

**TECHNOLOGY ENTREPRENEURSHIP EDUCATION:  
THE UNIVERSITY of SOUTH FLORIDA PHILOSOPHY, PEDAGOGY, and  
CURRICULUM**

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**ABSTRACT**

The Center for Entrepreneurship at the University of South Florida (USF) has developed and implemented a unique, novel, and innovative pedagogy and curriculum focused on Technology Entrepreneurship under the direction of an inter-disciplinary faculty from the USF Colleges of Business Administration, Engineering, and Medicine. The use of this pedagogy and curriculum has resulted in inter-disciplinary, team-based, project-focused learning opportunities for graduate students and faculty investigators. It has also resulted in significant benefits for the students, the University, and the Tampa Bay community with increased technology transfer and successful new venture formation. It is appropriate for adoption by other educational institutions.

**EXECUTIVE SUMMARY**

The Center for Entrepreneurship at the University of South Florida (USF) has developed and implemented a unique, novel, and innovative pedagogy and curriculum focused on Technology Entrepreneurship under the direction of an inter-disciplinary faculty from the USF Colleges of Business Administration, Engineering, and Medicine. The use of this pedagogy and curriculum has resulted in inter-disciplinary, team-based, project-focused learning opportunities for graduate students and faculty investigators. It has been demonstrated to be successful in the education of inter-disciplinary graduate students and in the commercialization of University-developed technologies, and has also resulted in significant tangible benefits for the students, the University, and the Tampa Bay community with the increased rate of successful commercialization of USF faculty innovations and development of successful new venture formation. Further, this success has made the students, faculty, University, and community more cognizant of the innovation and commercialization processes and the potential of new venture formation. It is appropriate for adoption by other educational institutions.

**INTRODUCTION**

It is the philosophy at the University of South Florida (USF), that entrepreneurship in technology ventures mandates an *inter-disciplinary* approach. To achieve this goal, the faculty at the Center for Entrepreneurship and its partner Colleges [Business Administration (COBA), Engineering (COE), and Medicine (COM)] at the University of South Florida has developed a team-taught, inter-disciplinary, project-based pedagogy and curriculum for graduate business, engineering, legal, medicine, and science students. This paper will outline the philosophy, pedagogy, and curriculum, and provide results and outcomes.

Entrepreneurship results in the creation of economic value by utilization of research and

technical information and knowledge in inter-disciplinary projects and ventures. Entrepreneurs have been shown to be characterized by innovative behavior and to employ strategic management practices; the main goals being profit and growth (Sexton and Bowman). Garravan and O’Cinneide found: “...the portfolio of skills of many entrepreneurs is relatively narrow. It is unusual to find breadth and depth of knowledge at the same time— many tend to be specialists, not general managers... the real entrepreneur is a person who can organize others and tap into the knowledge and expertise required on all aspects of establishment and start-up...In a start-up situation, problems encountered tend not to be one-dimensional, but highly complex, often incapable of being solved by a single expert. Many entrepreneurs are specialists within a particular field and tend to have a poor grasp of the intricacies of managing across the range of functions. It is in these situations that *true* (added by current authors for clarification and emphasis) entrepreneurial skills are demanded; to work across boundaries on complex, inter-related problems requiring the ability to take a holistic view and exercise skills of analysis and synthesis.” This supports and confirms our philosophy for an inter-disciplinary approach.

## **BACKGROUND**

The primary focus of the Technology Entrepreneurship pedagogy and curriculum is to educate students in the skills and techniques necessary for the creation and development of successful entrepreneurial activities. This has been accomplished through the development of a curriculum focused on opportunity recognition, technology and market assessment, product development, business plan development, new venture formation, and new venture financing. A second major focus is to assist the university administration in the identification of University-developed technologies and products for technology transfer and commercialization, and the third focus is to educate, assist, and focus the faculty on the potential for technology commercialization; a requirement for optimal technology transfer within a university. (Wright M, Vohora A, et. al.; Wright M, Birley S, et. al.)

## **PEDAGOGY**

Entrepreneurship education, as a discipline, continues in a state of flux. Some of the reasons for this include the breadth of activities which are often included under entrepreneurship, and the lack of a clear definition of entrepreneurship or entrepreneur. Sexton and Bowman, Hills, McMullan and Long, and Vesper, have reported that there are few accepted paradigms or theories of entrepreneurship education and training. Some authors feel the field of entrepreneurship has made limited progress, within the typical science framework, toward disciplinary status (Aldrich HE and Baker T; Busenitz LW, West PG III, et.al.); and others feel entrepreneurship is a “multi-disciplinary jigsaw” still in the theory-building stage (Busenitz LW, West PG III, et.al.; Wiseman RW and Skilton PF). However, it has been demonstrated that the entrepreneurial role can be acquired either culturally or experientially, which supports the view that it might be able to be influenced by appropriate education and training (Bannock).

