Nascimento, M. M., Alves, G. R., & Morais, E. (Eds.). (2018). *Contributions to Higher Engineering Education*. Springer Singapore, 158 p.

> "In essence, it is a matter of recognizing engineering as a multidisciplinary nature, adjusting university courses accordingly and explaining to the future students the richness and fascination of this way of seeing engineering, not as mere applied science but as a powerful convergence between sciences" (Figueiredo, 2015, p.9).

The scientific and engineering education community has shown concern to accompany the socio-economic and technological transformations and the challenges imposed by globalization, demographic changes and new technologies. In the European Context, with the Bologna Process, Higher Education Institutions (HEI) need to adjust teaching and learning approaches with the paradigm of students' autonomous learning integrating the promotion of technical and transversal skills (Hattum-Janssen, Williams & Oliveira, 2015).

An Engineer is seen as the combination of four dimensions: sciences, humanities; project; arts and crafts (Figueiredo, 2015, 2013; Adams et al., 2011). We have the 1) Scientist Engineer: in which he/she presents himself/herself as a thinker, emphasizing the area of analysis and explanation; 2) Business and Management Engineer: in which he/she is seen as a manager, entrepreneur, communicator and negotiator; 3) Project Engineer: where he/she focuses on strategy, synthesis and design; and 4) Artist Engineer: in which he/she prefers the practical realization, aesthetics and cultural values of arts and crafts (*ibid*).

In this sense, scientific efforts have been made to follow the international trend of studying and investigating in Engineering Education (EE). In Portugal, an example of that, is the "*International Conference of the Portuguese Society for Engineering Education*" (CISPEE) that has taken place since 2013. CISPEE congregates a scientific and pedagogical community with the intention to disseminate research and applications of teaching and learning methodologies based on projects, problems or other forms of active learning.

The recension of the book "*Contributions to Higher Engineering Education*" appears in the context of the CISPEE 2016. This book is organized in six chapters whose themes focus on pedagogical interventions in Higher Education (HE) in the EE. This book is characterized by its variety in format and content, as it is composed by works that report research projects (Chapter 1), case studies (Chapters 2, 3, 4 and 5) and conceptual issues (Chapter 6). These works offer a set of suggestions of interventions that can be applied in an Engineering course, with the objective of developing the essential skills increasingly required in the labour market.

The Chapter 1 "*International Cooperation for Remote Laboratory Use"* of Alves et al., focuses on the importance of experimentation in the process of training engineers. It emphasizes the role of virtual and remote laboratories in HE and the effort that teachers must make if they wish to integrate them into their educational practices.

The authors present an international cooperation between European and Latin American institutions in the field of EE, involving teachers and students, specifically, in Electrical and Electronic Engineering courses. They describe an Erasmus + project on the Laboratory "Virtual Instruments System in Reality (VISIR)", and the growth of the VISIR Community of Practice (CoP) deserves an in-depth analysis as well as its impacts on participants and contributions to EE.

The idea of a Federation of Remote Laboratories (FRL) will allow sharing resources and opportunities for remote experimentation among community partners. However, the implementation of a FRL triggers challenges/efforts like meeting the specific needs that each institution has to fulfil (institutional, curricular, cultural, legal, organizational, etc.) given its geographic location.

This book also addresses the importance of acknowledging how the profile of a university student influences academic success, and how HEI should promote conditions of access, equity, and processes that facilitate learning for all students. Chapter 2 "*Mature Learners' Participation in Higher Education and Flexible Learning Pathways: Lessons Learned from an Exploratory Experimental Research*" of Duarte, Pires & Nobre, describes the implementation of flexible learning processes for mature students in a postgraduate course in technology and industry management. Mature students are understood as adult students and workers who return to an education program after a period of activity in the job market, maintaining their full-time job.

Results of this study show that mature students adopt flexible learning paths that best suit their needs, and that academic success rates are similar and adequate, regardless of the path students choose, evidencing that mature students have the ability to solve gaps in their academic development successfully. However, it is necessary that flexible learning processes are adapted in specific situations, such as: time, rhythm and flexibility of course content.

As future work, the authors suggest to improve methodological procedures, such as characterization of the profile of mature students; analyse the changes in students' motivation; understand the learning processes in the different types of teaching (e-learning; b-learning) and the respective influence in mature students; and identify what kind of learning strategies are developed within a given intervention. In addition to what authors recommend, longitudinal and comparative studies should be performed to verify the effects of these interventions in different Engineering areas.

Chapter 3, of Leão et al. "*The Flow of Knowledge and Level of Satisfaction in Engineering Courses Based on Students' Perceptions*" addresses the importance of the

perception of Engineering university students in relation to aspects that influence the teaching and learning process, such as: the satisfaction in relation to the course, the academic environment and the working conditions, the involvement of teachers and students-teachers' interaction.

This work describes a particular case in the area of Electrical/Electronic Engineering carried out in four institutions of HE in Engineering (two Portuguese and two Brazilian) in six different courses (1st year curricula of the 1st cycle of studies). Results show that students are mostly satisfied with the course and with the interaction established between teachers and students. However, students report that teachers do not contextualize or adapt the syllabus contents of the course to the professional context, as over time students become aware and critical regarding the inclusion of integrated projects throughout the curriculum (and not only in the last years, as it is common).

