

Innovation Corps for Learning (I-Corps™ L): Assessing the Potential for Sustainable Scalability of Educational Innovations

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Abstract

The Innovation Corps for Learning (I-Corps™ L) is an initiative of the National Science Foundation (NSF) and the American Society for Engineering Education (ASEE) in cooperation with the University of Minnesota, Arizona State University, Colorado State University, and Tufts University to apply the highly successful principles of NSF I-Corps™ towards a culture that will sustain and scale educational innovations. The NSF I-Corps™ program, on which I-Corps™ L is based, uses established strategies for start-ups to build entrepreneurial skills in the engineering and scientific communities that encourage mainstream application of emerging technologies. The overriding purposes of the 8 week I-Corps™ L course are to (1) provide a framework for each of the participating teams (typically 20 to 24 in a cohort) to assess the potential of their educational innovation for sustainability and scalability, and (2) foster an entrepreneurial mindset within the education community so that education products, programs, and services are designed and implemented in ways that promote widespread adoption.

In this paper and poster we summarize the essential features of I-Corps™ L, the changes made in the three iterations of the program thus far, and key evaluation results. We also present our assessment of the potential of the I-Corps™ L to contribute to the transformation of STEM education through the sustaining and scaling of NSF-funded research-based ideas.

Introduction

The I-Corps™ L project focuses on addressing the longstanding challenge of systematically scaling and sustaining educational innovations that enact educational transformation. This challenge has been highlighted by several reports. Governmental, corporate and non-profit organizations have been calling for transformational change in science, technology, engineering and mathematics (STEM) education in the U.S. for many years (1-11). As a result, a number of federal agencies as well as corporate foundations have invested significant resources in an effort to improve teaching and learning in STEM disciplines. However, those efforts that may have the potential for transformative change often do not scale or extend far beyond their local settings; furthermore, they are difficult to sustain without continued external funding. A recent issue in the *Journal of Engineering Education* on transforming engineering higher education points out that change even at the local level requires consideration of the entire system:

“[F]urther progress will require the community, in studies of transformation, to be specific in descriptions of the broader educational ecosystem and how components of the system interact to affect change. Considerable work has been done at a local level... [C]hanges in these local contexts rarely extend to ever expanding spheres of influence inclusive of different cultures, institutional missions, and policies, types of leadership and values, and economic and political factors. As with any system there are inputs, outputs, and surroundings; these also affect potential for change.” (12)

Background on Improving STEM Education

The above quote highlights the complexity of the educational ecosystem. Given that any change happens within some context, it is necessary to take into account factors that may advance an idea or that may inhibit success. Many education-funded projects are undertaken at a local level, such as within one institution, within a curriculum, or even at the level of a single course. While the activities may be at a local level, i.e. within one institution, there are many interacting components that can influence or impact the advancement of an educational innovation. In particular, there are faculty and students, goals for a degree program or accreditation, institutional or departmental mission, the value and reward system, and so on. By addressing multiple components of the broader ecosystem, an educational innovation is likely to have more potential to be sustained for lasting change (13).

The Community of Practice model (14) has been used within engineering education to build and sustain emerging engineering education research communities (15-22). Wenger et al. (14) define a Community of Practice (CoP) as a unique combination of three fundamental elements: a **domain** of knowledge which is defined by a set of issues; a **community** of people who care about this domain; and the shared **practice** that they are developing to be effective in their domain. In other words, a Community of Practice is a group of people, who (1) share challenges, passion or interest, (2) interact regularly, (3) learn from and with each other, and (4) improve their ability to do what they care about.

The NSF-funded Rigorous Research in Engineering Education (RREE) project embraced the Community of Practice model to create a partnership that produced the RREE workshops (19). Organizational partnerships were formed among the American Educational Research Association Division I (Education in the Professions), the Professional and Organizational Development Network, and the ASEE ERM Division. The RREE was structured to promote a CoP among workshop participants to help the participants expand their own communities. A recent study by Kezar and Gehrke (23) proposes a Community of Transformation (CoT) model that is a subset of the Community of Practice model specifically focused on transforming STEM education. Kezar and Gehrke describe three defining elements crucial for creating new or innovative cultures in CoTs, distinctive from CoPs and Professional Learning Communities (PLC):

1. A compelling philosophy;

2. Living integration of the philosophy throughout activities and communications, creating a new world of practice;
3. A network of peers to break the isolation, brainstorm revising practices, and help sustain changes once an individual returns to the status quo environment.

