Looking ahead: What are the lessons for education in Microbiology and beyond?

Higher Education has seen many changes, always faces new challenges, and educational approaches have to adapt in response and proactively. Issues such antibiotic resistance and food security emphasise the need to prepare for future skills demands of the global workforce, to spark the next generation's curiosity, and to generally spur public interest in sciences. Microbiology has always impacted on society's health, economy and environment, and keeps paving the way for new discoveries now often in collaboration or blending with other disciplines. In order to make highly innovative and transferable educational approaches accessible to microbiologists and other educators, the journal *FEMS Microbiology Letters* recently published a Thematic Issue 'Education'. The lessons from its unique and well received content are highlighted here.

Practical classes in schools are often restricted due to safety concerns, lack of resources and time, but universities can provide support for schools, and best practice in developing such material is discussed from selecting curriculum content via launch to evaluation. A broader education, where students of any disciplines are exposed to microbiology, prepares for an unpredictable future. Even historical microbiology enriches modern education by providing opportunities for safe 'hands-on' work with microorganisms. Comparing original works with what has been written about them proves an eye-opener in times when confidence in evaluating sources of information has become invaluable.

Information and communication technologies support learning, teaching and assessment if used informedly and in awareness of concerns such as tackling the multitude of platforms and the impact on the work life balance in a 24/7 environment. Educational content can be created and shared via social media in virtual communities. Material deposited online allows learning before entering the virtual or real classroom where concepts are then reinforced with the lecturer. Technology supports collaborative learning towards a shared understanding, and guest lecturers can join students via videoconference.

Yet, real-world tasks are crucial for learning at university. Students thrive when being involved in activities related to research on e.g. antimicrobial resistance, water quality, and environmental sources of microorganisms that endanger anyone with a weakened immune system. The International Genetically Engineered Machines competition allows students to experience all aspects of actual research including optimising its impact on society and considering ethical questions around genetic engineering. The teams are encouraged to develop business models, but all competitors have already become highly employable.

If a university course is well conceived in consultation with employers, well delivered, and developmental activities are highlighted to students, there is no need for much extra provision to develop employability skills and to evidence achievement. Career education prepares students for

becoming employees. Transferable skills allow graduates to adapt as lifelong learners to ever changing professional contexts and expanding knowledge, particularly if personal development planning had been instilled early on. The same goes for employability-related skills at a higher level for taught postgraduates. Employers also value the intercultural competence of internationally mobile students. Currently, Erasmus+ is the European Union’s major exchange programme for studying, teaching and research. Non-mobile students then benefit when interacting with visiting and returning students and staff. However, diverse needs of classes combining home and overseas degree students, as well as guest and returning home students pose challenges for lecturers.

Being a '21st century academic' requires a wide range of expertise and continuous skills development. Students deem pedagogic training for lecturers valuable. Academic culture is very slowly changing towards a more equal status of teaching and research. Academic appointments and promotions also consider teaching professionalism and excellence.

Undoubtedly, the current and next generations deserve the best and inspirational education, perpetual challenges drive educational improvements, and Higher Education has to remain prepared.

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