated with other data from students and faculty. The scope of the study is to examine how the lived student experience and perceived learning has changed based on these evaluations as the program has grown and developed.

EPICS collected student evaluations over the entire life of the program at the conclusion of each semester and they show part of the impact of changes in the program including the growth in size. Of particular interest is the period from the spring semester of 2010 through the spring of 2018, when the program has doubled in size and had to change long-standing processes due to the scaling. For example, the large size precludes being able to gather students in one place for seminars or presentations. These data are compared to data collected from the early years in the course directly where possible and for comparisons to the impact on the program [33].

The course evaluations included a number of Likert-style questions for students to rate their agreement with statements on a five-point scale. The fraction of students completing the voluntary evaluation varied between 54% and 79% from semester to semester (Figure 2).

![Figure 2 Percentage of Students Completing the Course Evaluation by Semester](image)

The evaluation focused on several themes, including the students’ perceptions of learning design, social applicability, multidisciplinary, and quality of course support (Table 1). The evaluation questions were grouped by these themes and plotted to observe trends. No statistical analysis was required to determine whether the students’ perceptions were decreasing with increased enrollment.
Table 1 EPICS Course Evaluation Likert-Style Statements

<table>
<thead>
<tr>
<th>Theme</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Learning</td>
<td>Having a real project helped me to learn design.</td>
</tr>
<tr>
<td></td>
<td>This course enhanced my understanding of design.</td>
</tr>
<tr>
<td></td>
<td>This course helped me apply knowledge from previous coursework in my</td>
</tr>
<tr>
<td></td>
<td>discipline to design problems.</td>
</tr>
<tr>
<td></td>
<td>Working with a real customer (partner) helped me learn design.</td>
</tr>
<tr>
<td>Social Context</td>
<td>My participation in EPICS helped me see how my discipline can be used to</td>
</tr>
<tr>
<td></td>
<td>help the community.</td>
</tr>
<tr>
<td></td>
<td>This course enhanced my appreciation for the role that my discipline can</td>
</tr>
<tr>
<td></td>
<td>play in the social contexts.</td>
</tr>
<tr>
<td></td>
<td>This course enhanced my understanding of the role the customer plays in</td>
</tr>
<tr>
<td></td>
<td>product design.</td>
</tr>
<tr>
<td></td>
<td>This course helped me develop my awareness of community needs.</td>
</tr>
<tr>
<td>Professional Skills</td>
<td>This course enhanced my ability to communicate effectively with audiences</td>
</tr>
<tr>
<td></td>
<td>with widely varying background.</td>
</tr>
<tr>
<td></td>
<td>This course enhanced my ability to function on a multidisciplinary design</td>
</tr>
<tr>
<td></td>
<td>team.</td>
</tr>
<tr>
<td></td>
<td>This course enhanced my appreciation for the contributions from</td>
</tr>
<tr>
<td></td>
<td>individuals from multiple disciplines.</td>
</tr>
<tr>
<td></td>
<td>This course enhanced my awareness of professional ethics and responsibility.</td>
</tr>
<tr>
<td></td>
<td>This course helped me develop my ability to identify and acquire new</td>
</tr>
<tr>
<td></td>
<td>knowledge as part of the problem.</td>
</tr>
<tr>
<td>Course Support</td>
<td>Assistance is available inside and outside lab.</td>
</tr>
<tr>
<td></td>
<td>The content of the lectures and skill sessions were relevant to the course.</td>
</tr>
<tr>
<td></td>
<td>The lab facilities supported my team’s needs.</td>
</tr>
</tbody>
</table>

Quantitative evaluation have always focused on specific course/program objective but the specific questions changed slightly. Table 2 shows the original questions and the percentage of students rating the course with an A or B grade for each objective, accumulated over the first 15 semesters starting in Spring 1996. 2835 responses were accumulated over 15 semesters: Spring 1996 through Spring 2003. [33]. Ability to Work on a Team consistently received the highest grades, followed by Communication Skills and Awareness of the Customer in an Engineering Project.
Table 2 Percent of students responding with a grade of A or B to the question: “Evaluate the impact that EPICS has had for you on your______.”[33]

