Introducing Entrepreneurship and Innovation to Engineering Students Utilizing a Mobile App Development Tool

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Introduction

This paper describes the creation of an inventive course utilizing smart device app development tools and the Lean LaunchPad methodology to teach entrepreneurship and innovation to engineering students. Our course will utilize Entrepreneurship Teams (E-Teams) and the structure of the course will be derived partially from the Lean LaunchPad methodology – a course that is offered at Stanford, UC Berkeley, Columbia, and other leading academic institutions.

The formation of this course is also partially based on materials from two very successful workshops developed and taught by the authors. One, the "Android App Development" workshop was designed around a software development tool called AppInventor. The other, "Introduction to the Lean LaunchPad Methodology" workshop was developed via our engineering outreach division, Engineering New Mexico, from ideas presented at the Lean LaunchPad educator's conference. These materials have been adapted for this new course and additional materials on digital marketing have also been included.

Teaching students innovation and entrepreneurship in a realistic fashion requires fresh ideas, actual products, and sales. In our course, students will encounter a truly immersive experience that is absolutely real world experiential learning. They will be creating, improving, and selling their products to real customers. To refine and improve their product's likelihood of success, students will learn and apply the Lean LaunchPad method to develop a viable business model. Currently nothing exists in our curriculum that offers this type of real-world hands-on business and product creation experience.

This course fills a growing demand at New Mexico State University (NMSU) for a more in depth application of the Lean LaunchPad, which has shown to have a tremendous amount of student interest. Previous workshops that have been offered on this topic were standing room only. Moreover, the course approach proposed here is scalable because the tools are readily available and the out of pocket expense to the student is only $25 for their Android Developer's Console account.

Course format

The course is offered as a three credit, 300 level undergraduate elective course during the summer semesters. A key aspect of our approach is that we leverage an app development tool (AppInventor) that does not require advanced programming skills. This powerful tool offers access to all of the mobile device's capabilities and allows the designer to make creative and

interactive apps. Teaching the E-Teams with this tool allows the course to focus on the innovative aspects of app development, the Lean Launchpad methodology, entrepreneurship, innovation, and product marketing.

Utilizing our novel teaching methodology, the E-Teams develop their own apps and signup as Google developers with a storefront and sales in Google Play. As official Google developers the students will have the latest developer tools available to them and the ability to monetize the app that they have created. Bank accounts can be set up through Google Wallet to handle the cash flow. With Google Wallet the students will receive real earning statements from Google Play detailing their app's actual sales, refunds, and advertisement commissions. In this way our course provides for a truly experiential and genuine approach to entrepreneurship and innovation where the E-Team's invention and improvements results in a direct financial gain to its creators. Online app sales are a very scalable market which is a key requirement of the Lean LaunchPad methodology to business creation.

The Lean LaunchPad business development methodology

Steve Blank has led the charge for the Lean LaunchPad, a process that guides startups through the creation of their business. It's a process that uses scientific experimentation to validate an entrepreneur's best guess, or hypothesis, about their business model.[1] The entrepreneur will hypothesize what the customer wants, who the customer is, as well as seven other key areas presented in Alexander Osterwalder's Business Model Canvas.[2] To test the hypotheses, the entrepreneur "gets out of the building" and talks to potential customers and key stakeholders. If the hypothesis is validated, the entrepreneur builds confidence in the viability of his or her business. It's a process where the entrepreneur searches for a business model, rather than execute a business plan.

Prior to the lean LaunchPad, the business plan was the key to creating a startup. Entrepreneurs would use "the decades-old formula, you write a business plan, pitch it to investors, assemble a team, introduce a product, and start selling as hard as you can."[3] While this approach was widely adopted, it was inefficient, with 75% of startups failing according to Harvard Business School professor, Shikhar Ghosh. The majority of professors and textbooks preached this approach.

The Lean LaunchPad has had quite a bit of success. It is the primary method used at upper echelon university's like Stanford University, Columbia University, University of California – Berkley, as well as quickly being adopted at institutions across the globe. Even the National Science Foundation has adopted it to help hundreds of the nation's best researchers commercialize their technology through the I-Corps program.

