Infusing Business Entrepreneurial Knowledge to 2nd year Computer Science Students

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In this paper, we describe a "Management and Entrepreneurship for Computer Science Professionals" course that was designed and implemented for undergraduate second year Computer Science students. The focus of this module was to build management skills among the computer science students, having as basic exercise the new product development process as well as to integrate skills and attributes of an entrepreneurial individual with the entrepreneurial process and related behaviour. It is considered an operationally focused module, as it aims to develop the interdisciplinary skills required for successful product development in today's competitive marketplace. Students experienced a navigation exercise from the creation of ideas for IT products and services, the evaluation of ideas in business and market terms to the design process of new products, the testing and prototyping phase, the intellectual property protection techniques, the marketing planning, the financing techniques and all aspects of business planning along with the practical components of the module and were interested in the use of the hands-on approach. We believe that other computer science departments will benefit from this approach.

Keywords

Computer Science Education, CS Curricula, Entrepreneurship Education, New Product Development, Undergraduate module.

1. Introduction

Entrepreneurship is a major driver of innovation, competitiveness and growth. Entrepreneurship can renew existing organisations, create new businesses, strengthen the national economy and enrich people's lives. Promoting an entrepreneurial culture is an important part of this effort, starting with young people and from school education [1,2,3]. There has been a lot of discussion about the inadequate preparation that many graduates appear to have for life in the modern business and industrial world. In 2002, a report compiled by the European Commission concluded that although numerous entrepreneurship-related activities are currently being realised at all levels of education, a lot are never integrated into the curriculum and as a result of this most students do not have yet the possibility of registering for entrepreneurship courses and programmes [4].

In the United States enterprise education in higher education has grown dramatically since the early 1980s. The number of related courses in 1980s were 300 and currently courses are over 1600. The number of endowed entrepreneurship chairs reached almost 240 by 1999 and just over 400 by 2004. This wide spread incorporation of entrepreneurship curricula in education is perhaps one of the reasons for the entrepreneurial nature of the US economy. As the OECD observes; *"For any person who makes his or her way through the education system to an undergraduate degree, a lack of knowledge about entrepreneurship can no*

longer have much force as an entry barrier to new business formation. A person must make some effort to avoid entrepreneurship awareness or training" [5].

The rapid development of new technologies, the shift change in customer needs and attributes, and the gradual increase of competition has forced all business to adopt New Product Development (NPD) as a necessary and unavoidable business practice. NPD is a complex and time-consuming process. According to Kotler [6], research has shown that 40% of new consumer products, 20% of new industrial products and 18% of new services related products have failed completely as products. Further research has shown that the new product failure percentage is even greater in countries outside the US. Chia [7] argues that University programmes must cultivate the imagination of the students: *"University education should be directed toward the opening of vision so that new ways of thinking and understanding are rendered possible. In so doing it prepares students for the adventure of life beyond the cloistered boundaries of academia".*

According to Shane and Venkataraman[8] the core of entrepreneurship is the entrepreneurial opportunity and the process of discovering, evaluating and exploiting it.

In the following sections, we describe the background of the module and the structure of the project that students undertook in during the module. We introduced and deliver this module in CITY College – an affiliated institution of the University of Sheffield.

2. Background of the module – Principles of Management and Entrepreneurship for IT Professionals

The module "Principles of Management and Entrepreneurship for IT Professionals" was offered to all second year undergraduate Computer Science students. The class was organised in two hour lectures per week and one hour class meetings per week (meeting the project groups). The lecturer in charge met with the student groups once a week for one hour. In addition to these group meetings, further individual office sessions were encouraged for advice and problem-solving. Most of the students had no prior experience of management modules, which was taken into consideration during the design phase of the module.