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Technical skills</td>
<td>71%</td>
</tr>
<tr>
<td>Understanding of the design process</td>
<td>80%</td>
</tr>
<tr>
<td>Communication skills</td>
<td>83%</td>
</tr>
<tr>
<td>Ability to work on a team</td>
<td>88%</td>
</tr>
<tr>
<td>Resourcefulness</td>
<td>79%</td>
</tr>
<tr>
<td>Organizational skills</td>
<td>77%</td>
</tr>
<tr>
<td>Awareness of the community</td>
<td>73%</td>
</tr>
<tr>
<td>Awareness of the customer in an engineering project</td>
<td>81%</td>
</tr>
<tr>
<td>Awareness of ethical issues</td>
<td>68%</td>
</tr>
<tr>
<td><strong>OVERALL EVALUATION</strong></td>
<td><strong>84%</strong></td>
</tr>
</tbody>
</table>

The changes were made to reflect the evolution in the learning outcomes. For example, the program now formally teaches a human-centered design process and the extended design questions capture those aspects. The program also has become very multidisciplinary with nearly 40 different majors participating each year. As part of an effort to accommodate the diversity of disciplines across and outside of engineering, the leadership team removed the words “engineering” and “technical” from the evaluations. Finally, a structural change was made in the way the data from the university course evaluations are reported. In the first decade of the program the questions were evaluated with letter grades and the results reported with each response. The new system used a Likert scale and the data is reported in aggregated form with averages and means. The early evaluations provide a benchmark and inform the new evaluation data but a direct and longitudinal comparison is not possible.

The EPICS course evaluations also include a set of open-ended questions as well as a free comment area to allow students to elaborate on their experiences in EPICS (Table 3). The question “What are the three most valuable things you have learned from being a part of the EPICS program?” have been used with the same wording since the beginning and the results were reported by Coyle et al. [33]. The data for two snapshots of time were coded using the
previously employed coding scheme allowing new themes to emerge. Responses that captured multiple categories in the coding scheme were included in all of the appropriate categories.

Table 3 Open-Ended Questions in the EPICS Course Evaluations

<table>
<thead>
<tr>
<th>EPICS Course Evaluation Open Ended Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the three most valuable things you have learned from being a part of the EPICS program?</td>
</tr>
<tr>
<td>Would you recommend EPICS to your friends? Why or why not?</td>
</tr>
<tr>
<td>If you are not returning to EPICS next semester, why not?</td>
</tr>
</tbody>
</table>

While the course evaluations measure students’ self-reported perceptions of the course and their learning, they are clearly limits to the data and biases. Within the program, learning and accomplishments are assessed individually and by team [53]. These data are used as one part of the programmatic evaluation. Other metrics for measuring students’ perceptions of the course is whether they choose to return to take the class again. EPICS is set up to allow students to return for multiple semesters, providing a continued design thread through their education and allowing them to apply their other coursework to real world problems. While different majors allow EPICS course credits to apply toward graduation requirements in different ways, all majors support students continuing for at least six credit hours. In this study, we also evaluate the rate of returning students to look for a drop off that might indicate a change in student satisfaction.

Results

Students’ self-reported rating of the overall EPICS course has remained fairly consistent over the duration of the program as enrollment has varied, and while enrollment increased in the last few years. There was a dip when enrollment waned in 2005 and 2006 but students’ ratings still remained at a high level. They increased and remained consistently high over the last eight years as enrollment increased the program changed as described earlier. (Figure 3).
Figure 3 Students’ response to the overall course-rating question by semester.

Looking into specific themes, students’ responses to each of the statements regarding their learning of design concepts, social context, or professional skills each showed no signs of decrease to correlate with the increase in enrollment (Fig 4-6). In Figure 4, which displays the results for the design questions, there is a slight upward trend for all of the categories. The ratings are high with the average score high and very high. “Working with a real customer (partner) helped me learn design” showed a small drop over the last four semesters. It is interesting that “Having a real project helped me learn design” is slightly higher than “This course enhanced my understanding of design”. This may be from the perspective of the students on what they are learning themselves and what they perceived as being taught. This phenomenon has been seen in relation to the experiential nature of the course, in which students attribute some of their learning to themselves, and while they learned during the experience, they did not perceive that the advisor or the course taught them. Further study is needed to explore this phenomenon. The lowest rated of the design questions was the applying knowledge from their discipline. The projects span disciplines and knowledge areas and while the rating is high, it would be another interesting area to probe.
Figure 4 Students' perception of design learning did not decrease with enrollment increases.

