

Teaching Lean LaunchPad to Transfer Students to Increase Engagement and Persistence

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Abstract

We present a work in progress that demonstrates increased engagement and academic persistence by transfer engineering students when the Lean LaunchPad™ (LLP) ^[1] methodology is applied to teach the engineering design process. Transfer students entering engineering programs typically do not receive the same level of attention entering freshman do. New Mexico State University (NMSU) and Howard University (HU) saw an opportunity to improve academic persistence, graduation rates, and overall experience by co-developing a program that helps transfer students be more successful. A collaborative 3-year grant was awarded from the National Science Foundation's (NSF) Broadening Participation in Engineering program. The objective of the grant is to increase persistence and graduation rates by increasing engagement and by developing a sense of community amongst transfer engineering students.

A week-long workshop that uses the LLP framework was developed to help students design and develop a predetermined university-oriented innovation project. During the workshop, students work in teams, interact with faculty, and visit various parts of campus. While working to identify “product-market fit,” students learn about hypothesis development, test design, hypothesis testing, customer discovery, data analysis, insight generation, and the importance of an iterative process. After two years, preliminary survey results and qualitative evidence at NMSU shows the LLP workshop participants have higher GPA levels as compared to their engineering peers.

Introduction

Freshmen focused first-year experience programs do not always address the needs of transfer students that begin their university studies after the freshman year. The same ‘university shock’ experienced by some freshmen can also be experienced by transfer students ^[2] even after completing their two-year degree. In collaboration with HU, NMSU is working to increase engagement and academic persistence among students transferring into engineering from other higher education institutions. Both institutions are minority serving institutions and share several challenges. A common challenge facing both institutions is to improve graduation rates. We intend to use student engagement to increase academic persistence and therefore graduation rates ^[3]. A three-year NSF funded program is supporting the development and delivery of an immersive five-day workshop at each institution. The workshop is offered the week before the fall semester for incoming transfer students in engineering. Howard University and NMSU are working together to develop the workshops. However, each institution is structuring and shaping the workshop in a manner that the instructors believe fit best with their respective institutions. The focus of this paper are the workshops offered at NMSU during the first two years, the qualitative effect it has made to date on the students who participated in it, and how NMSU plans to move forward.

The first workshop at NMSU was offered the week before classes began in the fall of 2015 and the second was offered again the week before classes in the fall of 2016. The workshop was

loosely structured around the LLP methodology for creating startups as well as the engineering design process. Students were placed on teams and given a predetermined innovation seed project that was based on a university related problem. They developed hypotheses of design solutions, made a test plan, got out of the building to test their hypothesis with customers and stakeholders, and iterated until they validated (or invalidated) their solutions. Along the way, they learned about value propositions, product-market-fit, the scientific method, customer-centric design, and teamwork.

Just as the first year helped shape the second year's workshop, the second year's workshop is influencing the design of the third and final year of the workshop under the NSF grant. Several key insights were gained by NMSU that can be leveraged to develop similar programs.

Institutional Partnership

Partnerships between minority serving institutions such as Hispanic Serving Institutions and Historically Black Colleges and Universities can positively impact many of the at-risk students. These institutions by their very nature have more experience addressing the issues facing minority transfer students. The partnership presented here has a substantial number of minorities in attendance. Howard University has a 20% Black student participation in STEM courses and NMSU has a 49% Hispanic participation rate in STEM. The total transfer enrollment from both institutions into engineering is approximately 300 students. This represents roughly 10% of the cumulative student population of the partner institutions.

To facilitate this partnership and help build a model that is replicable, the workshop was designed to scale-up. In the first year, the innovation seed projects at institutions were independent of each other. In the second year, the projects were the same at both institutions with local teams only. In the third year, the projects will be shared and have team members from both institutions. This ramp-up of workshop integration puts less initial strain on the institutional partnership and allows both partners the time to work on their respective contributions and to fine tune potential logistical issues. Our institutional partnership has matured and strengthened over the past two years as we work towards next year's cross-institution student teams.

Workshop Goals, Objectives, and Outcomes

The overarching goal of the research grant is to heighten student engagement by highlighting the connection between conceptual knowledge and its application to innovative engineering design. It is anticipated that this engagement experience will have a positive effect on the academic persistence to graduation of participating engineering transfer students at both partner institutions^[4].

