

2006-1541: FACILITATING ENTREPRENEURSHIP EDUCATION AT PRIMARILY UNDERGRADUATE INSTITUTIONS (PUIS): PROPOSED FUNCTIONAL AND TEMPORAL MODELS

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Facilitating Entrepreneurship Education at Primarily Undergraduate Institutions (PUIs): Proposed Functional and Temporal Models

Abstract

This paper presents efforts to document best practices and develop resources to facilitate and strengthen entrepreneurship at primarily undergraduate institutions (PUIs) nationwide. The efforts include a multi-dimensional framework involving simultaneous functional, temporal, and developmental perspectives in entrepreneurship education. Current areas of emphasis focus on a body of knowledge and core competencies; a stage gate model for developing products and services; ways to foster heterogeneous teams; and guidelines for staffing and staff professional development. This paper focuses on (1) a functional model, which focuses on what students should know and what they should be able to do, and (2) a temporal model, which focuses on how product or service concepts grow and evolve over time. This work is a result of a collaborative project by ten PUI faculty and staff from seven institutions that was initially funded by NCIIA. While the collaborators represent a range of disciplines, the group includes a concentration of faculty in or affiliated with engineering programs. As such, the group is invested in furthering entrepreneurship education in engineering at PUIs and across disciplines.

1. Introduction

This paper presents efforts to document best practices and develop resources to facilitate and strengthen entrepreneurship at primarily undergraduate institutions (PUIs) nationwide. It describes a multi-dimensional framework for entrepreneurship education, and specifically focuses on cross-cutting functional and temporal models.

This work is a result of a collaborative project by ten PUI faculty and staff from seven institutions that was initially funded by NCIIA. While the collaborators represent a range of disciplines, the group includes a concentration of faculty in or affiliated with engineering programs. As such, the group is invested in pursuing entrepreneurship education within engineering at PUIs as well as across disciplines. The project seeks to help institutionalize entrepreneurship at PUIs by identifying common issues and concerns, strengthening the sense of community, and initiating future collaborations.

This paper first describes the background and motivation behind the project, with particular emphasis on primarily undergraduate institutions, and how they provide a different environment for teaching entrepreneurship. The next section provides an overview of models for entrepreneurship education, focusing in particular on functional and temporal models. The final section of the paper discusses future directions.

2. Motivation

Primarily undergraduate institutions represent the majority of educational institutions in the United States and serve the majority of students. In the U.S., there are over 1800 2-year

institutions, over 2000 other 4-year institutions, and around 260 doctoral universities. Similarly, of the roughly 16 million college students, 40% are at 2-year institutions, 40% at other 4-year institutions, and roughly 20% are at larger universities¹. This parallels the broader economy, in which smaller firms provide much of the innovation and job growth.

PUIs differ, however, from research universities in several important ways:

- PUIs have much higher teaching loads. While senior faculty at a research institution may teach a course or two a year, PUI faculty teach 4 to 9 courses a year, and may have responsibilities in multiple departments or programs.
- PUIs usually have fewer resources and facilities (e.g. machine shops, engineering programs, and technology transfer offices) and more limited faculty and staff expertise.
- PUIs are less likely to have externally funded research programs that produce technology for commercialization; 90% of federal research funding goes to 125 research universities².

At the same time, new products are being developed and brought to market at an unprecedented speed, necessitated by multinational competition, rapid dissemination of information, and the need to rush new products to market to capitalize on ever-smaller strategic windows of opportunity. Given the current environment, PUIs must find ways to help students learn about entrepreneurship both economically and effectively.

A number of PUIs have developed entrepreneurship programs that are housed within their engineering or business programs. Some of these institutions offer curricula that utilize interdisciplinary courses, where engineering and business students work together to gain an understanding of each others' disciplines. This approach enables students to enhance their understanding of entrepreneurial ventures and their ability to work with peers from other disciplines to see a project through to fruition. All of these programs recognize the importance of having graduates who understand concepts such as intellectual property, business plan development, and how to start and operate a business.

Such programs can vary greatly by institution, primarily because of limited faculty resources to develop such programs. Since entrepreneurial education requires broad expertise, the limited faculty resources of the PUIs, along with their typically heavy and diverse teaching loads, can easily make a specialized faculty member shy away from incorporating entrepreneurial topics that would typically go beyond the scope of the course. Additionally, this potential resource strain can limit a PUI's ability and willingness to develop a set of courses that support entrepreneurial ventures. These limitations make the development of a readily accessible, thorough, and comprehensive resource pool particularly important.

This collaborative project by ten PUI faculty and staff from seven institutions began during conversations at the NCIIA (National Collegiate Inventors and Innovators Alliance) 2005 conference. The discussions centered around the recognition that PUIs differ widely from research institutions, as discussed above, and although PUI faculty could learn from their research colleagues, they would also be well-served by a PUI network to identify, develop, and disseminate best practices for their institutions, particularly with regard to entrepreneurship

education.