Figure 5 shows the responses to questions in the theme of the community and the role of a real customer. All four questions show very close scores to each other and a slight increase over the analyzed period. Figure 6 shows a similar consistency between the questions in the theme of professional skill outcomes. There is a similar pattern of variation and an overall increasing trend. The final theme focused around the course support structure. Students’ perception of the availability of assistance, appropriateness of supporting learning experiences, and the quality of lab facilities have remained level or increased over time. All of the data allays the concern that the learning and student experience is being impaired by the changes in the program with the increase in size. Similarly, the questions in Figure 7 around course support did not change significantly with the expansion.
Figure 5 Students' perceptions of social context learning did not decrease with enrollment increases.

Figure 6 Students' perceptions of professional skill development did not decrease with enrollment increases.
Another indication that the student experience is not being compromised was the high rate that students responded positively to the question “Would you recommend EPICS to your friends?” 88.1% said yes from 2009-17 without significant differences between years.

The qualitative data used the same question “What are the three most valuable things you have learned from being a part of the EPICS program?” since the early days in the program. The responses published in 2005 are plotted along with the data from 2009-10 and 2017-18 as three snapshots in the program in Figure 8. The data was coded with the same themes as the prior study for comparison. Figure 8 represents only those themes that emerged in the earlier study.

Teamwork continued to be a major theme in 2017/18, with 61.8% of students identifying this as a key learning from the course, but this was reduced from 85.7% who identified this as a key learning in the early years. It is unlikely that the reduction in the identification of teamwork as a learning outcome is because of changes to the EPICS program as comments from other data and the evaluations themselves support teamwork as a strong learning outcome and component to the program. It was surprising that the leadership also decreased. That is surprising as one of the adjustments for the larger program size has been explicit leadership training that is corporate sponsored. Current students have even more leadership roles on the teams in comparison to the earlier cohorts, as students have been empowered with more of the coordination between teams, including new leadership positions for team finances, documentation, and communications. The leadership series have been very popular. A change that occurred since the beginning of the program is that the first-year engineering program has gone through significant change and

![Figure 7 Students' perception of course support did not decrease with increasing enrollment](image-url)
teamwork and leadership are taught to all first-year students. From prior research, it has been found that when students perceive that they have a skill and are applying it in the setting, they do not attribute that course or experience with new learning and therefore may not explicitly identify it as a new learning outcome for them. When EPICS started, there were few if any structured team experiences for students in engineering or other disciplines. Currently, the colleges of engineering and science, which includes computer science, practices team-based learning extensively. While the percentage of students reporting these skills as key learnings did decrease, there were still more than two thirds of the students reporting that they learned or developed teaming and leadership skills, which is impressive and gratifying. This is an issue that is worth pursuing further and will be monitored to see if the trends continue.

Another reduction was in the area of organization skills and project management. This is intriguing and is possibly due to the earlier emphasis on project timelines. In the earlier data, a higher percentage of the students was taking EPICS as an option for their senior design and had graduation deadlines to meet. Much of the growth within EPICS has been in first and second year students. EPICS projects are decoupled from the semester timeline and can be extended to multiple semesters. With less critical deadlines to finish, perhaps the emphasis has been more on perfecting the designs rather than meeting a hard deadline. Our community partners are often accommodating and compromise to invest more time on the project for a better quality design.

In the original data the “technical and design skills” was comprised mostly of specific skills related to the projects such as a coding language or analysis tool needed to complete the project. Design was lumped into the category but the specific design references were a minority of this category. In the first decade, design was taught but there was no specific design process standardized across the program. Since different disciplines use different design processes, the students were be able to use any design framework they wanted. The philosophy was that we did not want to “impose” a process on them. The students were not learning any design process with this method. Between 2005 and 2009, the program shifted to teach a structured design process and employed for all projects. The data shows that 77% of the design and technical skills are from mentioning design or the design process for the 2009/10 dataset and 69% for the 2017/10 cohort.

Communication remained a significant outcome for students, with just under half of the students in all cohorts reporting communication as a key learning. In their responses, many of the students listed different aspects of communication but it was only coded once for that student. For example, they stated that they learned how to present in design review settings (oral communication) and to prepare proper documentation and reports (written communication). Since the comparison dataset did not distinguish different forms and only recorded one category for each student, the same process was followed for this data. This raised an interesting feature of the data. In the early cohort, the number of categories checked per student was 2.6 but only 2.1 for the latter two cohorts. It is not clear why this occurred. The data is normalized by the number of students who responded. Some students did not follow the instructions but wrote a
short reflection on the most meaningful aspect of the learning. Others, as noted with the communication, listed multiple dimensions to categories and only counted once.

