

Pandemic pedagogy in Life Sciences: the assessment conundrum and diversifying delivery modes

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Abstract

COVID-19 had a significant impact on higher education, forcing emergency remote teaching. The quantity versus quality assessment conundrum is a continuing debate and the rapid transition to online delivery provided an opportunity to assess this.

We compared data on assessment number and type, student experience and outcomes, pre-COVID-19 and during the COVID-19 pandemic. Data on perceptions of differential modes of learning are assessed in the form of extra-curricular summer schools to replace or enhance modular laboratory and fieldwork practicals. There was minimal decrease in assessment load (9.6%) and type (12.5%). Differences in student perceptions of assessment and modules were insignificant ($t=22$, $p=0.1$) between years and student outcomes revealed an average 4% increase in the COVID-19 year. Summer schools were viewed very positively, with 72% preferring the intensive teaching format. This study provides additional evidence in the assessment dilemma and developments towards more flexible modes of learning.

Keywords: pandemic pedagogy, life sciences, assessment and feedback, flexible learning

Introduction

COVID-19 enforced a rapid transition to emergency remote teaching (ERT) in March 2020. Hodges et al. (2020) described emergency remote teaching as an attempt ‘not to re-create a robust educational ecosystem but rather to provide temporary access to instruction and instructional supports in a manner that is quick to set up and is reliably available during an emergency or crisis. Milman (2020) refers to it as ‘pandemic pedagogy’ and Youmans (2020) describes adaptations made during this period as ‘trauma-informed teaching’. Teaching in a crisis is unlike already established blended learning practice (a mix of online and face to face delivery). One of the main differences being when transition is enforced through a crisis, there are significant time limitations and online may not be as effective as there are limited additional resources to meet students’ needs and many degree programs cannot substitute hands on practical skills.

The School of Life Sciences at the University of Essex runs six UG programs covering Biomedical Science to Marine Biology. All programs of study were significantly affected due to the practical laboratory and field skills necessary for completion of science degrees. These were unique challenges whereby some learning

outcomes could not be fulfilled through the virtual delivery format (Bacon and Peacock 2021; Barton 2020; Campbell et al. 2020). Many laboratory and field based practical skills are critical to the study of ecology, biomedical and natural sciences with hands on experiences being an essential component of the curriculum. Bacon and Peacock (2020) determined that life sciences were significantly impacted due to large lab practical and field components that require hands on, immersive experiences to develop essential practical skills. Ramlo (2021) used Q methodology (Q), a mixed method, to determine and describe faculty staff views regarding emergency remote teaching. These findings indicate that creating the best learning situations for students is not one-size-fits-all and that there are discipline-specific and pedagogical issues to consider when moving face to face (F2F) courses to online that are not fixed simply with technology.

In addition, the quantity versus quality assessment conundrum is a continuing debate in the literature (Harland et al. 2015; Galvez-Bravo 2016; Tomas and Jessop 2018; O'Neill 2019) and the enforced rapid transition to online alternative assessment during COVID-19 provides an opportunity to assess the impact of streamlining assessment on student outcomes and experience.

We consider the possibility that ERT during the pandemic provides an opportunity to examine the nature of assessment and the viability of offering differential modes of delivery for a life sciences higher education experience. For example, it is often difficult to run ecology and marine biology field practicals during term time due to seasonal weather during the main terms of the academic year (October-March). Therefore, we consider the perceptions of students to alternative modes of delivery including online and term time assessments versus non-assessed summer schools for skills only. Intensive field/lab work in a summer school format that allows for the development of skills that students cannot learn online may also prove a worthwhile alternative to continuous assessment of practical work throughout the term, thus opening options of widening access to higher education through flexible modes of learning.

We were keen to understand what our successes and failures were, what we can learn from ERT and what positive aspects can be drawn from the crisis in relation to the higher education experience for life sciences students. Success, of course, can be measured in a variety of ways and it is important to consider the attributes and characteristics (Hodges et al. 2020). For the purposes of this study, we examine assessment, student experience and outcomes to determine if the intended knowledge and skills that were the focus of the module were gained by our students.