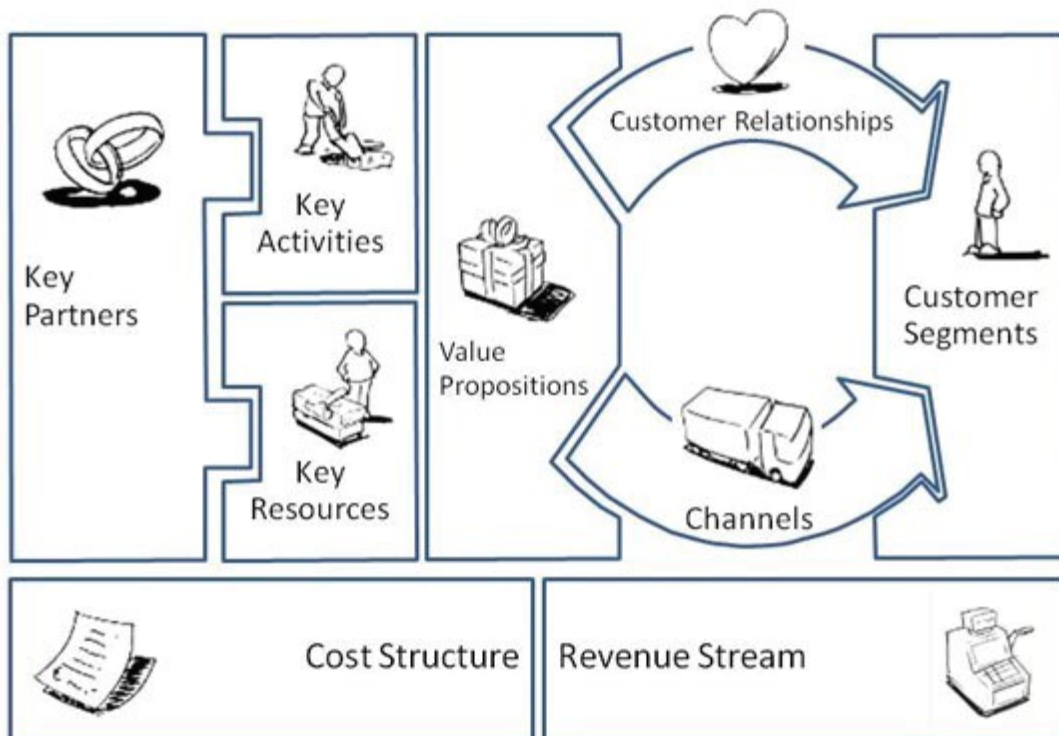
The goal of improving STEM education is addressed in the I-Corps™ L course by fostering an entrepreneurial mindset within the education community so that education products, programs, and services are designed and implemented in ways that promote widespread adoption. Improving STEM education, for example, is essential to meet the national imperative to prepare more college graduates for STEM careers. The 2012 report to President Obama, “Engage to Excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics” provides a well-documented case for the need (24). Recent estimates suggest that the US will need at least three million STEM graduates in the next 10 years. The 19 April 2013 issue of *Science*, “Grand Challenges in Science Education,” argues for making science education a priority, and includes provocative articles, such as, “Transformation is possible if a university really cares” (25). Research suggests that the climate in undergraduate STEM learning environments is part of the problem (26, 27). Hunter Rawlins, President, Association of American Universities, argues, “There is an urgent need to address the institutional and cultural barriers that keep faculty members from adopting the best teaching practices in their classrooms” (AAU Undergraduate STEM Education Initiative). Improving STEM education at all levels is a challenge and the potential contributions of the I-Corps™ L are helping researchers consider sustainability and scalability early in the research process, providing an approach for assessing research based instructional innovations’ viability, and fostering the development of an “entrepreneurial” mindset to complement their “research” mindset.

Outline of the I-Corps™ L program

The program provides participants a model approach to 1) assess the potential of educational innovations for sustainable scalability and 2) for those innovations assessed to be promising, to develop a transition plan to move them forward to widespread adoption. Thus, the expected outcomes of this exploratory project are two-fold: (1) enable the project team to effectively assess the potential of their innovation for sustainable scalability, and (2) identify a path by which promising innovations can garner broad acceptance, i.e., implementation or adoption.

Both I-Corps™ and I-Corps™ L are based on Steve Blank’s Lean Start-Up approach (28, 29). During the course, participants engage in extensive customer discovery, conducting at least 100 interviews with potential adopters, collaborators, and users. Key features of the Lean Start-Up approach used to search for a sustainable and scalable model are:

1. Hypothesis testing using a **business-modeling** tool, the Business Model Canvas (BMC)
2. “Get out of the building” using **customer discovery** to test your hypothesis
3. Based on customer feedback, **agile development** to rapidly iterate your innovation (product or concept) to design/build something users would adopt.



Source: <http://www.businessmodelgeneration.com/>

Figure 1. Graphic of the business model canvas.

