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Editorial

Engineering Education and Technological/Professional Learning

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The focus of this Special Issue is aimed at enhancing the discussion of Engineering Education, particularly related to technological and professional learning. It was associated with TEEM'18 (6th International Conference on Technological Ecosystems for Enhancing Multiculturality), in particular the special track (under the same nomination) [1] from which the authors of the best works were invited to submit an extension of their paper. Later, it was also associated with CASHE'19 (1st Conference on Academic Success in Higher Education). In parallel, since this special issue had an open call, several works were submitted, from different universities and countries (Australia, Canada, Japan, Portugal, Spain, United Arab Emirates, United Kingdom), creating a more global view of different, yet similar concerns.

A special thanks to all authors who responded to this call, contributing to the compiled multicultural vision on this theme. The quality of the works received was carefully scrutinized by a panel of international reviewers. To all of them we would like to express our sincere appreciation. Even though not all of the received works were accepted (from 18 submissions, we selected 10 papers to include), the quality of the papers received attests to the significance of debating this theme.

Here the reader can find works tackling several interesting topics such as: Educational resources addressing students' development of competences, the importance of final year projects as a link to the professional environments, professional project management competences, the importance of multicultural and interdisciplinary challenges, sustainable product design focusing on future professional menaces, and ways of improving didactical issues aimed at students' involvement and their development as future engineers.

In the 21st century, students face a challenging demand: They are expected to have the best scientific expertise, but also highly-developed social skills and qualities like teamwork, creativity, communication and leadership. Even though students should be prepared through their academic education, there is still a gap between academic life and professional life. This gap is usually fulfilled with informal learning provided by older colleagues while these young engineers are immersed in the professional field. Though unavoidable, this gap can be lessened if students are already aware of some important working and social skills [2–4].

Engineering education organizations have been addressing new professional challenges, guided by general concerns, such as teamwork abilities, argumentation and persuasion abilities in multiple social contexts, creativity, complexity handling, leadership, and strong work ethics [2]. This stresses

the importance of these competences being worked through college along with communication, scientific/technological expertise, problem-solving or analytical/quantitative skills. Nowadays, it is as important to address scientific expertise as students' social and professional competences. Even though both are important, they do not play equal parts in the minds of students and teachers [5–8]. Plus, the outcome perspectives from academic and professional worlds can be quite different. Thus, different points of view must be acknowledged and documented.

The need for a better understanding of engineering education in the 21st century is reflected in scientific research [4,5,7,8], where it is common to encounter big experiences, involving funding and school commitments. However, it is less common to encounter similar important scientific studies that can be applied by any good willing teacher. Smaller scale studies, representing better-contextualized teaching closer to professional demands, can also bring valid insight to this discussion in the scientific community. The purpose of this Special Issue was to help identify good practices and/or particular concerns that young engineers, their teachers or their employees feel needed improvement.

"Tutorials for Integrating CAD/CAM in Engineering Curricula" [9] talks about the importance of developing computer-based competences within engineering courses. The authors discuss how the use of specific tutorials helped their students solving engineering problems in real-life settings.

"Development of Final Projects in Engineering Degrees around an Industry 4.0-Oriented Flexible Manufacturing System: Preliminary Outcomes and Some Initial Considerations" [10] is also dedicated to digital engineering competences. It explains how an educational tool, made to develop final projects in an engineering degree, helped students exploring different aspects in parallel, such as automation, supervision, instrumentation, communication and robotics.

"Lessons Learned from the Development of Open Educational Resources at Post-Secondary Level in the Field of Environmental Modelling: An Exploratory Study" [11] explores a different perspective of our digital era: it claims students tend to seek more resources when they are enrolled in a course with online materials. Authors claim that if these open educational sources are well designed, students' achievements, involvement and satisfaction are very positive.

Another important 21st century engineering competence is project management. "Project Management Competences by Teaching and Research Staff for the Sustained Success of Engineering Education" [12] brings us a study about the importance of improving professional project management competences. Authors describe how research may be used to improve teachers' skills while guiding students into this process.

Professional and socio-professional engineering competences are addressed in "Fostering Professional Competencies in Engineering Undergraduates with EPS@ISEP" [13], under the scope of the European Project Semester. During a semester, students from different countries, degrees and cultures, come together and use their diversity of experiences and expertise to solve a problem through a Project Based Learning (PBL) experience.

Future professionals should also develop vital competences regarding rethinking products and business models in order to address the emergent sustainability problems. As the author of "Eco-Design and Eco-Efficiency Competencies Development in Engineering and Design Students" [14] explains, students may gain sensibility as they develop professional competences while working in assignments provided by real industrial companies with this concern in mind.

"Enhancing Railway Engineering Student Engagement Using Interactive Technology Embedded with Infotainment" [15] starts with a brief review on different teaching pedagogies addressing their suitability and use of interactive technologies. The authors discuss a new teaching application which they think can improve students' participation and performance.

Students' perceptions regarding their development through their education as future engineers are addressed in "Students' Perceptions Regarding Assessment Changes in a Fluid Mechanics Course" [16]. The authors chose a crucial aspect to analyze: the impact of different methods of students' assessment. Social and scientific competences are analyzed in parallel.

The importance of the learning objectives being completely understood by the students from the beginning of each course is the theme of "An Extended Constructive Alignment Model in Teaching Electromagnetism to Engineering Undergraduates" [17]. This work addresses the importance of a modification in students' perceptions of what each course may represent and how it can aid them as future professionals while developing strong consolidated competences throughout their degree.