According to Garravan and O’Cinneide, the following are among the most commonly cited objectives of entrepreneurship education and training programs:

- to acquire knowledge germane to entrepreneurship;
- to acquire skills in the use of techniques, in the analysis of business situations, and in the synthesis of action plans;

- to identify and stimulate entrepreneurial drive, talent and skills;
- to undo the risk-adverse bias of many analytical techniques.

Entrepreneurship education, in the sense of focusing on the creation of new economic entities centered on a novel product/service, has been, until recently, relatively rare. In a survey which was confirmatory of this, Solomon, et.al, reported that the most common course offerings in Entrepreneurship education programs were: Small Business Management and Entrepreneurship, with New Venture Creation and Technology and Innovation being less common. (Solomon GT, Duffy S, et. al.) The one notable exception to this might be modern technological entities where the creation of a small new enterprise is based largely upon scientific know-how in areas such as electronics and biotechnology. (Sexton DL and Bowman NB)

*At USF, a pedagogy has been developed focused on inter-disciplinary team-based projects that result in new venture formation and long-term success for the newly-founded companies and the University that developed the research and technologies which are the basis for many of the companies. The curriculum has been developed through cooperation between students, faculty, Colleges, and University organizations and is structured such that students from the disciplines of science, medicine, engineering, law, and business can be engaged and participate. Inter-disciplinary teams of students are formed around specific projects under the direction of an inter-disciplinary faculty from the partner Colleges and the Center with strong professional experience as academicians, practitioners, and entrepreneurs. In certain cases, University investigators and faculty who develop new innovations also participate directly with the student teams as mentors to assist in the education and training processes.*

The pedagogy developed at USF to teach Technology Entrepreneurship is based on constructivist-learning theory using a collaborative learning mechanism within the inter-disciplinary, project-based student teams. Constructivist learning theory assumes that learners develop knowledge based on a process of organization and understanding of their experiences. These experiences create schemas, or mental models (Kearsley G). New information causes perturbations in these organization structures and processes which require reflection on and reassessment of previous experiences and developed knowledge with resultant formation of new knowledge to account for the new information. Teacher-instructors assist students and student teams through these processes to aid in the development of insight and knowledge. Collaborative learning (CL) is based on the concept of small teams of students assisting each other in the learning process. Johnson, et. al. (Johnson DW, Johnson RT, et. al.), identify 5 elements in true CL:

- 1) Positive interdependence—strong, continuing linkages between the students leading to success for all team members together;
- 2) Promotive interaction—the gathering and sharing of knowledge and learning between the team members;
- 3) Individuality accountability—accountability by each team member for three processes: 1) active engagement in the group activity, 2) completing a fair share of the team's work, 3) assisting other team members in learning achievement and demonstration of competence;
- 4) Development of social (teamwork) skills—learning of skills in leadership, decision making, trust building, communication, and conflict management;

- 5) Group self-evaluation—continual and on-going evaluation of the team processes and modification as required.

CL is especially useful when the students are heterogeneous in terms of background, experience, expertise, and achievement—a sine qua non of inter-disciplinary teams (Klemm WR). This type of learning is an active, team-based process where the teams and team members construct knowledge based on what they know and the relationship of new information presented by the instructor, obtained or developed by the team, or by the individual team members within the interactions of the class or the individual teams. It is generally found that the knowledge developed and generated by the inter-disciplinary team concept is much broader and deeper than could be formulated by any one individual or team of individuals with similar background. (Kanucka H and Anderson T)

By using real and live projects within a case-based, collaborative learning, inter-disciplinary team environment under the direction of instructors with strong academic credentials and experience in conjunction with experience in the “real-world” as practitioners and entrepreneurs, the pedagogy is designed to provide the students an opportunity for “situated learning” to identify and become a part of a “community of practice”. A key aspect is the notion of the *apprentice observing the “community of practice”*. Lave and Wenger propose that the initial participation in a culture of practice can be observation from the periphery or “legitimate peripheral participation”. The participant moves from the role of observer, as learning and observation in the culture increase, to a fully functioning member. The progressive movement towards full participation enables the learner to piece together the culture of the group and establish their identity. Vygotsky’s had previously discussed the “Zone of Proximal Development”. This theoretical construct states that learning occurs best when an expert guides a novice from the novice’s current level of knowledge to the expert’s level of knowledge. Bridging the zone of proximal development construct with legitimate peripheral participation construct may be accomplished if one thinks of a zone in which the expert or mentor takes the learner from the peripheral status of knowing to a deeper status. This pedagogy is designed to allow the instructor to function in the role of expert/mentor and to help transition the student-learner from peripheral status to the deeper position.