In May 2005, this group received an NCIIA grant proposal to identify and document best practices³. The group prepared an initial set of five topic areas during that summer and met in August 2005 to critique and validate best practices, brainstorm connections between topic areas, identify areas of future development, and plan strategies for documenting and disseminating the group results. Since the meeting, the group has communicated largely through an interactive wiki website (www.pui-eship.org), regular teleconferences, and face-to-face meetings at conferences. The group welcomes additional input to better represent PUIs nationwide.

This work in progress will result in a collection of tools and best practices, developed through the consensus of specialized faculty from various disciplines and PUIs, will provide interested faculty and institutions access to a wide range of resources to assist in planning and presenting entrepreneurial courses or series of courses. Through these resources, interested faculty from all disciplines can avail themselves of the most current ideas and information in entrepreneurial studies.

3. Models

This work is built on a foundation of common models to organize the best practices, making it easier to offer the material in a very useable format, as well as making it easier to understand and navigate for new and seasoned users.

Ideally, a general model for entrepreneurship education offers several benefits:

- It organizes and categorizes existing knowledge and resources for both teachers and students.
- Faculty with limited experience teaching entrepreneurship can find useful material more easily.
- Gaps and opportunities for further work can be identified more readily.

However, a model also presents some potential challenges, since it provides a particular viewpoint, which necessarily emphasizes some topics and deemphasizes others. This is particularly challenging for multidisciplinary areas like entrepreneurship education; courses and programs might emphasize a variety of topics, including creativity, design, engineering, financials, and marketing.

Literature reviews⁴⁻⁶ have identified a variety of possible models, but none that seemed particularly suitable to entrepreneurship education at PUIs. Furthermore, it is not clear that any one model is sufficient. Therefore, we are focusing on three semi-orthogonal models: functional, temporal, and developmental.

The functional model addresses the knowledge, attitudes, and skills students acquire in entrepreneurship programs, and efforts are currently focused on defining a body of knowledge (BOK) and related core competencies. On the other hand, the temporal model addresses how product or service concepts grow and evolve over time, and efforts are currently focused on a stage gate model specifically intended to support student projects and teams. However, it may

omit some topics that appear in the functional perspective. The developmental model addresses how students, faculty, and programs develop and evolve over time. To date, we have primarily concentrated on the functional and temporal models, as discussed in the subsections below.

These models will help newcomers determine where they are and where they might want to go, and make it easier for them to find relevant material. For the group developing the best practices, these organizational methods will be beneficial in identifying gaps or areas in which more work is needed.

This collection of tools and best practices minimizes the need for faculty at PUIs to do extensive research when designing new courses or augmenting current courses to include entrepreneurship topics, providing continually improved and updated information from a wide variety of experienced faculty.

3A. Functional Model

The functional model is probably the most comprehensive perspective, since it seeks to include everything that might appear in an entrepreneurship program. To develop the functional model, two teams (a core competency team and a course module team) identified lists of educational topics that might be covered in an entrepreneurship course. These initial lists were generated prior to the August 2005 working meeting.

The core competency team generated a working list of topics, subtopics and knowledge items by 1) interviewing entrepreneurs and entrepreneur service providers and 2) reviewing existing educational materials for entrepreneurship⁷⁻¹⁵. In conducting these interviews and resource reviews, the team addressed the following areas: terms and definitions, entrepreneurial concepts, general concepts, pertinent resources, and entrepreneurial/business skills. Within these areas, the team identified eight core topics; each of these topics was then divided into subtopics, supported by specific knowledge items that were garnered from the interviews and resource review. Knowledge items were defined as either beginning, intermediate, or advanced.

The course module team approached the body of knowledge via a search of both traditional textbooks and online syllabi¹⁶⁻³⁶. From these resources, the team identified a set of topics and organized them into a three-tiered structure: core, extended, and optional. The core topics, those that the team considered important for most entrepreneurship courses, were further sorted into four main groupings: general introduction and skills, stage one (product ideas and concept development), stage two (business evaluation, planning, and pre-production), and stage three (the business plan).

During and following the summer meeting, the core competency team and the course module team collaborated to combine their initial sets of topics into a single comprehensive list. Moreover, the collective group agreed to incorporate the beginning/intermediate/advanced (BIA) sorting discussed previously, as well as the knowledge/attitudes/skills (KAS) approach from Bloom's Taxonomy³⁷ to ensure appropriateness of educational content and achievement of learning objectives. Next, we investigated different ways of organizing the topics by topic area to create the framework for the functional model. After researching a number of different

groupings based on available literature^{5,6,35,36,38-41}, along with an assessment of the entrepreneurship program profiles outlined for eighteen different college programs that are part of the National Association for Community College Entrepreneurship⁴², we agreed that the Kauffman Foundation model³⁹, with some modifications, would be best suited as a functional organizational template. This organizational structure, which defines both Tier 1 and Tier 2 levels, encompasses many of the core topical areas identified earlier, and includes both technical, business, and personal development elements.