As an Accreditation Board for Engineering and Technology (ABET) accredited institution, the NMSU authors are practiced at developing objectives and outcomes. The project objectives and learning outcomes for the summer immersion experience using the LLP methodology follow the program objectives and outcomes guidelines set by ABET ^[5]. Our program objectives and outcomes are designed to support the overall goal of engaging students through innovative engineering design and experiential learning.

The specific objectives for the workshop are that students will be able to:

1. Conceptualize, analyze, design, implement, and evaluate engineering solutions;
2. Work effectively as a team member;
3. Communicate effectively through speaking, writing, and the use of presentation tools;
4. Adapt to technological changes and innovations to gain efficiencies in cost, time, and performance and;
5. Become aware of ethical and societal concerns relating to the problems being solved.

Using ABET's concept of outcomes based learning, there should be learning outcomes that are measurable and targeted to help the students in reaching the stated objectives. The learning outcomes for the workshop are listed below.

The student will:

1. Apply the Lean LaunchPad process to engineering design;
2. Analyze a problem, and identify and define the requirements appropriate to a solution;
3. Design, implement, and evaluate an engineering design to meet desired needs;
4. Function effectively on teams to accomplish a common goal;
5. Understand professional, ethical, legal, security and social issues and responsibilities;
6. Communicate effectively with a range of audiences;
7. Analyze the local and global impact of your design on individuals, organizations, and society.

Lean LaunchPad Innovation and Engineering Design Process

New Mexico State University has innovation and entrepreneurship programs to support students with their preparation for careers in engineering design, innovation, and the creative economy. For example, the College of Engineering has an "Innovation Space" that is both managed and staffed by engineering students. The workshop's emphasis on innovation and working in teams dovetails well with the need to promote an innovation mindset and get students thinking about entrepreneurship. As it would turn out later, several students who completed the workshop became strong contributors and leaders in the Innovation Space.

The workshop itself utilizes team-based experiential learning^[6], coupled with real-life problems to demonstrate the steps required to work through the engineering design process. By practicing and learning these skills the students become better prepared to interact in their engineering courses. Many of the personal interactions required of the workshop participants between faculty and their peers are what would be expected of them in their engineering curriculum. By having the students work on actual university related design problems, their interest level remains high and they tend to display more ownership of their solutions. Having an open-ended problem format that was less constrained also offered the student a more genuine and creative engineering experience.

The workshop leverages the LLP methodology to provide the students with an experiential engineering design learning experience. The LLP process forces the participants to formalize a series of hypotheses ^[7] that are tested and refined based on feedback provided by possible stakeholders and customers. Students test their ideas and modify their designs to reflect their newly gained knowledge. In this regard failure is an option. Failure of the student's hypothesis happens on a routine basis and requires the student to go back to the drawing board, figuratively and literally. These 'failures' are used as learning opportunities where the student's initial assumptions are challenged. Student teams that work in the LLP paradigm learn to leverage their mistakes to move towards a workable engineering solution.

The approach used by students in the workshop parallels that of the engineering design process. It starts with students identifying the problem. In this case, a university-oriented problem, like locking-up one's own bicycle without a traditional lock and key. Then, the problem is researched and an initial hypothesis is developed about what the solution is. Next, a plan to test the hypothesis is developed and implemented. This is when the students, in the words of Steve Blank, "get out of the building."^[8] They talk to customers and stakeholders about their solution. In the bicycle lock scenario, students spoke with other students and faculty who ride bicycles to school, facilities personnel, and even the university police department. After hearing from these stakeholders, students refine their solution based on the feedback they gathered. They develop a new or refined design (or hypothesis) that they believe will better address the problem. Finally, they cycle through the process again and again until they validate their hypothesis or believe there is not a reasonable solution within the parameters of the project.

By following the process, students begin to self-identify as engineers, or at least as engineering students. Moreover, students begin to feel like a part of the campus community because they are working with their peers and faculty, visiting various facilities, and interacting with people they otherwise would have never known. They develop confidence in themselves, the process, and their decision to attend NMSU.

The First Year of the Workshop

The first year of the LLP workshop followed a 5-day format in which students were guided by faculty instructors and student mentors. The workshop kicked-off Monday morning and ended Friday afternoon, with most days going from 9:00 AM to 4:00 PM. The first-third of the workshop was focused on teaching the LLP concepts, the middle-third was focused on "getting out of the building" and prototyping, and the last-third was focused on the final presentations. The workshop concluded with an energetic group discussion amongst all participants, the faculty instructors, and student mentors.