Students attended the module lectures and participated in project teams in an entrepreneurial skills building exercise. For each step along the new product development process useful tools and techniques that supported new product development practice were provided to them. Although the module focused on the application of management principles to new product development, the same principles could be more broadly applied to innovation management and entrepreneurship. We made extensive use of the resources on innovation management in the world wide web for each step of the innovation management cycle. The resources were listed in the module's Web site to both communicate information to students and to converse with them about their group coursework. The week after the end of the course was dedicated to the presentation of the final projects. The targeted audience comprised of technical, business and financing experts assuming the role of the Evaluation Committee for financing the proposed business plan and the market accessibility of the new product. The final presentation required advanced communication skills in order to prepare students for an accurate and coherent account of their achievements.

2.1 Aims and Learning Outcomes of the Module

The aims of the module were to:

- introduce concepts of creativity and entrepreneurial design; introduce successful market attainment regarding IT results;
- introduce techniques for successful product design aligned with market needs;
- introduce methods for accessing niche markets global wide;
- provide methods for successful business planning and monitoring;
- provide methods for evaluating risks in relation to cost benefit analysis;
- create knowledge on the protection of intellectual property rights emerged from IT projects;
- introduce methods and techniques for innovation financing;
- examine the management skills gained through the coursework assignments.

The expected Learning outcomes were:

- Understanding & Knowledge: The method of idea generation through practical exercises and tools; the method of evaluating ideas for IT projects in practical market terms; the concept of designing IT product characteristics in terms of market needs; the concept of thinking global markets and specialised market needs (niche markets); the techniques for IT product prototyping and testing; the methods for protecting IP rights emerged from IP projects; the techniques for assessing business and technological risks in relation to cost benefit analysis; the concept of business and marketing planning; the methods for innovation financing.
- Cognitive Skills: think in terms of creating enterprises capitalizing on IT innovation capacities; relate technical skills with market concepts; communicate technical skills in an enterprise environment.
- Practical Skills: design new enterprises based on new IT products; monitor an IT enterprise through a business planning exercise; present technical achievements in business terms.

2.2 Seven-phase schematic framework – New Product Development (NPD)

Extensive web-based material was used to guide students through the learning process. The students mostly utilised the open to public web based materials for NPD from the URENIO research unit (http://npd-net.urenio.org).To reduce the risk of developing a new product that would not be a success in a market and to minimise the costs of such a development, an on-line New Product Development Roadmap was utilised (Figure 1). Such a roadmap is a tool that can help companies and organisations to successfully develop new products or upgrade existing ones through a series of logical steps, starting from the process of idea generation and ending at the launch of the product into a market.

The seven-phase schematic framework is:

1. Idea Generation;
2. Idea Screening;
3. Concept Development;
4. Business Analysis;
5. Product Testing;
6. Technical Implementation; and
7. Commercialisation.

