The Immersive Workbench for Engineering Educators: (Re)Thinking Collaborative and Distance Learning Platforms as Technological Enablers

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The stimulating stream of contributions sketching new landscapes in Engineering Education and Pedagogy, initiated by the inspirational editorial of Matthias Utesch addressing the pivotal role that is going to be played by Skill-Driven Learning and Teaching (SDLnT) [1], and carried on with ever new and exciting energy by Manuel Castro and Elio Sancristobal [2], Thrasyvoulos Tsiatos [3], David Guralnick [4], Tatiana Polyakova [5], Istvan Simonics [6] and Carina Soledad González-González [7], is a multifaceted and vivid representation of the exciting challenges that forward-looking educators face in this sector.

I would like to thank the International Journal of Engineering Pedagogy (iJEP), its Editor-in-Chief Matthias Utesch and its Editorial Board for the opportunity they gave me to share my thoughts on future trends in the Engineering Education.

In this editorial, it is my intention to start elaborating further on two of the core questions that Engineering Pedagogy aims at answering, namely *With what?* (Aids) and *How?* (Methods), as pointed out effectively by Tatiana Polyakova [5].

The current pandemic, still extremely variegated on a geographical standpoint, is fortunately disclosing several, significant clues on the forthcoming post-Covid era. Vaccination campaigns are showing their efficacy, new therapies are expected, the importance of proactive healthcare surveillance is becoming more and more evident and that painful feeling of "indefinite home-sheltering" we endured in the past months has started to fade, even if at different paces and even if many efforts have yet to be made. From a teaching perspective, this pandemic has also forced us to devise and exploit *resilient educational shelters* capable of coping with online learning and teaching on a scale as large as never before in order to avoid the disruption of our pedagogical ecosystems. Engineering Education has emerged as one of the fields that were better prepared to the unexpected, thanks to an array of technological enablers already in use, such as online teaching and learning platforms, remote laboratories, MOOCs and so on. Now, we, the engineers, have started to consider newer and even more promising elements, as the ones listed by David Guralnick in his editorial [4].

But what about the software and computational tools we have gathered – more or less deliberately – in those quite effective educational shelters to face the approaching thunderstorm? What about collaborative and distance-learning platforms, the modern descendants of the forerunning groupware platforms that from the '80s of the past century have now become the core technical enabler of the didactic activity? Should we keep following their current usage patterns unaltered? Should we wait for the tacit return of more traditional ways of teaching, where we have simply to select the tool we need, depending on the educational scenario? Should we overlook the fact that students, if not properly engaged, face the risk of becoming passive digital users of such platforms? Definitely not.

It is my belief that collaborative and distance-learning platforms can be seamlessly integrated in Engineering Education curricula, provided that newer and even more effective usage patterns can be defined and agreed for them. This is, therefore, the subject I would like to propose to your attention: what would (or should) be the most promising and enriching dimensions along which these platforms can evolve? How to trigger their upgrade from mere technological enablers, which now allow to connect distant teachers and students, to cyber-physical systems behaving as an *immersive workbench* capable of revealing and activating new paradigms in Engineering Education? How to revive the student-centred perspective with immersive experiences and foster cooperation and collaboration functionalities even more?

I think that the following dimensions, at least, can be sketched: adaptability, pervasiveness, inclusiveness, glocalisation[1].

Adaptability. We all agree on the necessity of implementing personal learning strategies and differentiated learning paths. Currently, engineering educators can leverage on the available online learning management systems to collect data and enact those intervention. The introduction of AI-based functionalities and predictive learning analytics in these platforms, provided that data privacy and integrity challenges are coped with, can add the ability to identify the most promising learning alternatives for each student (or students group), thus speeding up the implementation of adaptive learning strategies.

Pervasiveness. Mobiles already represent a large quota of the devices used by students to attend online lectures via distance-learning platforms. However, their hardware and sensor capabilities are still underexploited. Consequently, they could be integrated even more closely into engineering didactics in multiple ways: as portable sensor arrays to be used in learning projects based on the Mobile Crowd Sensing paradigm, as enablers of remote laboratory experiences or as computational platforms to be extended with ad-hoc sensors developed by students.

Inclusiveness. Without the possibility to share a classroom during the past months, students have relied heavily on functionalities such as text chats, video meetings, forums and collaborative sketchbooks offered by the platforms mentioned above. In order to reach a broader inclusion rate and to increase student's motivation to participate even more actively, Augmented/Virtual Reality (AR/VR) and holograms, when used massively not only remotely but even within the classroom itself, could become the true game-changer component. Additionally, a much more frequent and systematic adoption of these approaches promises to attain a broader inclusiveness, capable of supporting students with disabilities – as well as their teachers and their parents who often play the role of caregivers, too – by lowering learning barriers and reducing the risks of learning loss more effectively than ever before.

Glocalisation. If we adapt global educational practices to local features, if we are able to create pedagogical opportunities where global and local needs can meet, the

[1] According to the Cambridge Dictionary, the idea that local conditions must be considered in a globalized context.

resulting quality of Engineering Education will be enhanced further and the learning environment will become even more student-centred, inclusive and sustainability-aware. For instance, the seamless introduction of real-time translation engines into collaborative and distance-learning platforms promises to bring a true *glocalised* advancement. From a global perspective, it can tear down geographical barriers even more, unveiling an entire set of collaboration opportunities and activating larger international networks and programmes. From a local point of view, it can foster in students the increased perception of how the attention to culture-specific aspects may shape inquiry-based learning approaches differently, thus highlighting negative elements triggered by globalisation, such as delocalisation or technological gaps amongst different countries, and helping to counterbalance them.

There is plenty of further improvements, from both the technological and the pedagogical perspective, to creatively rethink the way these technological enablers can be used in the near future: I would be delighted to ask the iJEP community members to share their thoughts on this fascinating topic.

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