Customer discovery informs participants' development of the nine elements of Osterwalder's Business Model Canvas (30, 31), on which teams identify value propositions, customer segments, revenue streams, key partners, and other elements critical to sustainable scalability. The process is illustrated in Figure 1. As with the I-Corps™ course, I-Corps™ L begins with a three-day, face-to-face Kick-Off session, followed by five consecutive weeks of Online Sessions, and ending with a two-day, face-to-face Wrap-Up. Each team is comprised of three members, including a principal investigator, an entrepreneurial lead, and a mentor. I-Corps™ L teams receive support in the form of mentoring and funding to accelerate the learning that helps assess the potential for successfully sustaining and scaling the innovation.

I-Corps™ L launched with a pilot course that ran January-February, 2014, in which nine teams started and completed the program. The pilot was based on and followed the syllabus for the I-Corps™ course as shown in Table 1.

TABLE I. SEVEN-WEEK I-CORPS™ L COURSE

3-Day Kickoff Workshop	5-Week Online Sessions	2-Day Wrap-up Workshop
<ul style="list-style-type: none"> • Teams learn the Lean StartUp approach - business model development and customer development process. • Teams are introduced to the Lean Launch Pad software. • Teams meet with customers and present what they learned to the class. 	<ul style="list-style-type: none"> • Teams “get out of the building” and test their business model assumptions. • Each of the five online classes has two parts: <ul style="list-style-type: none"> ○ 1.5 hours: Team presentations. ○ 1 hour: Class discussion of the weekly lecture. 	<ul style="list-style-type: none"> • Teams present the lessons learned in their exploration of sustainability and scalability.

Some aspects of the course worked well; however, other aspects, such as the “shock and awe” approach, often used in I-Corps™ courses, didn’t work well for the I-Corps™ L teams. We made some mid-course modification, which helped. Eight of the nine teams completed 100 or more interviews and about half the teams significantly revised their value proposition and/or customer segments. An example of the development is the ELeVATE (Experiential Learning for Veterans in Assistive Technology and Engineering) team who conducted 102 interviews. Their development is reflected in the changes to their Business Model Canvas – Initial (Fig. 2) and Final (Fig. 3). See FIE 2014 paper for further details (32).

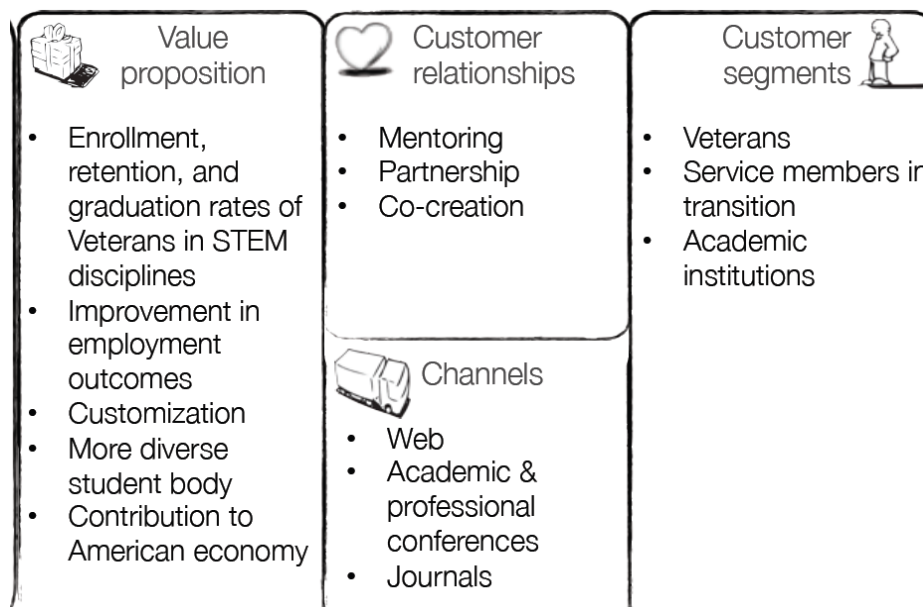


Fig. 2 ELeVATE’s Initial Business Model Canvas (focus on value propositions and customer segments)