Another potential benefit is diversifying the mode of delivery. This already exists in the Open University (OU) model, whereby the OU refers to an open-door policy, i.e. no entry requirements and the concept is to make higher education open to all. The OU teaches through its own unique method of distance learning called 'supported open learning' which is flexible to allow students to work when and where they choose to fit in with jobs, families, and other commitments. Therefore, the aims of this paper are to a) determine the effect of ERT on assessment, student experience and outcomes in 1st and 2nd year Life Sciences students and b) to determine the effect on the learning experience of students on different modes of delivery (in term time vs intensive summer schools).

Methods

To evaluate the impact of the sudden shift to alternative modes of delivery and assessment, data on assessment, student experience and outcomes from first- and second-year undergraduate (levels 4 and 5) modules from the School of Life Sciences at the University of Essex were compiled. We also consider the student experience of a level 5 voluntary non-assessed laboratory summer school which was run as a skills catch-up program in June 2021. Third year modules were not taken into consideration as they were either entirely exam or field-based with minimal assessed coursework. However, we do include student experience survey data of a third-year compulsory field course as this was also run in June 2021 alongside the voluntary summer schools.

Student outcome data for these cohorts were obtained from the School of Life Sciences exam boards and student feedback was sourced from the Student Assessment of Modules and Teaching (SAMT), mid-term feedback surveys (done by module supervisors) and summer school surveys (based on questions adapted from SAMT). SAMT is a central survey comprised of open and closed standardised questions for student module feedback and is carried out every year for individual modules, thereby allowing all enrolled students the opportunity to participate. SAMT data were selected for two academic years: 2018-2019 and 2020-2021 to compare the effect of ERT with the former, hereto referred to as the 'pre-COVID-19' period and the latter taking place in the height of COVID-19 restrictions (hereto referred to as the 'COVID-19' period). The early COVID-19 period fell within the academic year of 2019-2020 but was not analysed due to the paucity of SAMT data due to the emergency nature of the transition in March 2020. For outcomes and SAMT comparison of pre-COVID-19 with COVID-19, only first and second year modules with adequate representation of SAMT data (minimum 50% class feedback response) were considered. However, the COVID-19 SAMT data were not as representative of the courses as the pre-COVID-19 period due to a shift from in-person completion of the SAMT forms in class time to an online format during the pandemic which resulted in poor compliance of students in completing the feedback survey.

Figures were created in Microsoft Excel (2019), and in which a t-Test (Two-Sample Assuming Equal Variances) was also performed. Non-standardised, qualitative data in the form of midterm feedback was represented in word cloud analysis generated in TagCrowd (Steinbock, 2021) A maximum word limit of 30 was set and common English words were removed.

Results

The mode of delivery for the first- and second-year Life Sciences curriculum were predominantly migrated to an online format during the COVID-19 period (Figure 1). Lectures were available in both synchronous and asynchronous format to accommodate students who could not access real-time learning either due to COVID-19, different time zones or technological issues. Of the entire first-and second-year curriculum, only one module was withdrawn, this was due the rationalisation of optional modules by the University during the pandemic. One other module, which was a residential field course, was postponed but took place in September 2021. In total, 90% of the fieldwork-based practicals took place virtually and the remaining 10% were cancelled (Figure

1). One other tropical residential field course was converted to a virtual module as an option, with another option to defer to 2022.

A total of 69 virtual practicals and alternative assessments were carried out in the COVID-19 period compared to the 78 practicals carried out in the pre-COVID-19 academic year. Practical sessions were delivered in alternative formats that took place either virtually (71.8%) or were postponed until it was deemed safe to conduct in-person under government guidelines (16.7%; Figure 1). To compensate for any missed skills, virtual practicals were supplemented by additional non-assessed, voluntary, in-person summer schools that took place after the exam period under eased government restrictions.

