BERA Conference 2022

Session type: Individual Paper

Special Interest Group: Educational Technology

Title: Game-based Learning in Engineering Education: How can we reconcile seemingly conflicting interests of students, academics, universities and national policy makers?

Outline

It is perplexing how a single video game can easily surpass a billion-dollar revenue per year whereas a prominent STEM education virtual laboratories company can barely cross USD 5M in 2020 despite the twentyfold rise in demand since the outset of a global pandemic [1]. Even though the underlying core elements of both products are similar to a great extent, nevertheless their market demand and desirability levels are incomparable. These observations raise yet unanswered questions about the academic nature and how it influences the adoption of solutions from the *Education Technology* (EdTech) industry. What could be the reasons behind this mysterious impediment to progress in *Game-based Learning* (GBL)? Does it have something to do with the nature of the engineering curricula, complicating the implementation of GBL? Is there a misalignment between existing tools and modules' learning outcomes? Would it be possible that some of the academic community's interests are dismissed in the creation of EdTech solutions?

According to a survey from the World Economic Forum 2020 [2], many developed and developing countries are striving for large-scale adoption of online education technologies over the next five years, with the UK anticipated to be ranked 12th among 29 countries. To improve their standing in the upcoming years, the UK academic community will need to exploit opportunities to be on par with the latest EdTech adopted in the global landscape. Despite such interesting forecasts, there has been yet no indicators of GBL mass adoption in engineering education, which means given the current trend, it might be hard for UK *Higher Education Institutions* (HEI) to win this global competition.

Unlike theoretical domains, such as management studies, engineering curricula involve heavy use of physics and mathematics that are tricky to incorporate in game contexts. In addition, the practical element is an indispensable part of every engineering programme that requires handling the gamification of teaching activities with delicacy to maintain students' hands-on experience. These curricular challenges suggest rethinking GBL for engineering higher education, tailoring it to the needs of its academic community [3]. Hence, our oral presentation underscores the potential behind adapting GBL to engineering teaching activities with emphasis on practical laboratory sessions. We will go through the core elements of a complete and balanced GBL-based virtual laboratory that encompasses the learning, assessment, and psychometric aspects. We will also showcase an exemplar virtual laboratory that is the outcome of a collaboration between academics from three UK HEIs.

The creation phase of virtual laboratories is equally important to the formulation of their aforementioned specifications. A community-engaged philosophy should be embraced in the making of EdTech solutions in general. In this context, the community members/representatives would become partners rather than target end users of the developed products and services. Notably, the community is heterogenous with it being comprised of different stakeholders, potentially with conflicting interests. A crucial part of our presentation would be on navigating a common ground of interests between all involved stakeholders, including students, academics, university administration and national policy makers.

Students are at the forefront of the pipeline; they normally seek equitable learning opportunities that meet personalised learning needs, for instance, varying learning pace from a student to another. Individual differences shall be accommodated in EdTech solutions in ways conventional classrooms are unable to. Academic staff, on the other hand, sometimes feel reluctant to incorporate digital solutions, partly because they lack the technical skills of doing so, and also due to "fearing the unknown" with little faith in how virtuality will serve their reality-dominated teaching activities. Top university management has a major role to play with their final say as they manage decision making and financial matters. After decades of investing into conventional teaching facilities (e.g. classrooms and laboratory assets), their fears of potentially losing their investments to the emerging digital solutions are understandable. A similar scenario was previously inherent to robotics when they were regarded as a real concern for causing unemployment. Eventually, robotics has become a core element of Industry 3.0 onwards.

Our presentation will cover a holistic framework that serves the interests of all GBL stakeholders. With a demo virtual laboratory that we have collaboratively developed with other UK academics, we will showcase how it could engage students, complement conventional classrooms, and reassure top management and policy makers on the value of GBL.

We believe our presentation will attract enthusiasts about GBL and digital transformation from HEIs and EdTech sector. The session will drive interesting discussions and engage like-minded community to drive forward the emerging GBL across engineering courses.

Learning outcomes dismissed (academics lacking technical skills, unfamiliar with GBL as a concept "fear of the unknown", reluctant)

Universities (Industry 2.0 mindset fearful of the rise of robotics and job losses -> losing investment in facilities, financials)

Student (Equitable learning opportunities, personalised learning at your own pace)

References:

[1] Deloitte, *Labster ApS Annual report 2020*. Available at: https://regnskaber.cvrapi.dk/80875443/amNsb3VkczovLzAzL2M1LzU4L2ZjLzBhL2FmNTMtNDI2OS1hZGE3LWY4NWFiNjE1NGUyOQ.pdf [Accessed January 31, 2022].

[2] Whiting, K., 2020. *Is this what higher education will look like in 5 years?. [online] World Economic Forum*. Available at: https://www.weforum.org/agenda/2020/11/higher-education-online-change-cost-covid-19?utm_source=twitter&utm_medium=social_scheduler&utm_term=Education,+Gender+and+Work&utm_content=05/01/2021+00:00 [Accessed January 31, 2022].

[3] Stanitsas, M., Vareilles, É., Kirytopoulos, K. and Aldanondo, M., 2018, June. *Sustainable development in serious games: rethinking game-based learning strategies for master's degree engineers*. In MOSIM'18-12ème Conférence internationale de Modélisation, Optimisation et SIMulation (pp. 8-p).