



by Pedro Manuel Saraiva

While studying Chemical Engineering at the University of Coimbra (Portugal), back in the 1980s, there were two classes I found potentially interesting, but particularly boring: statistics and management. The irony of destiny would see me later obtain a PhD from MIT, strongly based on the development and application of applied statistics. Even now, I still lead research activities in this area, and since 1993 I have taught management and entrepreneurship to a large number of science and engineering students at the University of Coimbra.

I was among the first faculty members to run such an academic pedagogical experience in Portugal. I aimed to create a class that was less boring than the one I had attended in the 1980s (where we were exposed to management through a set of theoretical lectures, focusing mostly on accounting principles and rules).

My Story

Twenty years later, I have developed this academic offer in a sustained and increasingly well-accepted way. My story lays out what I have learned from this rewarding and creative experience, after dealing with thousands of students of different nationalities and backgrounds, under different learning contexts, on a variety of courses (e.g. entrepreneurship, management and entrepreneurship, innovation and entrepre-

neurship, new ventures and bioentrepreneurship, chemical product design, innovation in bioengineering, new product development, and management processes), at both undergraduate and graduate level (e.g. chemical engineering, materials engineering, chemistry, biochemistry, molecular and cell biology, physics engineering, biochemical engineering, biomedical engineering, bioengineering, energy for sustainability, MBA, and executive training programs).

From this wide variety of teaching experiences, all sharing entrepreneurship as a common core, with audiences of mostly science or engineering students, I have learned five main lessons, or good practices, which I will now share.

1. Running the Class as a Startup

There is no better way to gain practical entrepreneurship learning experience than to consider the class as a new venture, created at the beginning of each academic year: an organisation with its own culture and structure, typically ending happily, as the last day of classes is usually a call for celebration, with student teams making their final pitches and some kind of dinner to follow.

Therefore, at the beginning of term, we discuss the critical elements of the class as a new venture, producing a set of guidelines which include:

Books

- Our mission: to 'contribute, through a participative learning process, to the training of engineers and scientists in entrepreneurship skills and practice, and in being able to understand how organisations work'.
- Our vision: 'to always be a class of reference in the teaching of innovation, entrepreneurship and management to engineering and science students, always undergoing continuous improvement and disruptive experimentation'.
- Our signature, suggested by a former student, which states that 'this is a class which, by the end of the course, will have supported the beginning of a professional, innovative and entrepreneurial life'.
- A logo, also designed by a former student (Figure 1), that represents the enlightening incubation of students and their dreams that we, as a group, try to promote and achieve.



Figure 1: Class Logo

- We also assume, under written terms, the values to be shared, skills that will be practiced, learning outcomes, and content that will be covered across a the semester.
- The class stimulates the coexistence of learning at several levels (individual, teams, course as a whole), to reinforce competencies and knowledge, and is therefore strongly supported by work conducted in teams of 5-7 members (each one appointing a team coordinator), who are asked to deal with a wide variety of challenges and contributions to lectures.
- The class is managed by a board of directors, chaired by myself and includes all the team coordinators. We meet once a week, to validate decisions and identify and implement improvement opportunities regularly, rather than waiting for the end of term (which is too late!).
- A performance appraisal system, reflecting the strategy and goals adopted by the class. This is discussed by the board of directors, and comprises continuous learning and evaluation practices, including teamwork and peer evaluation (every time a team makes a presentation, they are asked to self-assess, and receive quantitative



Saraiva, P.M., (2015) *Emreendedorismo*, 3rd edition. Coimbra: University of Coimbra. (In Portuguese).

evaluations from all the other teams. I take these evaluations into account, and tend to agree with them when assigning final grades), as well as regular progress assessments at individual, team and class-wide levels.

- In the first week, both myself and all students are invited to sign a one-page written 'contract', stating our commitment to the mutual learning experience that we are about to share with one another.

Always keeping in mind how boring I found my management classes as a student, I find these initial steps quite important, as they set the proper mindset and organisational culture for the course. Taking such an entrepreneurial approach is beneficial to the design of the learning experience: what better environment could there be than one where the class is seen as a new venture to be created, managed and nurtured week after week? In my experience, this kind of environment is critical, and at least as important as the course content and the way it is covered.

2. Interacting with Entrepreneurs and Practice

It is impossible to over-emphasise the importance of interaction with entrepreneurs as a powerful learning experience. We have taken several steps in that regard (keeping in mind that 15 minutes with an entrepreneur may be just as relevant as many hours of lectures):

- I consider myself a kind of serial entrepreneur, having created several small companies over the years, as well as other organisations, business ideas and competitions. I have played the role of business 'angel', helping others create their own businesses: something I really enjoy and always keep in mind as a professor. Having faculty members that are themselves established entrepreneurs with practical experience in the field in charge of entrepreneurship classes and teaching is helpful.
- Invite guests to the class, to share their own experiences as entrepreneurs. If possible pick some former students, to show that the class may contain some future successful entrepreneurs who will one day share their own experiences with forthcoming generations of students. This reinforces levels of trust, self-confidence, and belief in that dreams can be made into reality.