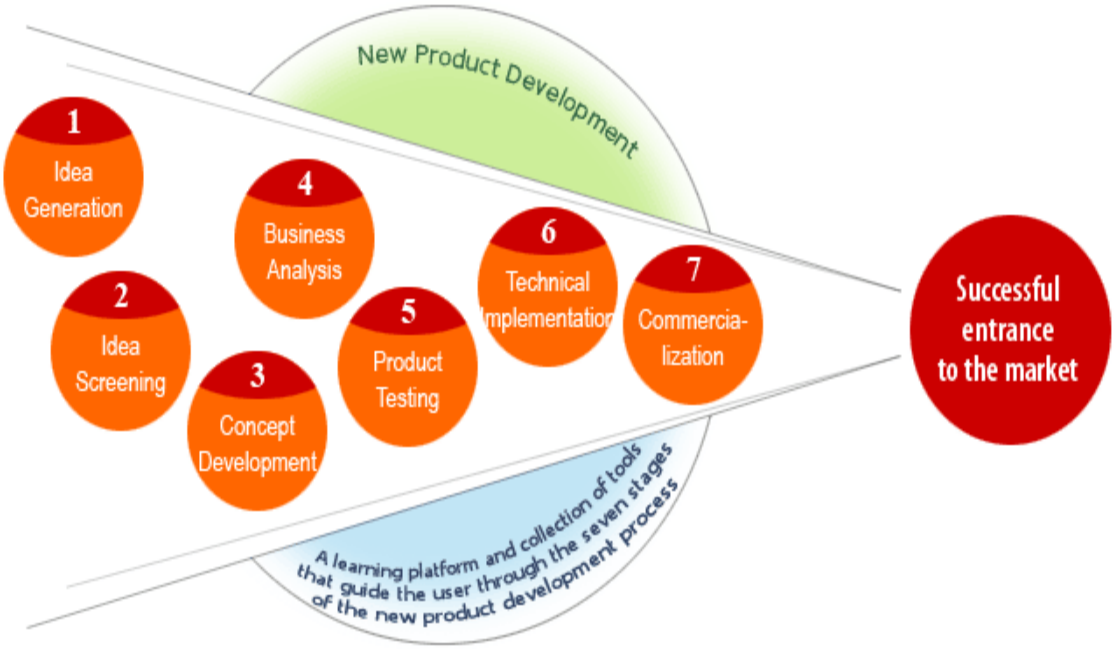

Figure 1. An on-line New Product Development Roadmap

This process contains a series of activities called "Levels" and control points, called "Assessments" (Fig. 2). Each Level contains information and well-defined series of activities concerned with the particular Level of the development and each Assessment is a decision point where senior management can keep on or stop funding the process. In more detail, a *Level* contains all the information and tools that are needed to successfully complete the particular Level and an *Assessment* contains the required questions or specifications or mandates to which the results of the previous Level are compared to so that a go / kill or hold decision can be made.

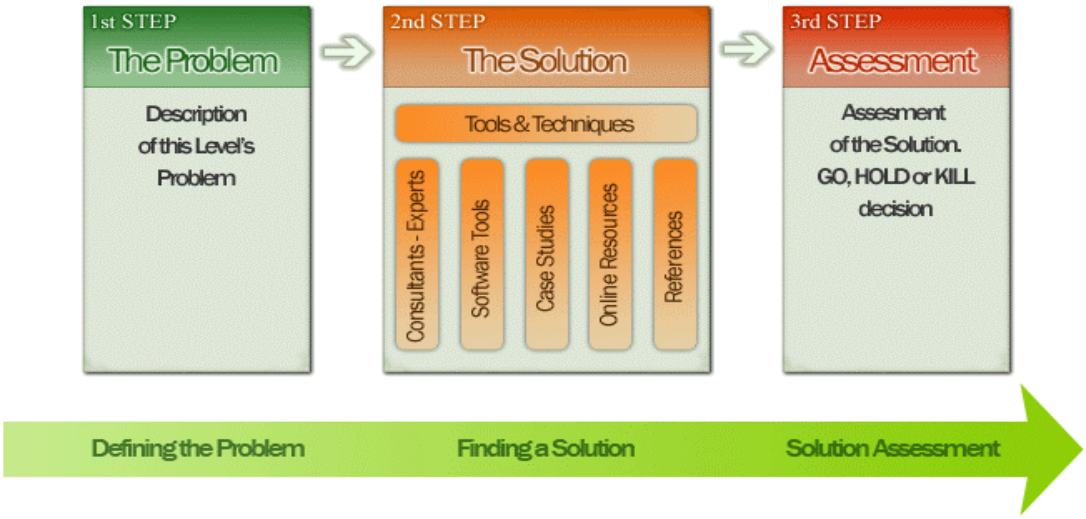

Figure 2. New Product Development; Stage 1 – Idea Generation

Each Level is split up in sections that include *a definition of the problem* that the Level is asked to tackle, a *possible solution* to the problem and an *analysis of the tools* available to tackle the problem. Each tool is properly defined, the references, on-line resources, software sources, organizations that can help to use the tool are given and case studies of where and how the tool has been used are presented in separate sections. All Assessments are designed to work interactively with a potential roadmap user. Also tools and templates developed are given for the same reason.