The final year project is also addressed in "A Systematic Review of Project Allocation Methods in Undergraduate Transnational Engineering Education" [18]. In this work, several strategies of project allocations are identified studying the corresponding students' experiences and learning gains. Authors discuss how different factors can affect these allocations and they make recommendations in order to solve some of the identified challenges.

We believe these papers may provide an insightful reflection of our own practices as engineering educators. Hopefully, those reflections on particular aspects of our teaching may contribute to enhance students' development towards the upcoming challenges of their future career! In the meantime, work continues [19,20].

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References

1. Viegas, C.; Marques, A.; Alves, G. Engineering Education and Technological/Professional Learning. In Proceedings of the 6th Technological Ecosystems for Enhancing Multiculturality (TEEM'18), Salamanca, Spain, 24–26 October 2018; ACM: New York, NY, USA, 2018; pp. 58–60. [CrossRef]
2. Johansen, B. *Leaders Make the Future: Ten New Leadership Skills for an Uncertain World*; Berrett-Koehler Publishers Inc.: San Francisco, CA, USA, 2012; ISBN 9781609944872.
3. Wood, R.; McGlashan, A.; Moon, C.-B.; Kim, W. Engineering Education in an Integrated Setting. *IJEP* **2018**, *8*, 17–27. [CrossRef]
4. Crawley, E.; Malmqvist, J.; Ostlund, S.; Ostlund, S.; Brodeur, D.R.; Edstrom, K. *Rethinking Engineering Education—The CDIO Approach*; Springer: New York, NY, USA, 2014. [CrossRef]
5. Malmi, L.; Adawi, T.; Curmi, R.; Graaff, E.; Duffy, G.; Kautz, C.; Kinnunen, P.; Williams, B. How Authors Did It—A Methodological Analysis of Recent Engineering Education Research Papers in the European Journal of Engineering Education. *Eur. J. Eng. Educ.* **2018**, *43*, 171–189. [CrossRef]
6. Borrego, M.; Bernhard, J. The emergence of engineering education research as an internationally connected field of inquiry. *J. Eng. Educ.* **2011**, *100*, 14–47. [CrossRef]
7. Huang-Saad, A.Y.; Morton, C.S.; Libarkin, J.C. Entrepreneurship Assessment in Higher Education: A Research Review for Engineering Education Researchers. *J. Eng. Educ.* **2018**, *107*, 263–290. [CrossRef]
8. Bernhard, J. Engineering Education Research in Europe—Coming of Age. *Eur. J. Eng. Educ.* **2018**, *43*, 167–170. [CrossRef]
9. Ullah, A.M.M.; Harib, K. Tutorials for Integrating CAD/CAM in Engineering Curricula. *Educ. Sci.* **2018**, *8*, 151. [CrossRef]
10. González, I.; Calderón, A. Development of Final Projects in Engineering Degrees around an Industry 4.0-Oriented Flexible Manufacturing System: Preliminary Outcomes and Some Initial Considerations. *Educ. Sci.* **2018**, *8*, 214. [CrossRef]
11. Hassan, Q.K.; Rahaman, K.R.; Sumon, K.Z.; Dewan, A. Lessons Learned from the Development of Open Educational Resources at Post-Secondary Level in the Field of Environmental Modelling: An Exploratory Study. *Educ. Sci.* **2019**, *9*, 103. [CrossRef]
12. Cerezo-Narváez, A.; de los Ríos Carmenado, I.; Pastor-Fernández, A.; Yagüe Blanco, J.L.; Otero-Mateo, M. Project Management Competences by Teaching and Research Staff for the Sustained Success of Engineering Education. *Educ. Sci.* **2019**, *9*, 44. [CrossRef]
13. Malheiro, B.; Guedes, P.; Silva, M.F.; Ferreira, P. Fostering Professional Competencies in Engineering Undergraduates with EPS@ISEP. *Educ. Sci.* **2019**, *9*, 119. [CrossRef]
14. Neto, V. Eco design and Eco-Efficiency Competencies Development in Engineering and Design Students. *Educ. Sci.* **2019**, *9*, 126. [CrossRef]

15. Kaewunruen, S. Enhancing Railway Engineering Student Engagement Using Interactive Technology Embedded with Infotainment. *Educ. Sci.* **2019**, *9*, 136. [CrossRef]
16. Sena-Esteves, T.; Morais, C.; Guedes, A.; Pereira, I.B.; Ribeiro, M.M.; Soares, F.; Leão, C.P. Student's Perceptions Regarding Assessment Changes in a Fluid Mechanics Course. *Educ. Sci.* **2019**, *9*, 152. [CrossRef]
17. Maxworth, A. An Extended Constructive Alignment Model in Teaching Electromagnetism to Engineering Undergraduates. *Educ. Sci.* **2019**, *9*, 199. [CrossRef]
18. Hussain, S.; Gamage, K.A.; Sagor, M.H.; Tariq, F.; Ma, L.; Imran, M.A. A Systematic Review of Project Allocation Methods in Undergraduate Transnational Engineering Education paper. *Educ. Sci.* **2019**, *9*, 258. [CrossRef]
19. Viegas, C.; Marques, A.; Alves, G.R. Engineering Education addressing Professional Challenges. In Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'19), León, Spain, 16–18 October 2019; Miguel, Á.C.G., Francisco, J.R.S., Camino, F.L., Francisco, J.G.-P., Eds.; ACM: New York, NY, USA, 2019; pp. 51–53. [CrossRef]
20. MDPI–Education Sciences: Special Issue: Engineering Education Addressing Professional Challenge. Available online: https://www.mdpi.com/journal/education/special_issues/Engineering_Education_Addressing_Professional_Challenges (accessed on 15 November 2019).