The real world aspect and community awareness increased slightly in the final cohorts compared to the original. More than double the number of students mentioned the customer or also users, which is the term employed in the professional development sessions on design, were mentioned by students. This may be a factor from the teaching of user-centered design and the importance of interactions with the users. In the early days of the program, all of the partners were local and students had regular in person interaction with them. The current portfolio of projects includes many projects that have global partners with limited personal interaction so that increase in customers and users is encouraging.

![Figure 8 Student response rates to the question “What are the three most valuable things you have learned from being a part of the EPICS program?”](image)

Two categories arose that were not present in the original data and these are plotted with the other data in Figure 9. The first was ethics. This was 3.1% of the 2009/10 cohort but 5.3% in 2017/18. The original data reported few mentions of ethics explicitly. The design education materials integrate Ethics as part of the supplemental learning to the project work. This did not result in an increase in the identification of ethics and program’s leadership team will explore this area in the future.

A larger new category was the multidisciplinary and diversity category. Several students commented that they learned to work with other disciplines or diverse teams. The program has
become much more multi-disciplinary, as mentioned earlier, and this aspect came out in the data. Not as strong as teaming in general, communication, or design, but it was notable.

Similar to the results of the student evaluation, the rate at which students chose to return to the EPICS program did not decease over the span from 2010 to 2018 (Figure 10). This is significant as the course is typically used as an elective and students are free to enroll as many semesters as they choose. The number of returning students is a partial indication of their interest and engagement in the experience. The number of returning students across time has tended to be much higher in spring semesters than in fall semesters, while overall fall enrollment tends to be higher than in the spring (Figure 11). This is in large part due to the increase in size of the first-year learning community. Students in the learning community use two semesters of the course as a substitute for the traditional introduction to engineering course. This sequence is a fall and spring semester sequence. Most of the students cannot fit the course into their already packed sophomore year. Students can use EPICS in their junior and senior years as a technical elective. In the early years of the program, before 2001, the fall semester had higher enrollment as seen in Figure 1. In the years between 2001 and 2008, the data shows that the higher enrollment semester moved between the fall and spring as different factors affected when students started and left the program. The average duration of enrollment is approximately 2.3 semesters showing that most students enroll for multiple semesters.
Figure 10 Percentage of students in a given semester who were enrolled in the previous semester per academic year.

Figure 11 Number of new and returning students by semester.
Discussion

The EPICS Program has undergone significant changes over the past 23 years. In that time over 7000 students have come through the program and over 400 projects have been delivered to local and global community partners. When this analysis began, the research team believed that differences would arise as the program evolved and the analysis would attempt to discern what the meaning of the differences. The surprising findings were few changes. This may be an indication that the student experience has remained similar, as the program has expanded.

In the early years, students met in weekly lab divisions of about 10-20 students. All students convened together in weekly common lectures and end of the semester presentations in cohorts of four teams. As the program has grown, changes were made to the course structure to accommodate the larger numbers of students, including moving from common lectures to online learning and from end of semester presentations to twice per semester design reviews [25]. The team size and experience remained 8-25 students with a few exceptions, like the popular EWB-USA section that has grown to about 40.

While the self-reported data is limited by itself and may be biased toward the stated learning outcomes of the course, the findings are consistent with data obtained from alumni. A study collected survey responses from over 500 alumni with follow-up interviews on the impact of the EPICS experience in industry [34]. In that study, alumni cited the service-learning experience as a significant experience in their undergraduate program. Graduates came from across the years of the program and the data from the surveys and interviews showed little difference as a function of the year they participated. The data showed that while the projects were different, the overall experience was similar in learning outcomes.

As the program has grown, more instructors have been involved. In the last year, 57 instructors from multiple disciplines taught the 44 divisions of the course. The data shows strong consistency in the student experience over time even with the large number of instructors. Instructor orientation involves short workshops at the start of the semester. Whenever possible, new faculty overlap with experienced faculty for a semester of mentoring. Most of the sections have more than one instructor with several coming from disciplines outside of engineering allowing experienced mentors to be paired with new faculty. The program does not have an extensive and uniform training to completely calibrate faculty across all the divisions. Like the students, our faculty learn as they are doing.