The low barrier to entry for mobile apps

The barriers to entry for physical products have never been lower. The Lean Launchpad helps startups minimize investments until confidence in the business model has been built. However, physical products still often require significant investments in intellectual property, manufacturing, the supply chain, advertising, and time working with the retailers. Without a proven track record and/or an investor, the barrier to starting your business is still very high.

Mobile and web products and services enjoy a considerably lower barrier to entry. In addition to being able to minimize the time invested in a launching a mobile product (because it has been validated through the Lean LaunchPad process), the out of pocket expenses are very low. An entrepreneur starting a company only needs to invest in a computer, software, a business license, and a Google Play license – all of which can be had for under $1000.

This low barrier to entry creates opportunities for a new era of small, and potentially large, businesses. The global mobile app market is expected to reach US$150 billion in 2016.[4] Furthermore, mobile apps are receiving substantial investments from Venture Capital (VC). In 2014, VC funding in mobile was over US$7.8 billion.[5,6] With an understanding of the Lean LaunchPad and basic knowledge in mobile app development, aspiring entrepreneurs can get their business off the ground relatively easily.

Apps for all with AppInventor

A free modern mobile platform application (app) development tool offers an innovative and exciting approach to the introduction of many basic app programming skills. This free software development tool called "MIT App Inventor" or simply "AppInventor" provides an inviting and lush development environment that provides the student with immediate visual, and at times, tactile feedback about their programming changes. It does not require conventional programming language skills to create the working app.[7] Instead it utilizes a block programming development environment that provides the developer with drag and drop programming capabilities of the mobile device's most useful features. The low barrier to programming apps with AppInventor is what makes it especially useful for teaching entrepreneurs who are not programmers, computer scientists, or software engineers.

Google Developer's Console and Google Play

The Google developer's platform provides entrepreneurs with a comprehensive app marketing and development environment. The developer's console is available to anyone at the onetime cost of $25. The apps created with AppInventor can be directly imported into Google's developer's console. The developer's console provides an easy to use interface for creating the app's storefront in Google Play. The console also allows limited app releases for testing and provides the entrepreneur with the ability to target specific device platforms. Console users are provided with detailed charts regarding the app's number of downloads, installs, current installs, number crashes etc.. Direct feedback via consumer ratings and comments provide a constant stream of highly specific feedback.

Teaching innovation through experiential learning

Innovation is usually taught with a focus on the technology. However, a technology cannot be an innovation without being a part of a business – otherwise it is just an invention. Given the low barrier to entry for mobile apps, teaching innovation can be more than a thought experiment. Students can work through the Lean LaunchPad process to find a viable business model for an app idea, develop the app, and actually sell the app. Students can learn first-hand how their app

does in the marketplace. They can leverage the scientific method to iterate to a better business model and app. Using apps and the Lean LaunchPad may be the best practical way to teach innovation experientially. The fact that the E-Teams are selling their creations in the same way any other company would sell their app provides the ultimate in experiential learning. A real team with a real product and real income is not easy to replicate in a classroom environment.[8] Our entire product development process involves hands on development experiences with real world banking statements and earnings.

E-Team formation

E-Teams are groups of students working on an entrepreneurial project. Each student E-Team will strive to have a diverse selection of engineering majors and at least one software engineer per team. Teams do not require financial support and will create their product with sweat equity. The cost of our approach to the E-Teams is minimal. Therefore it is a just a matter of creative effort and marketing on the part of the E-Teams to improve their income stream for any needed financial support. Specifically, E-Teams are formed at the beginning of the course based on the following process:

- Each student proposes an idea for an app.
- Students and instructors select the most promising ideas.
- Those students whose ideas have been chosen recruit remaining students (of varying disciplines, skills, and talent) to their E-Team.
- A course enrollment of up to 30 students would then form approximately 7 to 10 E-Teams.

The entrepreneurship and innovation ecosystem

The entrepreneurial ecosystem at NMSU is extensive and involves stakeholders at many different stages of the innovation process. From a student's perspective their first introduction to entrepreneurship is typically in courses designed around our Entrepreneurship minor offered in the college. These courses introduce students to the challenges facing today's innovators. To assist interested students the college has created the Aggie Innovation Space (AIS) to provide prototyping and testing facilities to innovators. The AIS has received support from Intel Corporation in the form of funds, tools, low-resolution prototyping materials, oscilloscopes, breadboards, 3D printers, and scanners. In addition to the AIS, the students also have access to professional engineering services and fabrication for innovators to build fully-functional prototypes and products.

