Work-in-Progress: A Sandbox Model for Teaching Entrepreneurship

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Abstract **- While major research universities enjoy a large pool of cutting-edge research projects for technology transfer, small liberal art institutions have to adopt a different model for promoting entrepreneurship due to resource limits. We propose a sandbox model for teaching entrepreneurship in a software engineering class. Student activities are closely monitored and coordinated by the instructor. Introduction of entrepreneurial thinking is tightly integrated with the milestone projects in the class. Students are allowed to fail, but they can always resume from the next milestone. We admit that the sandbox approach is highly debatable. Some faculty members believe that a fixed project topic may limit the creativity of students. On the other hand, we argue for the effectiveness of the approach. A good coverage of entrepreneurship topics can be achieved without requiring extra room in the curriculum. We report our preliminary experiences of implementing the sandbox model at Hofstra University.**

Index Terms - Entrepreneurship, Sandbox Model, Software Engineering Education.

INTRODUCTION

An innovative and dynamic professional never lives in an ivory tower. Integrating entrepreneurial thinking [1] into computing curriculum motivates the next generation of IT workforce people who see the value of creation and how research can be transformed to produce the wealth for the society. The EXCE2L project develops course modules about innovation, entrepreneurship, and global aspects in core computer science courses. This paper reports our initial efforts in embedding an entrepreneurship module in a required undergraduate software engineering (SE) course at Hofstra. We intend to investigate a curriculum model called "sandbox" that can be easily replicated by peer institutions.

The sandbox model is motivated by the fact that some universities do not possess the same resources as the major research institutions, where many faculty research projects are available for technology transfer [2]. It uses a fixed term project topic to engage students and weaves the discussion of a variety of entrepreneurship topics in a collection of milestone projects. Each milestone project is well prepared so that student failure is allowed. Students can always resume from a subsequent milestone, given the partial implementation provided by the instructor. All student activities are closely monitored by the faculty. The monitored environment helps students to gain a complete experience of the software engineering process for making a business idea the reality.

LEARNING GOALS

Entrepreneurship is the process of starting a new business/product or service and it involves several activities such as: opportunity identification, business and financial planning, resource gathering and start-up stage. In the SE class, we concentrate on the "technical" aspects of entrepreneurship. In particular, we expect students to be able to perform the following, after the completion of the class:

1. Assess technical feasibility of business ideas by exercising computing and engineering principles.
2. Make simple budget plans based on the complexity analysis of a project.
3. Practice design decisions given business requirements.
4. Deliver, present, and market prototype systems.
5. Adopt proper development model for a vibrant environment like a small start-up company.
6. Have experiences of role rotation in virtual start-up environments.

We expect the students to acquire many other useful information, e.g., intellectual property protection, market research, and venture creation, from the entrepreneurship seminars organized by the department. The SE course module tries to build student ability that transforms a business idea into a complete product.

TERM PROJECT TOPIC

The sandbox model adopts one single term project topic, for which a collection of milestones are developed. The selection of the project topic has to satisfy a number of constraints. First, the project size should allow a student group to complete the project within a reasonable amount of time (e.g., ten weeks). The nature of the problem should permit an extensible and expandable software architecture, which allows students to split and share tasks. The topic needs to cover most of the branches of computer science so that students can apply what they have learned. In addition, it should be interesting enough for students to further derive new business ideas. For the fall 2009 SE class at Hofstra, the term project topic is to create a cross-platform 2D game

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which can be deployed on prevalent desktop systems as well as portable computing devices.

MILESTONE DESIGN

As shown in Table I, there are nine milestones, each corresponding to a major stage of a complete software engineering process. A number of entrepreneurship topics are addressed in each milestone.

TABLE I
MILESTONES AND ENTREPRENEURSHIP TOPICS

#	Milestone Title	Entrepreneurship Topics
1	Project Specification	Project Assessment, Tech. Writing
2	High-Level Design	Company Organization
3	Low-Level Design	Budget Planning, Project Management
4-8	Implementation, Testing	Agile Software Engineering
9	System Evolution	Business Plan Development

In milestone 1 (project specification), students are given a business idea (i.e., the project topic) and they are asked to assess its feasibility from both the technical and business perspectives via an informal discussion in class. Later, they need to submit a revised and complete business plan.

Prior to the beginning of milestone 2 (high-level design), students are required to organize several virtual start-up companies with four students per company in average. Each virtual company adopts a simple structure which consists of one CEO (project leader), one technical writer (optional), and two to three programmers/testers. The CEO is responsible for keeping track of all company financial data, assigning tasks, negotiating virtual pay rate of each member, and determining the bidding strategy for each milestone contract. The SCRUM development paradigm [3] is adopted in the class. Inside each virtual company, programmers/testers have to bid for sprint tasks to "get paid." During the semester, students have to switch roles in each milestone, thus permitting one student to experience all the roles. It is quite usual for a group to fail a milestone due to a wide variety of causes ranging from technical difficulty to group management issues, e.g., some of the group members "change jobs" or simply quit in a milestone. However, all virtual companies manage to have a prototype system ready by the end of the semester because a solution is available for each milestone, based on which a student group can resume the work in the next stage of the project.

In milestone 3, the discussion of budget planning and project management is integrated with low level design. In this stage, students need to customize and nail down all the details of an object oriented design of the game (using UML tools), which consists of over 20 classes and 150 functions. Meanwhile, the CEO of each virtual company has to estimate the potential cost of implementing the whole project. Another interesting topic is the exercise of engineering decisions. Students are asked to compare and apply a number of design patterns (e.g., command pattern and observer pattern), for ensuring the platform independence of the game engine.

Milestones 4 to 8 address implementation and testing. It is required that each student has to serve as the CEO (SCRUM leader) in at least one milestone, thus allowing each student to practice project management and access basic financial function of a company. During the implementation, various agile software engineering approaches, such as paired programming, prototyping, evolutionary development are experimented. This allows students to have real experiences of the pros/cons of each development model, for meeting the "time pressure" to release the product. All virtual companies manage to finish a prototype of the game on the Windows platform using Windows GDI and 2D API of DirectX. One student finishes a 3D prototype of the game using XNA. According to the report documented at each stage. In average, the labor cost of the project is around 400 hours.

At the end of the semester, all students are asked to submit a business plan on the same project topic (cross-platform game). They are asked to review and re-write each of the major components of a business plan: business idea, feasibility analysis, budget planning, and market analysis. Interestingly, most of the students are quite pessimistic about developing a profitable 2D game for the IPhone platform. Given the experiences of developing prototypes, they can make quite professional and convincing analysis of project development cost. In addition, each student is required to compile an impressive company personnel profile to impress the potential investors. Marketing activities were not implemented due to time constraints.

SUMMARY

We have presented a sandbox model for teaching entrepreneurship in software engineering classes and our initial experiences with it. The fixed project approach is debatable and we plan to further support our argument via a thorough assessment in 2010. Our future directions include completion and dissemination of the course materials (milestone projects), and correlating our practice in the SE course with other core CS courses.

ACKNOWLEDGEMENT

This work was supported by NSF under contract CPATH-0829641.

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