Building on the collective topic list we had generated, we reorganized our content to fit the Kauffman Foundation format, modifying the Tier 1 and Tier 2 levels slightly to better suit primarily undergraduate institutional education, and creating Tier 3, 4, and 5 topical areas.

The Tier 1 topics are now as follows:

- I. The Entrepreneur
- II. Economics, Finance, & Accounting
- III. People & Human Resources
- IV. Sales & Marketing
- V. Products & Services
- VI. Operations

The functional decomposition of the general topic areas, framed first by Tier 1 and then supported by Tiers 2-5 (see www.pui-eship.org for further details on the sub-tiers), provides a level of specificity that will enable us to develop KAS and BIA classifications for the specific topical areas, within a framework of an accepted generalized format for entrepreneurship education. As this effort continues, we will then develop course module and resource material for each of the topics and classifications. Additionally, we plan to map the functional model and its underlying curricular materials and resources to different disciplines (such as engineering, or science, or the arts), such that faculty from different disciplines can each view and apply the functional model through an appropriate discipline-specific lens.

3B. Temporal Model

The temporal model addresses the entrepreneurial process in a chronological manner – how concepts evolve into products and services. It dovetails nicely with the product development process commonly taught in engineering programs, but is expanded for implementation in multiple disciplines, from engineering to business to theater.

A general process model should satisfy the following objectives:

- Applies across the engineering disciplines and in interdisciplinary contexts
- Builds on sound educational theory
- Relates to industry best practices
- Enables filtering and sorting
- Emphasizes the need for iteration in the process
- Highlights synergies between entrepreneurship and disciplinary content

While we considered many models, we focused on the Cooper's Stage Gate Model for product development^{43,44}. Cooper's model consists of stages and gates. Stages are sets of parallel

activities; gates evaluate the results of stage activities. Cooper’s model has a clear framework of activities, decision points, and criteria. In particular, the gates provide a filtering process that both encourages and enables feasibility review that is critical to the development process.

Cooper’s model has some weakness as applied to undergraduate engineering education. First, it is designed for the large, distributed teams used in large corporations’ product development processes. More importantly, it ends with the product launch, which may not be the educational focus of most undergraduate programs, engineering or otherwise. Accordingly, we revised the model to start with problem exploration and conclude with the business plan. It is important that students recognize the need for a business plan and its components but it is not always feasible or necessary to proceed to product launch in a curricular setting. We are also adjusting the stage activities and gate criteria to better fit typical student teams.

Thus, the proposed stages in the Stage Gate Model being developed are as follows:

1. Exploration
2. Concept Elaboration
3. Venture Proposal (Business Plan Light, Dehydrated Business Plan)
4. Project Definition
5. Product Development
6. Feasibility Validations
7. Business Plan

Following the definition of the stages, we are in the process of developing specific stage activities/materials and gate criteria. Simultaneously, we are addressing the applicability of this model across disciplines by mapping appropriate stages to different disciplinary areas. Table 1 shows some courses and programs from engineering disciplines and which stages we think might be most relevant. Empirical testing by faculty, upon completion of the model, is planned.

Table 1: Stage Emphasis for Different Engineering Programs

Course or Program	Stages Emphasized
Product Design	4, 5, 6
Mechanics	2, 6
Thermodynamics	2, 5, 6
Engineering Science	2, 5, 6
Capstone Design Class	1, 2, 4, 5
Introduction to Engineering	1, 4, 5
Creativity	1, 2, 3

4. Future Directions

In addition to refining and developing detailed content for the two models separately, the collective group also plans to map the intersection between them. Table 2 illustrates how these intersections can provide additional insight. Categorizing resources both functionally and

temporally enables faculty to more easily identify resources appropriate to student projects in their particular course or program.

Table 2 – Intersection of Temporal and Functional Models

Functional Model: Tier 1 Topic Areas	Temporal Model: Stages and Gates						
	1. Exploration	2. Concept Elaboration	3. Venture Proposal	4. Definition & Design	5. Development	6. Validation	7. Business Plan
I. The Entrepreneur							
II. Economics Finance, & Accounting							
III. People & HR							
IV. Sales & Marketing							
V. Products & Services							
VI. Operations							

In the coming months and years, we plan to continue our regular discussions, both in person at conferences/working meetings and through teleconferences/email, further refine our developments and documentation using the group wiki (www.pui-eship.org) and expand our network of interested PUI colleagues. As this dynamic project progresses, the addition of new faculty interested in the project, along with the continued discourse among the group’s current participants, will allow for continuous improvement and the sharing of ideas among disciplines and PUIs. In the long term, we hope to create a collaborative and robust compendium of resources, processes, and supporting materials to facilitate entrepreneurship education at PUIs across the disciplines.

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