- You can also ask teams of students to suggest speakers they would like to invite to give a short lecture (e.g. 30 minutes) on topics related to innovation, management, creativity or entrepreneurship.
- Assign a challenge, to be addressed by student teams: to identify someone they consider a leadership role model, spend time with him or her (e.g. sharing a day of work, having dinner or just a cup of coffee), and write down the three most important lessons, taken from this experience, to be shared with classmates.

These opportunities are really important. Students lose some unjustified fears, become less shy and are confronted with real world entrepreneurship learning opportunities, while also establishing contacts that may be useful in their future.

3. Motivational and Operational Work Combined Together

In the European context in particular, where a lot has yet to be done to increase existing levels of entrepreneurial culture, spirit and awareness, a class devoted to this topic must do a lot of motivational work, dealing with the 'soft' issues related to understanding of entrepreneurship and entrepreneurs. At the beginning and end of the semester, I ask how many students plan to become entrepreneurs in the future, and their underlying reasons for doing so. Typically, less than 25% plan on a career in entrepreneurship. Only 5% of these consider doing it in the short term and by choice (rather than due to the absence of alternatives). We therefore work on exploring the characteristics, skills and lifestyles of entrepreneurs, and by the end of the course these numbers have usually increased. However, this should not be taken for granted, or even considered a goal. What really matters is that students have a better, more well-informed notion of what entrepreneurship is about, in order to make a better decision regarding their professional future. It is also very important to stress that being self-employed cannot be taken for granted as 'better' or 'worse' than working for someone else (it depends on who you are, and which you prefer), as well as that 'intrapreneurship' is just as important as entrepreneurship.

However, as an engineer, I strongly believe that a class on entrepreneurship should also cover, in detail, what we have learnt about coming up with fuzzy business ideas and converting them into successful, sustained new ventures, products or services. This more technical and operational side of entrepreneurship, including proper definitions, knowledge of methodologies and practical application of available tools, must not be forgotten or underestimated. To really learn about entrepreneurship, you must go beyond simple slogans and shallow views of the topic, and dive as deeply as possible into the 'hard' side of entrepre-

neurship and management, including coverage of all the relevant areas. Entrepreneurship classes should be fun, but in some cases they also mean hard work (yes, you do need to understand technical concepts and tools, including how to compute Net Present Values).

Finding this balance between 'soft' and 'hard' topics is never easy. I adapt it each academic year, and according to specific audiences, but a 50/50 split is always a good starting point.

4. A Book after Two Decades

Although I was asked for a while (namely by different groups of students) to write a textbook, I avoided doing so for the following reasons:

- Entrepreneurship cannot be learned from books and I believe that there are too many books in general, sometimes without much added value.
- Only after a long period of maturation time, and feedback from several pedagogical trials and years of practical experience, did I believe I had enough authority and accumulated knowledge in the field to start writing.

In 2009, an opportunity appeared, and as an entrepreneur I accepted the challenge from Coimbra University Press: to write a book on entrepreneurship. In 2011, the first edition was published (Figure 2).



The book is an academic textbook, in the sense that it tries to go deeply into the concepts, approaches and tools of entrepreneurship.

- It covers around 100 real-life practical examples of entrepreneurs.
- It adopts a wide-ranging view of entrepreneurship, including intrapreneurship, social entrepreneurship, family-owned companies, cultural entrepreneurship, women in entrepreneurship, nano- and micro-entrepreneurship, youth entrepreneurship promotion, science-based entrepreneurship and

bioentrepreneurship.

- A chapter is devoted to science- and technology-based entrepreneurship, a first for a Portuguese-written textbook, benefitting from my own engineering background and the experience I have gained.

Due to the book's success a third edition was published in 2015, updated and substantially enlarged, taking into account the feedback received from its practical use, and also reflecting some of my more recent thoughts, given my experience as a Member of the National Parliament since 2009. In this edition:

- Readers are challenged to accomplish a broader range of practical exercises.
- A considerably larger number of examples are covered.
- New material on making certain territories (either at the local, regional or national level) more entrepreneurial is included.
- More extensive, practical information is provided on how to build innovation and entrepreneurship based ecosystems.
- A conceptual model for higher education institutions (HEI) entrepreneurship, including full self-assessment tools, is provided, together with a detailed analysis on how HEI can become more entrepreneurial and intrapreneurial, and contribute to the regional and national development of entrepreneurship.
- More space is dedicated to creativity and ways of coming up with business ideas.

- A deeper analysis of the impacts of entrepreneurship is provided, regarding development, economic growth and job creation.
- Further attention is paid to young, high-growth companies, usually known as 'gazelles', and ways to promote and sustain their appearance.
- The connections between entrepreneurship, innovation and quality are explored as key drivers for the sustainable success of societies in the 21st Century.