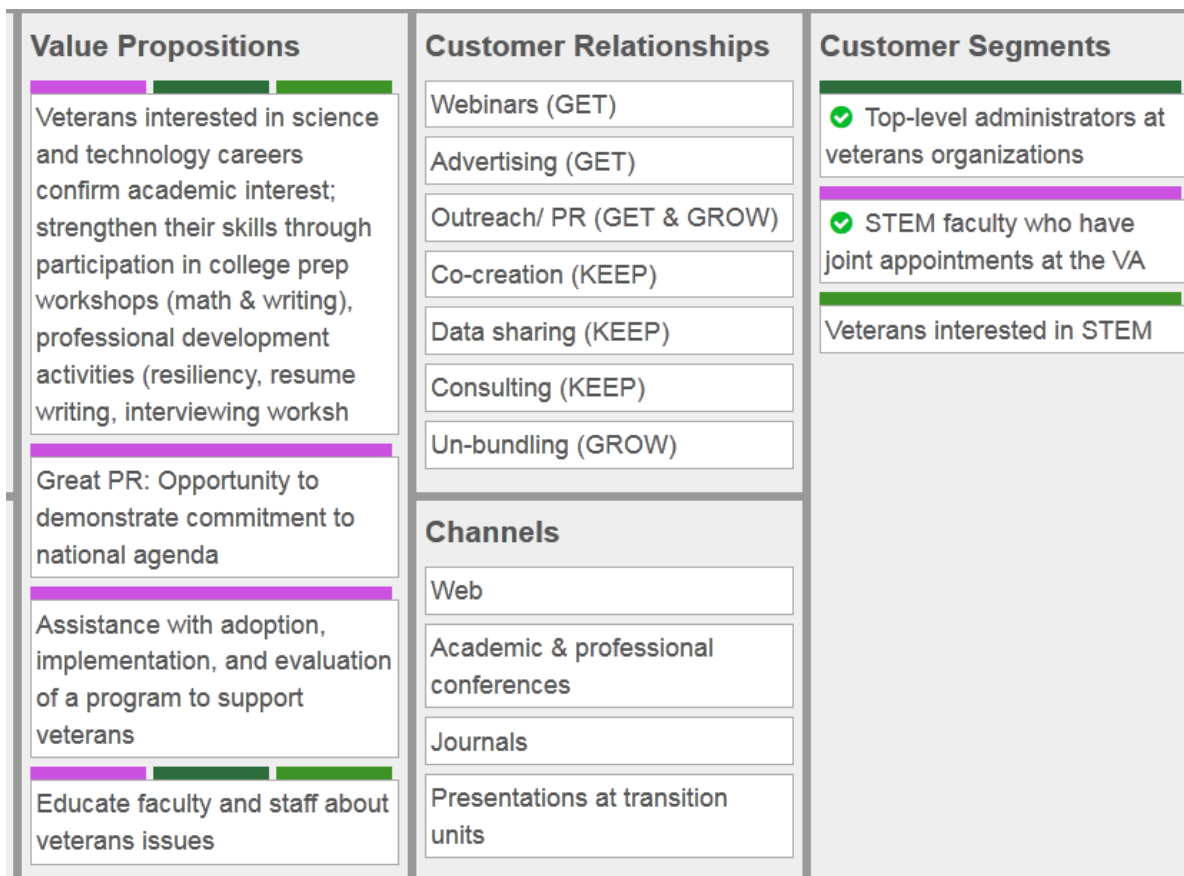


Fig. 3 ELeVATE's Final Business Model Canvas (focus on value propositions and customer segments)

Assessing and Changing the I-Corps™ L Program

Quality Evaluation Designs (QED) conducted a comprehensive evaluation focused on three facets of the I-Corps™ L program:

1. Program delivery, including the 3-day initial workshop, 5 webinars, and 2-day final workshop
2. Impact of I-Corps™ L program delivery on I-Corps™ L teams
3. Program effectiveness in fostering innovative, effective, and scalable learning strategies.

Results from the pilot implementation were used to redesign the course for subsequent cohorts.

A second cohort consisting of 24 teams was conducted in January-February 2015. Following this cohort additional refinements were made and a third cohort consisting of 21 teams was conducted in July-August 2015.

Extensive evaluation data—both quantitative and qualitative—were collected on each cohort. Extensive refinements after each course resulted in increasingly higher participant ratings. The evaluation results

indicate that ongoing refinements to the course contributed to a much more productive experience for the participants.

We are now in the process of reviewing the extensive evaluation results and redesigning the course for a cohort starting in July 2016. We are also revisiting the I-Corps™ L approach using insights from the literature, including:

McKenna, Ann F., Froyd, Jeffrey, and Litzinger, Thomas (2014). The complexities of transforming engineering higher education: Preparing for next steps, *Journal of Engineering Education*, 103(2), 188-192;

and reviewing recent literature on transformational change, such as

Kezar and Gehrke (2015) Communities of transformation and their work scaling STEM reform, Pullias Center for Higher Education, Rossier School of Education, University of Southern California.

Indications are that the I-Corps™ L course has significant potential to contribute to the transformation of STEM education through the sustaining and scaling of NSF-funded research-based ideas. We are confident that continued refinement of the I-Corps™ L course as well as increasing the number of pathways into I-Corps™ L through brief I-Corps™ L Awareness Sessions and a two-to-three-week Introduction to I-Corps™ L courses will contribute substantially to sustained and scaled education innovations.

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