2.3 Coursework of the Module – Creation of an investment file for a new IT enterprise based on the development of new product

The coursework was an exercise of creating a new IT enterprise based on the innovative characteristics of a new product. In the first week of the semester students were grouped in teams of 3-5 students. Each group represented a team of potential entrepreneurs, building in a stepwise approach an investment fiche, presenting a blueprint of the potential enterprise to third party financing audience. It was explained in detail during the first lecture that this was not so much a software development exercise, but an exercise on the creation of a business concept. During the semester student teams built an investor fiche that was presented to potential investors at the end of the module. The investment fiche included the following chapters:

Chapter	Brief Description
1.Description of the idea	Idea generation – creativity session.
2.Selection of the idea	Idea selection session.
3.Product specifications	Business concept development session.
4.Business analysis	Business analysis session.
5.Production management concepts	The production design concept
6.IPR management	Intellectual property rights management.
7.Marketing planning	Commercialization planning.
8.Business planning	Business planning session.
9.Business financing planning	Financing of innovation.
10.Presentation	Completing the investment fiche. Presenting the investment fiche to an audience.

For each week a detailed description was given to students. An example is given below for week number two.

Week #2	Idea generation – creativity session. Investment fiche – chapter 1 description of the idea Concepts Idea generation, creativity techniques, tools and solutions, brainstorming methods, competitive intelligence program (CPI), conjoint analysis, delphi technique, morphological charts, six thinking hats, TRIZ methodology. Assessing the idea generation process. Choose one or more of the above-mentioned creativity and idea generation techniques. Utilising the technique(s) schedule in a three-hour working session that will exercise the technique concluding a set of ideas (two to three) for a new product development. Ideas could lead to new IT products (software, hardware, network web applications, IT services,

	new usage of existing programmes and everything that IT applies as commercial value). Of course, students are not expected to draw completely innovative ideas in such a small time period, but they are expected to exercise creativity sessions presenting some of their ideas. For each of the selected ideas a self evaluation assessment session must be exercised using the evaluation template given in the lecture notes. Note for the group working session: Each group member should individually study the lecture notes and relative sources regarding the available tools and techniques for idea generation. The team must decide upon the technique(s) that will be used in the idea generation session. The team leader must make the final decision regarding the selection of tools in case of disagreements. To one of the team should be assigned the role of record keeping during the meeting. Notes and relative sources are in the course web site. *Derivables:* The documentation of the idea generation session (i.e minutes and results of the brainstorming exercise) (up to three pages). Include references and sources. Description of the idea (1 page per idea), describing the concept, the usage, the users, the market (industrial, consumer, commercial, entertainment etc) The self assessment session results An executive summary of the idea generation session (for non IT-readers - up to 15 lines) describing the idea generation results. The formal results of the exercise will be returned in week 3, for preliminary assessment and guidance, no mark will be given at this stage; the final assignment will be delivered in week 12. *Assessment criteria:* Completeness of the documentation of the techniques used in derivable 1 (30%). Completeness of description and innovativeness of the ideas in derivable 2 (30%) Completeness of the self-assessment session in derivable 3 (20%) Argument setting abilities in describing the session results in few words in derivable 4 (10%) *Marking* All the group members received a common mark

In brief, the rest of the weeks of the module delivery include:

- Idea selection session (Week #3): Idea screening to meet market needs, tools and solutions, market research, qualitative research, FMEA failure modes and effects analysis, dot sticking, PMI analysis, assessing idea screening.
- Business concept development session (Week #4): Concept development for IT products, tools and solutions risk management, forced field analysis, quality functional deployment (QFD), decision tree analysis, KANO model case study in business concept development.
- Business analysis (Week #5): The functional planning of an IT enterprise, tools and solutions, cost benefit analysis, product life cycle methodology, critical path analysis, stakeholders analysis.
- The production design concept (Week #6): The market and beta testing of new IT products, tools and solutions, prototyping techniques, product testing, industrial design, digital models, system engineering and reverse engineering, lean manufacturing, manufacturing and quality issues
- Intellectual property rights management (Week #7): The protection of IPR for IT products and services, tools and techniques, protecting IP, patents, industrial design, software, IT usage, trademarks, registered names.
- Refining Derivables (Week #8): the Lecturer schedule a 20-minute working session with each group of students discussing the improving issues for deliverables – an interim report was delivered from each group.

- Commercialization planning (Week #9): Planning the marketing issues for the product, tools and solutions, the marketing plan, target market definition, product pricing, distribution channels, product promotion, sales management. Using the marketing-planning template provided in the course web site schedule a four-hour working session that will exercise the technique of marketing planning. The template leads to a preliminary marketing plan template directing students to the process of marketing planning.
- Business planning (Week #10): The financial planning of an IT enterprise, tools and solutions, business plan.Using the business-planning template provided in the course web site schedule a four-hour working session that will exercise the technique of business planning. The template leads to a preliminary business plan template directing students to the process of business planning.
- Financing of innovation (Week #11): The mechanism for financing innovation of IT projects, tools and techniques, spin-offs, business angels, venture capitals, third party financing.
- Completing the investment: minor changes (Week #12)
- PowerPoint presentation, the final Product was presented to potential investor audience (Week #13)

2.4 Coursework - Group Projects

Each week, group of students submitted coursework that was overviewed by the instructor with feedback for guidance and suggestions for improvement. At the end of the semester students delivered the final practical that consisted of all weekly assignments synthesizing a final investment file for a start up company. Some of the proposed product ideas as they were submitted/presented by the students groups were:

Streamer - is a "Built-in mobile phone camera to be used as web camera through USB interface. The specific group submitted an 85-page report that included: Description of ideas; Selection of idea; Product specification using Kano method; Business Analysis and a cost benefit analysis; Intellectual Property Rights (IPR) and fill out the Patent Cooperation Treaty (PCT) form, meaning the PCT demand, PCT fee Calculation Sheet and PCT Request form in order to obtain a patent; Marketing Plan that included an Analysis of the Current Situation, Description of the Market, Market Analysis, etc; and a Business Plan of the proposed company.

4Logistics "Glass Polarisation" – is a controllable polarization of the glass so that the driver decides on the coming light intensity; increase/decrease glass polarity scale and coming light intensity. They submitted a100-page report that described: the idea generation session; the idea selection process, the techniques used for screening ideas which are discussed in detail; the business concept development session; the business analysis session; the production management with the product testing session; the IPR with a patent issuing of their product; the marketing plan and business strategy plan; and presentation of their business financing plan (private funds, business angels, public funds and venture capital analysis).

EzPark "a service to find and reserve parking slots" – is a service offered for drivers through SMS to find and reserve parking positions in private parking stations that are closer to them (described in a 55-page report). Also the group followed the same outline as with all other student groups and their first task was to come up with innovative ideas. Brainstorm tools available on the web used to boost the group's inspiration and the final product of the group

session was chosen among more than fifteen (15) ideas. Out of all the ideas generated in the brainstorming session, the three more interesting ones were chosen by the group. The next session involved discussing the new product's characteristics; a number of alternatives were suggested, their difference being in the interface between user and provided service: SMS-based, voice-activated, GPS-based. Also user criteria were discussed in detail. At the next session, the students prepared the business and cost-benefit analysis of the project. Legal and Intellectual property matters were examined and the students prepared all the procedures for that. Finally the group presented the marketing and business plan. The vision of the specific company (group) was to become synonymous with the provided service and by 2010 to control the majority of relevant market.