NMSU also has the Arrowhead Center, an on-campus entrepreneurship resource center, which houses experienced advisors and an Innovations Network with the mission of harnessing the intellectual capital of our region's residents and channeling their entrepreneurial spirit. The Arrowhead Center facilitates the building of an innovation-based, high growth economy. They work to connect innovators and inventors with venture capitalist to obtain funding for taking products to market. This center offers multiple grants to provide seed money to local entrepreneurs. The Arrowhead Center may be requested to pay for student assistant in the form of advanced programming assistance and business development. We will therefore encourage

successful E-Teams to leverage the Arrowhead Center as the next logical step in their business development process.

Teaching assistants and student mentors

The personnel hired for the course will include two student employees to assist in course development and to help administer the class during the summer semester. Their primary role will be to assist the faculty and students of the course with their app development and marketing. They will also be utilized during the course as peer mentors. In this role they will assist the E-Teams by answering technical and non-technical questions from the course. Mentors with programming experience will be available for the students to utilize when needed for ideas requiring more complex software implementations.

Student outcomes and goals of the course:

The following are the outcomes developed by the teaching team for the course:
- Learn to function in both development team and business partnership roles.
- Create new or innovate existing apps with real value
- Understand the multiple methods of app monetization
- Understand the Business Model Canvas portion of the Lean LaunchPad approach.
- Have a monetized app with actual income stream

Student assessment and grading

Assessment of the student's progress in the course will be based partially on peer evaluations and conventional faculty grading of reports, homework, and presentations. The peer evaluation is used to keep students engaged in class while weekly presentations are occurring and to keep group and individual participation high.
Specifically, the student's grade will be calculated as follows:
>15% Peer grading
>30% Progress as measured by weekly write-ups and presentations
>30% Skills homework
>25% Final "lessons learned" presentation and video report

Assessment of the course and continuous quality improvement

A thorough evaluation of the course is imperative to understanding what strategies worked best. A pre-assessment questionnaire will be developed to first gauge the student's familiarity with the course topics at the beginning of the semester. This evaluation will be in addition to the regular course evaluation process for all college of engineering courses. Students will be asked in the end of semester questionnaire specifically if they felt that the course met each of its specified goals. Additionally, we plan to implement a peer review process of our teaching effectiveness. External reviewers will be asked to assess the course materials developed and to offer suggestions for improvement. The key to successful course enhancement is to implement a Continuous Quality Improvement (CQI) cycle to review assessments and to implement changes suggested by the students, external reviewers, and peer evaluators. It is proposed that the CQI

cycle be performed each semester to fine tune the course and allow for future adaptations depending on the student's needs.

Adapting the course for non-engineering majors

The course presented here is readily adaptable to a truly interdisciplinary teaching approach. Product innovation and discovery would be immensely helped by having the inclusion of a broader student population with their diversity of backgrounds. If additional technical workshops on software development were created, the course could be tailored to emphasize any one of a number of different instructional aspects. The possible focuses could include the electronic marketplace, advertising strategies, object oriented programming, interdisciplinary team building, or product development and discovery. This course could be offered university wide and taught in a readily scalable fashion with the help of enough engineering peer mentors.

Conclusions

The course discussed here offers students an immersive learning experience focusing on the successful business creation strategies of the Lean LaunchPad business startup methodology. Students learn a powerful business development method that can later be applied to non-app ideas for products and businesses, Recent improvements in app development software tools allows computer novices to create interactive and useful apps that have the potential to be quickly transitioned into sales in one of the largest business creation segments. The combination of AppInventor and the Google development environment provides anyone with a good idea to quickly develop, refine and sell their idea for a profitable app. This course utilizes all of the modern tools and methods in combination with real world experiential learning to teach engineering students the key aspects of entrepreneurship and innovation. E-Teams are used to provide interdisciplinary team building experience so that the engineering students learn to work with other professions. The students are introduced to the extensive entrepreneur ecosystem available to them so that those that have viable ideas or just have the drive can pursue their ideas for products and businesses.

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