The overall program employs two streams of quality control in addition to faculty mentoring. One is the placement of one graduate teaching assistant (GTA) in each division along with the instructors. Each GTA mentors 3-4 divisions so they experience different instructors. The program’s leadership staff trains and supervises the GTA’s and uses them as a method of calibrating across the divisions and teams.
Student leaders are a second branch for training under the supervision of the program’s leadership staff. Since students return from semester to semester, they help share the culture and values of the program to the new students. Student leaders participate in training sessions led by the program staff and carry those lessons back to their teams. Students, by design, lead the project work and the class itself. The faculty, GTA’s and student leaders work as a leadership team to mentor and guide the other students along on their design journey. The data shows that the culture and student experience has remained consistent even with the diversity of projects, students and community partners.

Another constant in the model has been that each lab division has one or more real community partners that work with the students to co-develop solutions needs in the local or global community. In the early years, all of the partners were local and students could visit them during their lab times. The last decade the number of regional, national and global partnerships has increased to where nearly half of the teams cannot physically visit their partners during the lab time. Virtual communication is used heavily to maintain contact with the partners.

As service-learning courses tend to depend heavily on the investment and enthusiasm of individual instructors, there was concern that as programs expand beyond the direct control of a single instructor, the educational experience may degrade. The key question of this study is whether, through the evolution of the educational and administrative support structure of the program, the student experience diminished. It was somewhat surprising and gratifying that the data has remained very positive and aligned with the program goals. The main experience that the student has in the program is a student-led, community-engaged design experience. This data shows that keeping that core experience and values is a scalable proposition.

Community impact and student learning remain co-equal goals of the program. Future studies are examining the community partner perception. As the program has grown in size and scope, it has gone through different physical spaces. The early years had dedicated spaces that were simple and became very crowded. Off-campus labs were added while new buildings were under construction. The program moved into new labs that were specifically designed for the program in 2007. These moves and the space constraints do not show up in the data analysis. Clearly the new labs have given the program additional capabilities but the student experience seems to be resilient with the different conditions. It should be noted that the productivity of completed projects did increase when the new labs were introduced.

Over the 23 years of the program, the composition of students has changed significantly. Early on, most students were juniors and seniors. First year students were not added until the early 2000’s and in small groups. As the evidence of impact on early participation grew as well as the interest, first-year students were brought on and now number in excess of 300 per semester. Much of the recent growth has been in first-year students, which has changed the composition of the teams and the authors expected to see changes in students’ course evaluation responses.
The data shows that the student self-reported learning remains consistent with the learning outcomes of the course. This is due in part to the visibility of these outcomes within the course. It may explain why ethics is such a low category in the self-reported data. Critical thinking is an explicit learning outcome and analyses of student reflections show that ethical decision making is being practiced and explored. Students, however, do not list this as one of the three things that they learned from the experience. An interesting future study would be to examine explicitly students’ view of ethical development within the course. Limiting students to three topics limits their options and may mask learning that are not reported.

Limitations and Conclusion

This study relies on the self-reported and anonymous data from students at the end of the semester at a single, large Midwestern research university. While the data is limited in determining specific learning gains, it can offer insights into the lived student experience and perceived learning. The qualitative data is clearly influenced by the stated course learning outcomes and assessment criteria. The qualitative data was only sampled at two time periods after 2005. The data was very consistent across the three time periods. The findings from the self-report are consistent with other studies including surveys and interviews with alumni that show no significant difference across eras of the program. The learning outcomes reported in the analysis are also consistent with the alumni data. The consistency of the evaluations across the years of the program point to the power of the small team experience in the lab divisions of the course and the connections to real community partners. The core of the experience appears to be the small group experience and the program infrastructure. As the program evolved, it has added more instructors with a diversity of styles and expertise. The instructors, students and graduate teaching assistants are given a structure that allows freedom to operate within their own partnerships, personalities and expertise. The consistency of the student data indicates that the expansion and freedom given to instructors has not fundamentally changed the experience. The balance of structure and freedom emerged from the alumni data as a key attribute of the student experience. The current analysis shows how this balance of structure and freedom has allowed the program to expand while maintaining the core elements of the student experience.

References


45. T. J. Kennedy and L. Houghtalen, “Engagement in Practice: Lessons Learned While Developing Community Partners (and a New Engineering Program) for Service Learning”, Proceedings of the 2018 ASEE Annual Conference, Salt Lake City, Utah, June 2018