It is also the philosophy at USF that Technology Entrepreneurship is a *practitioner’s art*—based on broad curriculum content to develop intellectual breadth, domain depth, and application expertise and experience. Because of this, individualized instruction, mentorship, and graduated levels of increasing monitored responsibility of students, interns, residents, and fellows (which can all be included in the term “apprentices”) under the direction of experienced practitioners are crucial to this pedagogy. This “apprenticeship model” is defined and further discussed in Vygotsky’s work, which involves peers (novices) working closely together with a teacher (expert) in joint problem solving. The knowledge base and fund of knowledge is constantly enlarged and revised based upon on-going study, research, practice, and experience; and modified and refined with the guidance and mentorship provided on the scaffolding of the more extensive knowledge, expertise, and experience of the instructor. Further, the student/apprentice must develop an ability to function within, and to ultimately manage and lead, inter-disciplinary teams.

In summary, this model results in *increasing, graduated levels of monitored responsibility under the close direction of experts with significant domain expertise and academic and applied experience*—a model used successfully within the medical and legal professions for many years and quite applicable to the field of Technology Entrepreneurship. The final resultant teaching and oversight responsibility structure becomes: ***Entrepreneurship Faculty and Professional Mentors***→ ***Fellows***→ ***Interns***→ ***Graduate Students***→ ***Undergraduate Students***.

## CURRICULUM

The Technology Entrepreneurship curriculum at USF is structured into three modules of educational content:

- 1) Laboratory to “Proof of Principle”: Courses which focus on the movement of technologies from the laboratory to translation for the marketplace;
- 2) Commercialization: Courses structured to teach skills and techniques which will function as a vehicle for commercialization of technologies and products;
- 3) Support—Applications and Research: Courses which teach and develop applied skills and which teach and develop research skills to seek and develop answers to critical questions in the field of entrepreneurship.

### Laboratory to “Proof of Principle” Module

The Laboratory to “Proof of Principle” module is focused on the technical and market assessment of technologies and product development and development and assessment of strategies for the identification and protection of the intellectual property critical to technologies and products. The three courses within this module are:

- 1) Strategic Market Assessment for New Technologies
- 2) Strategies for New Product Development
- 3) Principles of Intellectual Property

### Commercialization Module

This module is focused on the skills and techniques necessary to move technologies into the marketplace through strategies appropriate for the technologies and products, whether these strategies are licensure, strategic partnerships, joint ventures, or the formation of new ventures.

The courses within this module include:

- 1) Overview of Regulated Industries
- 2) New Venture Formation
- 3) Business Plan Development
- 4) New Venture Financing (Principles of Private Equity and Venture Capital)
- 5) Strategies in Technology Entrepreneurship
- 6) Ethics
- 7) Operational Planning (Integrated Business Applications)

## **Support—Applications and Research**

This module is focused on the development of skills used in entrepreneurship and business through internships, independent study projects, and directed research projects. The courses within this module include:

- 1) Advanced Topics in Applied Entrepreneurship (Internship)
- 2) Research Seminar in Entrepreneurship
- 3) Independent Study in Entrepreneurship
- 4) Directed Research in Entrepreneurship
- 5) Case Writing in Entrepreneurship

## **OUTCOMES**

The USF Center for Entrepreneurship and the Technology Entrepreneurship program has benefited over 2000 students, and currently serves over 400 students annually. More than 400 graduate students have engaged in 35 team evaluations of 31 different USF investigators' new innovations, at the strategic assessment and business plan development stages. As a direct result of strategic recommendations developed by the inter-disciplinary graduate student teams and their faculty instructors, 21 new ventures have been launched in the development and commercialization of new USF technologies. As noted by the Association of University Technology Managers (AUTM) in 2002, USF was ranked in the top 10 nationally for the creation of start-up companies. (2002 AUTM Licensing Survey).

The breadth and depth of the curriculum has provided the opportunity for the creation of a fifteen-hour Graduate Certificate in Entrepreneurship. This certificate demonstrates a level of expertise and provides documentation of a level of education, training, and skill that employers desire and need. Development of a Master's of Science Degree Program in Entrepreneurship in Applied Technologies has been completed and was launched in Fall 2005.

The USF Technology Entrepreneurship Educational program was recognized by the United States Association for Small Business and Entrepreneurship (USASBE) as the Outstanding Specialty Entrepreneurship Education Program for its program in Life Sciences Entrepreneurship in 2004; and for the Outstanding Innovative Entrepreneurship Education Course for the *Strategic Market Assessment for New Technologies* course in 2005.

## **SO WHAT?**

The development and implementation of an innovative Technology Entrepreneurship pedagogy and curriculum at USF has resulted in unique and innovative inter-disciplinary, team-based, project-focused learning opportunities for graduate students and faculty investigators under the direction of an inter-disciplinary experienced and expert faculty. In addition, it has resulted in an increased rate of successful commercialization of USF faculty innovations and development of successful spin-out ventures.

## CONCLUSIONS

The Technology Entrepreneurship pedagogy and curriculum at USF has been demonstrated to be successful in the education of inter-disciplinary graduate students and in the commercialization of University-developed technologies. Further, this has made the faculty who develop new innovations more cognizant of the innovation and commercialization processes and the potential of new venture formation. This educational curriculum and pedagogical model can be used as a benchmark and best practice and is appropriate for adoption by other educational institutions.

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