The workshop participants consisted of 24 students transferring into NMSU's College of Engineering. Most were transferring from community colleges in the region, but some were from other universities in and out of state, and a few were from universities in Mexico. All were planning to major in an engineering discipline. Most had at least one year of higher education and were less than 5 years removed from high school. The participants were recruited through two primary channels. The workshop was advertised to prospective students at regional

community colleges and presented to all transfer students participating in orientation. Participants who completed the workshop were given a \$500 stipend.

The workshop was taught by four faculty members. One led the development of the workshop, as well as the delivery of most lectures and activities. The other three led various components of the workshop, like managing logistics, coordinating video conferences, and leading specific projects. All faculty members have LLP experience and/or training, as well as some entrepreneurial experience. Additionally, the workshop was supported by four current College of Engineering student employees. The student employees acted as peer-mentors to the workshop participants and ensured all supplies, meals, and facilities were ready throughout the week.

All five days of the workshop consisted of various lectures, discussions, and activities. The first day, the workshop participants were placed in teams, assigned projects, and learned about the LLP methodology and how it was going to be used in the workshop. The second day, students worked on developing their initial value proposition hypothesis and testing them. The third day, students worked on developing their business model canvas (BMC) hypothesis and testing them. The fourth day, they refined their BMCs and worked on their final presentations. The fifth and final day, the workshop participants finalized their presentations and delivered them in front of their peers, the HU participants and instructors, and visitors from the College of Engineering.

Since the primary goal of the grant was to increase engagement and academic persistence, several elements were integrated into the workshop to promote a sense of community and belonging. First, students were forced to work with their peers. A teamology ^[9] approach was used to form teams. Students were placed on teams using their personality types and cognitive mode scores. Also, students were encouraged, and at some points required, to work with peers they did not know. Second, the workshop was held at various facilities across the College of Engineering and across campus. This included having lunch catered from local restaurants and eating at the campus dining hall. Finally, students had the opportunity to tour some of the College's facilities and learn about some of the student organizations. For example, many students toured the Innovation Space and learned about the resources available to them through that facility.

First Year Results and Changes

On the last day of the workshop, just after the final presentations, the participants were prompted by the instructors to share what they liked about the workshop, what they would change, and how they felt the workshop would help them going forward. Most comments were positive and focused around how it helped them build their sense of community at NMSU. The participants liked that they had opportunities to interact with faculty (the course instructors), their peers, already enrolled students, as well as spend time in facilities across campus like classrooms, lecture halls, and the main dining hall. Most liked the group work and going through the process of creating project prototypes iteratively. Many even said they liked being taken out of their comfort zone by having to work with people they did not know and give presentations.

During the discussion, there were several suggestions to improve the workshop. Most participants were vocal about eliminating the LLP videos from Udacity's *How to Build a Startup*. They felt the videos were uninteresting and often redundant. Some participants suggested there be an option for the students living on campus to move into the dorms early; which is hypothesized to be a reason for lower than expected enrollment. Many students didn't initially understand what the workshop was about, so they felt there should be more information in the advertisement flyers. Also, several participants said they would have liked to have had the opportunity to meet student organizations and tour more facilities.

A few weeks after the first workshop, the instructors and peer mentors met to discuss in depth how the workshop went and what improvements could be implemented. Based on the student's feedback, decisions were made about what changes should be implemented for the second year, including:

- Bolster recruiting efforts during transfer student orientation days.
- Develop an effective waitlist system.
- Provide housing support, especially for those living in the dorms.
- Simplify the workshop content by emphasizing product-market-fit, not the entire BMC.
- Remove the *How to Build a Startup* videos from the workshop and supplement with interactive exercises.
- Develop better methods for helping students find customers to interview.
- Identify reliable telecom system and better coordinate presentations with HU.
- Feed "brain food" to the participants during mid-morning and mid-afternoon lulls.
- Hire participants to become peer mentors

Nearly a year after the first workshop, the instructors discussed the campus interactions they had had with workshop participants. The instructors interacted with many of the participants throughout the past academic year. Most had similar experiences where the students were happy to see the instructors and let them know they were glad to be at NMSU. They were also grateful for having participated in the workshop. The workshop instructors ended up having some of the participants in class, which immediately ensured a connection was made. Typically, the participants felt comfortable enough to engage the instructors regularly in class and during office hours. Some participants even visited instructors who were not teaching courses they were enrolled in. For example, one instructor met with a participant on several occasions to review her resume, coach her for the career fair, and help identify on-campus employment.