2.5 Assessment

The students expressed their interest in the course with active participation. Students had experienced the navigation from the creation of ideas for IT products and services, the evaluation of ideas in business and market terms, the design process of new products, the testing and prototyping phase, the intellectual property protection techniques, the marketing planning, the financing techniques and to the business planning along the product life cycle.

Students performed well as a team, with their marks ranging from excellent work to the acceptable range. Their final presentation in front of a wide audience from external experts (i.e. venture capital representatives, business people, entrepreneurs), gave them the incentive to prepare a professional presentation and to utilise business terminology that impressed the external audience as well as the non-expert audience that attended. It was noted that it was easier for some students to develop their business and communication skills further in comparison to others, who were technically oriented to programming and science. Some students really took advantage of the business skills offered by the course while others underestimated the importance of these skills. Five out of six groups functioned well and gave enthusiastic feedback about the experience. From student evaluation questionnaires, the student course board and from discussion with students we safely concluded at the end of the module that students thought positively of the practical components of the course and were very much interested and responsive to innovation in the use of the hands-on approach.

The basic assumption made was that groups would organise themselves to ensure equal contribution from all team members. However, a student's mark could be modified according to their contribution. This assumption was monitored in two ways. The first one was a requirement that all reports have the minutes in appendix of the group meetings held. Unexplained absence was questioned at the regular meetings of the lecturer in charge with the group contacts. The second mechanism was that each member of the group had to fill out an assessment of individual contribution to the group project. It was important that all members of the group had to sign the report as an agreed submission from the group as a whole. The lecturer in charge attempted to resolve disputes through interviews before making a final judgement. Finally, twenty percent of the final mark was contributed to the oral presentation of all group members during their final presentation to examine in-depth knowledge of their project idea, reasoned arguments, proper presentation and clarity and justification of their answers. The following areas were judged to assess the major final report - on time delivery and content of the progress report, proper preparation, attendance and participation to the weekly meetings, and in-class workshop and presentations and completeness of the final report's structure and justification.

3. Conclusions

The exercise of infusing business entrepreneurial knowledge to second year Computer Science Students was a valuable exercise. We recommend that students should be exposed: to the methods of idea generation through practical exercises and tools; to the concept of business and marketing planning; to the development of technical skills in an enterprise; to monitoring an IT enterprise through a business planning exercise; and to present technical achievements in business terms. It is still too early to draw too many conclusions about the success of the module. There will be an effort to follow up with the students that took the course after two to three years. We conclude that this type of approach enables students to develop creativity, entrepreneurship, and a sense of professional commitment as well as to enhance their communication skills, which is what Computer Science programmes must cultivate. In doing so, it prepares students for the adventure of life beyond the boundaries of academia. In fact, learning about entrepreneurship will include developing personal qualities such as creativity, taking initiative, responsibility, which will prove generally useful in life in any working activity.

References

1 Rodrigues M J.. European policies for a knowledge economy, Edward Elgar, 2003.
2 Heinonen J, Poikkijoki S A, Vento-Vierikko I. Entrepreneurship for bioscience researchers – A Case study of an entrepreneurship programme. Industry & Higher Education, February 2007;21-30.
3 Boyle T J. A new model of entrepreneurship education: implications for central and eastern European universities. Industry & Higher Education, February 2007;9-30.
4 Final report of the expert group. Best procedure project on education and training for entrepreneurship; November 2002.
5 OECD. Putting the young in business - Policy challenges for youth entrepreneurship, 2004.
6 Kotler P. Marketing Management - 7th Edition. EMI/Interbooks, 1991.
7 Chia R. Teaching paradigm shifting in management education: university business schools and the entrepreneurial imagination. Journal of Management Studies, 2000; Vol. 33: 416.
8 Shane S, Venkataraman S. The promise of entrepreneurship as a field of research. Academy of Management Review 2000; Vol 25, No 1: 217-226.