The chapters in the book's new edition now correspond to the sequence of topics covered in my classes:

- 1) Concepts: essential for an understanding of what entrepreneurs and entrepreneurship are all about.
- 2) Relevance: to explain how critical entrepreneurship is for development, job creation and well-being in modern societies, including the role played by higher education institutions.
- 3) From Ideas to Business: addresses all the steps and tools available, the mistakes to avoid and the things that should not be missed when finding and converting a fuzzy opportunity into a successful organisation.
- 4) From Science and Technology to Business: devoted to science-based entrepreneurship, from the point of view of our own model ('microvalleys of life'), in which a pipeline gradually converts science into value.
- 5) Innovation and Entrepreneurship Ecosystems: provides both conceptual and practical recommendations on how to build such systems and outlines a roadmap for the definition and implementation of national entrepreneurship agendas.



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I gained a Diploma from the University of Coimbra, Portugal (1987) and PhD in Chemical Engineering from MIT, USA (1993) and have held a number of academic and public positions including Assistant (1993-2001), Associate (2001-2010) and Full (2010 onward) Professor at the Department of Chemical Engineering at the University of Coimbra; Member of the Portuguese National Parliament (2009-2012 and 2012 onward) Pro-Rector of the University of Coimbra (2003-2004 and 2005-2006); Vice-Rector of the University of Coimbra (2007-2009); Member of the Board of BIOCANT-Biotechnology Science Park (2005-2009); Advisor of the President of Portugal for Higher Education (2006-2009); President of the Regional Agency for the Development of the Centro of Portugal (2004-2005 and 2012-2014). In

1998 I was the first receiver of the Feigenbaum Award by ASQ (American Society for Quality). My research activities include process systems engineering, data analysis, innovation, entrepreneurship and quality management, with several books and papers published. I have founded a number of new associations and companies, including QUAL (in the quality field), NECTON (microalgae biotechnology), SPI Ventures (Innovation and Entrepreneurship) and Creative Wings (Business Angels). In addition, I have successfully supervised around 10 PhD students and I am the author of more than 86 ISI publications, with over 500 citations and an h-index of 12 (as of June 2015).

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5. True Impact

One can, and should, try to get feedback from entrepreneurship classes, in the short term and in real-time if possible. This can be achieved by:

- Observation of students' presence and participation in classes.
- Number of students attending the class and its demand from other courses.
- Listening to students.
- Obtaining regular input in spaces devoted to doing so, such as the weekly board of directors meetings that I have made use of with promising results.

However, the most relevant impacts can only be seen or measured with longer term, realistic expectations. In that regard, I would underline the following results:

- Through teaching I learned a lot myself, became more entrepreneurial and intrapreneurial and was perceived as such. An increasingly large number of courses have shown interest in the classes, and the textbook has been very well-received. I have also faced a number of professional challenges in which I have benefitted a lot from this experience, such as being Pro-Rector and then Vice-Rector of the University of Coimbra (in charge of innovation and entrepreneurship), Board Member of BIO-CANT, business angel, advisor to the President of Portugal for Higher Education, President of the Regional Development Agency for the Central Area of Portugal, and a Member of the National Parliament.
- In 2015, some of my 'older' students held a meeting to celebrate the 25th anniversary of their becoming students of Chemical Engineering at the University of Coimbra. I had the great pleasure of being invited to give a somewhat long pitch of 15 minutes, in the same classroom (now part of our Science Museum) where pretty much everything started, 20 years ago. The speech ended with a rather emotional (at least for me) round of applause.
- Last, but really not least, a critical evaluation of long term impact should take into account the number of former students who end up creating their own jobs and organisations. Expectations here need to be moderate and realistic, and in my case this means aiming for an average of one each year (out of about 100 students): at least one student that goes on to create a successful company. In the third edition of my book, I pay tribute to some of them, having realised that this is the best way to evaluate the practical impact of entrepreneurship learning and teaching, as in a sense,

these students end up practicing what you have preached. Here is a nice sample of what these former students have achieved. This list is indeed the most rewarding result of two decades of mutual learning, and the best way to express the real world impacts of such an effort:

Catarina Fonseca, founder and CEO of itgrow, a company that provides information technology training to improve the job skills of young graduates.

Daniela Couto, founder and CEO of Cell2B, a spin-off that is developing new cell therapies for immune and inflammatory diseases.

Filipa Pato, well known oenologist and producer of FP wines, authentic wines without make-up.

Vivaldo Caseiro, founder of Grab&Go, a franchised network of shops with vending machines available 24 hours per day, all across Portugal.

Luisa Goulão, founder and CEO of slimcomfort, a company that provides new, wall-embedded ultrathin home heating solutions.

Pedro Lima, who created cognitiva, a SAP services provider that specialised in certain applications and modules, working for a number of large international clients.

Realising that such entrepreneurial adventures are taking place, building success, and creating value and jobs, is the most rewarding pay-off you can get from entrepreneurship teaching. It makes you want to carry on for at least another 20 years. You can expect another five new lessons to come from this continuous learning curve and experience.