This study would have benefited, if a specific characterization and a clear identification of the differences existing in the different institutions (contexts) regarding the curriculum and student learning profile had been done. Also, it would have been interesting to carry out studies over time, with the same students, in order to verify the evolution of students' perceptions throughout the course. The Inclusion of collaborative learning strategies with problem solving, in the first year of the study cycle deserves greater attention.

The development of knowledge, technical skills and soft skills are increasingly appreciated and valued by companies. In Chapter 4 "*Innovative Methodologies to Teach Materials and Manufacturing Processes in Mechanical Engineering*", Alves, Duarte & Marques present a methodology focused on students' motivation, describing the structure of the practical classes of a Production Engineering course on metallic and non-metallic materials, that consists in experimentation, project-based learning, research projects, presentation and discussion of papers, technical reports and visits to companies.

In this study, students acknowledged that although the work was demanding and time consuming, it contributed to their active participation in the learning process and motivation, increased knowledge about the program content, improved research capacities, as synthesis, communication and writing skills that are essential for the near future.

However, in my point of view, this chapter needed to clarify the procedures and treatment of data analysis to sustain the results obtained. In future work, it is recommended that improvement is made in the research design in order to understand the concrete impact of the applied methodology.

Chapter 5 "*Learning by Doing" Integrated Project Design in a Master Program on Product and Industrial Design*" of Gomes et al., presents another case with Project-based learning in order to stimulate motivation. It describes a course which articulates two scientific areas: Engineering and Fine Arts, with the focus on the development of new products.

Students developed projects in a real context, for real clients. There was a simulation of all the stages, tasks, needs and challenges that had to be realized in a design company. The best projects had the opportunity to be developed together with the industry, responding to the needs of the market, enabling students to get a job opportunity in the future. This work sook to show how the proximity between HEI and business is a key factor for academic success and how career opportunities for students emerge.

It is essential to invest in these types of interventions and analyse their impact, not only on student satisfaction, but also on the development of their technical and soft skills and on the benefits that companies get from these partnerships.

This book (Chapter 6) also addresses creativity as one of the skills that has gained relevance in HE and in the labour market, but that still needs to be reinforced and stimulated. In fact, day-to-day Engineers are faced with a variability of problems, which imply their resolution, so it is necessary to promote the development of skills, such as proposing, selecting, seeking new approaches, as well as the development of students' intellectual curiosity. In the last Chapter 6 "*The Views of Engineering Students on Creativity*", Catarino et al., present the conceptions that university Engineering students have about creativity. The results evidence that few students used the personal involvement in their definitions of creativity, and that they adopted the following terms to define creativity: creation, new, path. Also the words creativity and innovation usually were associated.

In future works it is necessary to study how teachers plan and develop suitable activities that stimulate creativity through appropriate pedagogical strategies and interventions. These activities should allow students to reflect on creativity and how important it is for their future in the job market. Also, I recommend that experimental and quasi-experimental investigations be carried out in order to realize which pedagogical interventions are more effective in promoting creativity skills.

As final considerations, this book offers a vision of the paths that have been traced by Research and Education in Engineering. It also enables the scientific community to open up its horizons and gives some hints on possible collaborations between research and education in characterizing best practices which stimulate and promote essential skills that society and the labour market expect from Engineers.

There is still a long way to go in the area of Engineering Education. It is necessary to continue and extend the work that has been done: promote research; improve educational practices; establish partnerships between HEI/HEI and HEI/companies; develop CoP with a spirit of discussion, collaboration and help; make the management of HEI and teachers aware for the need to invest and improve the curriculum in an appropriate and practical way; raise awareness for the need and importance of technical and soft skills; and when planning an educational intervention, take into account and understand the personal and contextual characteristics as well as the learning strategies of

each student. For this, quality learning should be provided in order for the Engineering students to become successful Engineers!

References

Adams, R., Evangelou, D., English, L., Figueiredo, A. D., Mousoulides, N., Pawley, A. L., Schifellite, C., Stevens, R., Svinicki, M., Trenor, J. M. & Wilson, D. M. (2011). Multiple Perspectives on Engaging Future Engineers. *Journal of Engineering Education*, 100(1), 48-88.

Figueiredo, A. D. (2013). A historical interpretation of the nature of engineering practice. In Williams, B., Figueiredo, J., Trevelyan, J. (Eds.) *Engineering Practice in a Global Context: Understanding the Technical and the Social*, CRC Press, Taylor & Francis.

Figueiredo, A. D. (2015). A Engenharia e os seus Labirintos. *Newsletter SPEE*, 9, 9-10.

Hattum-Janssen, N., Williams, B., & Nunes de Oliveira, J. M. (2015). Engineering Education Research in Portugal, an Emerging Field. *International Journal of Engineering Education*, 31(2), 674-684.

Daniela Pedrosa
Universidade de Aveiro.
Centro de Investigação de Didática
e Tecnologia na formação de formadores (CIDTFF/UA).
Email: dpedrosa@ua.pt