The Second Year of the Workshop

The second workshop, offered a year after the first, made the changes in the bullets above, as well as significantly increased the amount of collaboration between the partnering institutions. Most notably, HU used NMSU's base schedule from the first year and augmented it by updating it with more interactive curriculum. For example, instead of watching an LLP videos about getting out of the building, participants did mock-interviews with each other, instructors, and peer mentors. These efforts appear to have made the workshop not just more enjoyable for the participants, but also helped ensure it increased engagement and sense of community.

Bolstering recruiting efforts during orientation, implementing a proactive waitlist system, and coordinating early entry to the dorms for on-campus students helped increase the number of participants from 24 to 35. Although this was shy of the targeted workshop size of 40, it helped the team identify critical factors that contribute to enrollment.

Focusing on product-market-fit (instead of the entire BMC), replacing the LLP videos with active exercises, and supporting the front-end of the interview process, made the workshop more engaging and enjoyable. There were signs from the first workshop that the entire BMC was overwhelming, confusing, or uninteresting to most of the participants. After all, these are students just transferring into engineering programs, not necessarily aspiring entrepreneurs or business-oriented students. Therefore, working to understand the customer to develop solutions that address their pains, gains, and jobs proved to be exactly what they needed to justify their designs in the final presentations.

It was also invaluable to have peer mentors who participated in the prior year's workshop interacting with the participants. The peer mentors knew how the students felt and could relate to them on a deeper level than the instructors. Often their conversations shifted from the workshop to which classes are challenging or which parking lot was better at different times of day. These high-quality interactions are believed to help the transfer students develop a sense of community and belonging.

Like the first year, the workshop concluded with a rich discussion that was very positive. Overall, the participants enjoyed the workshop. Most said they were thankful for the opportunity to attend and wished the workshop was longer. There were several suggested changes, but most seemed relatively minor. The piece of feedback that stood out the most was to increase the level of interaction in various ways. Specifically, the participants wanted:

- More interactions with workshop participants (peers) on the first day
- More interactive prototyping throughout the workshop
- Wider variety of innovation seed projects (so they relate to each engineering discipline)
- Tours of facilities and resources across campus
- Interaction with student groups/organizations in the College of Engineering

The participants also suggested there be a better description of the program. Most didn't know what to expect. The term Lean LaunchPad™ did not resonate. Also, some participants thought they weren't qualified so they almost did not sign up for the workshop. They had several suggestions to improve how the workshop was advertised and communicated to future transfer students, but none seemed to adequately communicate their high level of enthusiasm and appreciation for the workshop experience.

The initial results indicate the workshop is making a difference. In addition to participants expressing strong favorable views of the workshop, it also appears to be helping students in the classroom. The grade point average (GPA) of all students enrolled in the College of Engineering (as of spring 2017) is at 2.98. The students who attended the workshop average 3.14. Although this margin is small, it's the difference between a "C+" and a solid "B". In the world of recruiting and job offers, the difference is huge. Many employers won't even consider a student

below a 3.0 GPA. It is yet to be determined if this difference results in improved academic persistence and higher graduation rates.

Going Forward

We believe the initial qualitative results indicate the workshop's student engagement will contribute to increased academic persistence of participating engineering transfer students. Preparation for the third and final year of the workshop is now underway. The emphasis will be to refine the offering, work to determine which factors contribute to its success, and develop recommendations about how to better replicate the approach at other institutions. Although the qualitative feedback immediately after the workshops and over the course of the last four semesters has been overwhelmingly positive, it remains to be seen if the workshop is truly increasing academic persistence, and ultimately graduation rates.

Should the workshop succeed in increasing graduation rates among participants, plans to implement a sustainable program will need to be developed and proposed to NMSU's administration. Ideally, a lower cost workshop would be developed. Whatever form the workshop takes after the grant, the instructors believe it is imperative to engage engineering transfer students directly to build a sense of community and increase their chances of graduation.

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