Immersive Learning for Practical Training in STEM

IMPACT SUMMARY

The Virtual Labs team, led by Maynooth University, is working to transform laboratory education through blending immersive virtual resources with an on-campus in-lab experience. This large-scale venture collaborates with enterprise partners and education technology providers to develop an innovative approach to enhancing the educational laboratory experience that best prepares students to embark on their future STEM careers.

IMPACT DESCRIPTION

Modern education is becoming increasingly complex, with the continuous development of new educational technologies, and an on-going debate on how they can be used effectively in training chemistry/bio-science students in essential laboratory skills. At the same time, adapting teaching to suit different learning styles is especially challenging.

To address these challenges, while enhancing the educational experience of science students at MU, Prof Rooney and colleagues in the Department of Chemistry at MU, assembled a consortium with partners across Ireland, (Technological University of the Shannon: Midlands Midwest (TUS), Dundalk Institute of Technology (DkIT), University College Cork (UCC) and Dublin City University (DCU)), to design an innovative project focused on the use of virtual laboratories and associated technologies as teaching tools. Priorities were to design, with learner, teaching staff and enterprise partner input, a modern, future-proofed approach to training for the benefit of students and to address the needs of employers of STEM graduates.

This Virtual Labs Initiative was funded in 2020 by the HEA under the Human Capital Initiative (HCI) Pillar 3, Innovation and Agility. Accordingly, its purpose aligns with several national priorities and with MU's Strategic Plan 2023-2028 with a goal to create, "a dynamic, responsive and inclusive learning environment, in partnership with our students" as well as with the Government's National Skills Strategy 2025, through the 'responsiveness of education and training providers to emerging employer needs and the quantity of graduates in STEM disciplines' (Ireland National Skills Strategy 2025). Further, it addresses recommendations of the National Strategy for Higher Education 2023 providing an 'excellent teaching and learning experience...with state-of-the-art learning resources' (National Strategy for Higher Education 2030). It is working to improve training in key practical competencies. This is required for Ireland's economic success, industries, including Biopharma, who are reporting 'a shortage of new graduates with core skills' (Skills for Biopharma, National Skills Council Report 2024). It set out to familiarise students with the training methods they will use throughout their careers. The CSO survey, 2022 reported that 75% of those in employment would choose a blended or remote course for training. Furthermore, in line with Ireland's Innovation 2020 strategy, it facilitates collaboration between academia, industry and government to enhance learning with a purpose to train graduates with skills relevant to the evolving needs of the workforce (Innovation 2020). In promoting an inclusive and accessible digital component, this groundbreaking initiative aligns with the Digital Education Action Plan 2021-2017.

It has significantly impacted students, educators, and the broader educational landscape. It allows students perform experiments and delve into complex concepts within a safe virtual space, thereby improving their confidence and comprehension of the course itself. It is also suited to learners who prefer interactive and visual presentations. Central to this design is the involvement of enterprise partners, with Analog Devices, Alltech, and Mindconnex directly advising MU, enabling high level interactions with students, facilitating insight into the skills required and opportunities available in the (bio)pharmaceutical/ chemical sector in Ireland. Enterprise partners have reviewed our courses, making them more relevant to the needs of industry. Our prioritisation of student-staff partnerships aligns with the NStEP Strategy 2022-2025 and student, staff and enterprise input informed a review of first- and second-year courses and the design of a new team-based fourth-year project.

Evidence of Impact

Immersive lab education is revolutionising learning, making education more flexible, inclusive and adaptable to diverse learning styles. It provides access to digital and cutting-edge technologies essential for future STEM careers. Virtual labs are a game-changer; however, sound pedagogical approaches are essential to maximize their impact. The Virtual Labs Initiative, led by MU benefits students, staff, industry stakeholders and wider society. There are a number of ways in which this research impacts STEM careers, including teaching and learning, economic, societal, sectoral, and external achievements.

TEACHING IMPACT

Finding a route to implement and deliver this innovative pedagogy at scale is key to the success of this initiative; our findings place us at the forefront nationally in understanding how to best deploy technology driven teaching innovations. To- date, training has been delivered in seven UG modules and one micro-credential course. This programme also focuses on the school/university transition, which is a critical development phase with a myriad of challenges. Consequently, we focused on first-year students introducing new ways of working in the lab and an innovative formal two-way feedback structure. A survey determined these scheduled sessions were the preferred, most inclusive/supportive communication channel for giving/receiving feedback (64%); 88% of students felt they had a *voice* in the environment.

STUDENT TESTIMONIALS

...more prepared... helped my confidence...enjoy the lab...

...work is very similar between the lab and the simulations...

...felt I could do a lot more in the lab because I had done the pre-lab work...

...definitely an effective way to help your learning...better to learn in a lab, but they really helped reinforce what you were learning.

ECONOMIC IMPACT

Supported by our industry advisory panel we are developing a pipeline of BSc graduates familiar with the digital tools of the modern workplace. We surveyed 45 managers to better understand the most desirable transversal skills and attributes and are seeking further input from 400 alumni. It is recognised that significant skills shortages could hinder the future growth and competitiveness of the Irish craft brewing and distilling industries. With industry experts we have co-created and co-delivered a micro-credential for lifelong learners, providing specialised analytical training to support this sector.

SOCIETAL IMPACT

The lab is a complex learning space with diverse cognitive and social demands. HEA statistics on Student Disability 2023 indicate 17.8% of respondents have a disability, of which 68% are hidden. We consider inclusivity in our practices and UDL is at the centre of our lab curriculum design.

SECTORAL INFLUENCE

We facilitate national/international discourse:

- Advising on new specification for Leaving Certificate Physics and Chemistry.
- Organised one event for second-level teachers.
- Partnered with HEI collaborators in three out-reach events.
- (Co-)organised two National Higher-Education events.
- Presented at five local/national, eight international meetings, to one Edtech partner
- Contributed to two HCI showcases.

EXTERNAL AWARDS

Awards received indicate the success of the Virtual Labs Initiative. In 2024, the team won a 'HEA Disciplinary Excellence in Learning, Teaching and Assessment (DELTA) Award' which recognises outstanding contributions to teaching and learning enhancement. Mr Colin Lowry, HEA Senior Manager of Teaching & Learning, Enhancement and Digital Innovation *commented 'this team's ability to drive change and implement impactful teaching strategies across multiple institutions is truly commendable and serves as a role model for similar collaborations*'. The team was also awarded 'Best Collaboration Project' at The Education Awards (2024) which recognises, encourages, and celebrates excellence in the Irish third-level education sector. In 2022, we were awarded a 'LearnSci Teaching Innovation Award'.