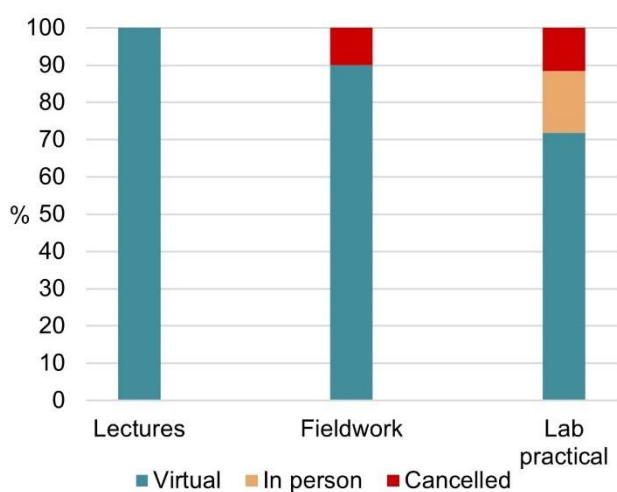


Figure. 1 Impact of ERT for Life sciences level 4 and 5 modules, fieldwork sessions $n= 10$ and lab practicals $n= 78$ during 2020-2021

The number of assessments for all first and second-year Life Sciences modules during the pre-COVID-19 period ($n= 167$) decreased by 9.6 % during the COVID-19 period ($n=151$) and different assessment forms ($n= 16$) also decreased by 12.5 % during COVID-19 ($n=14$; Figure 2). The types of assessments utilised for these undergraduate modules include data analysis and interpretation (DAI); worksheets; essay; Moodle quiz; multiple choice quiz; oral presentation; Mastering Biology online assessment; group work presentation; electronic voting system (EVS), scientific poster and 'other.' Mastering Biology is an add-on package to Campbell Biology, 12th Edition; offering online homework, tutorial, and assessments (Urry et al. 2020) and Moodle is a learning platform and course management system (CMS).

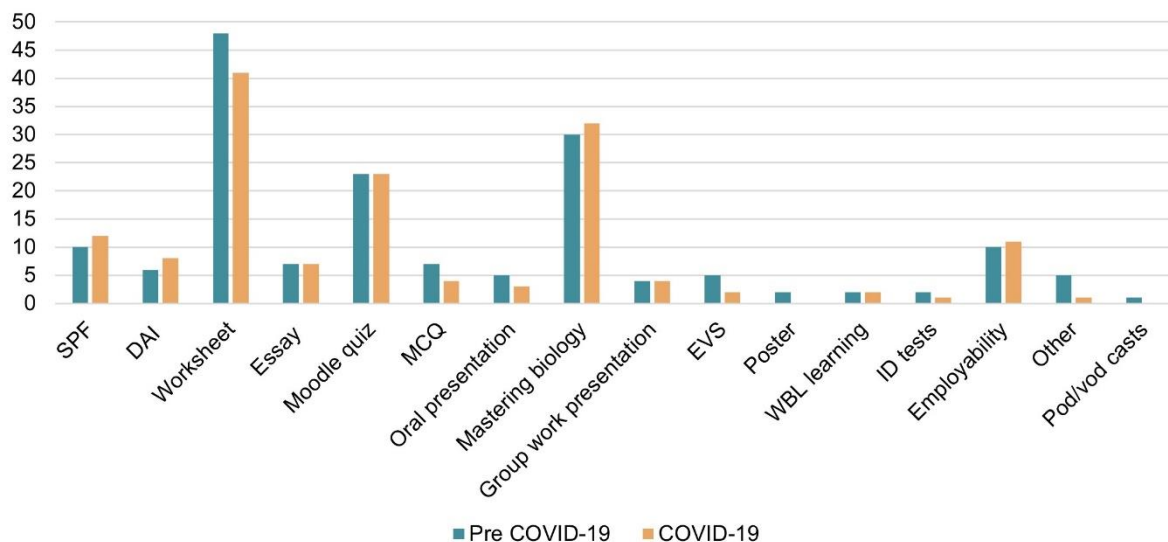


Figure 2 Assessment types for level 4 and 5 life sciences modules. Pre COVID-19 n= 167 and COVID-19 n= 151. SPF= scientific paper format, DAI= data analysis and interpretation, MCQ= multiple choice quiz, EVS= electronic voting system and WBL= work-based learning

Midterm feedback for 1st and 2nd year Life Sciences modules during the COVID-19 academic year were analysed as a word cloud (Figure 3) generated in TagCrowd (Steinbock, 2021). The word cloud format is highly suited to represent these kind of non-standardised, qualitative and anecdotal data (DePaolo & Wilkinson, 2014).

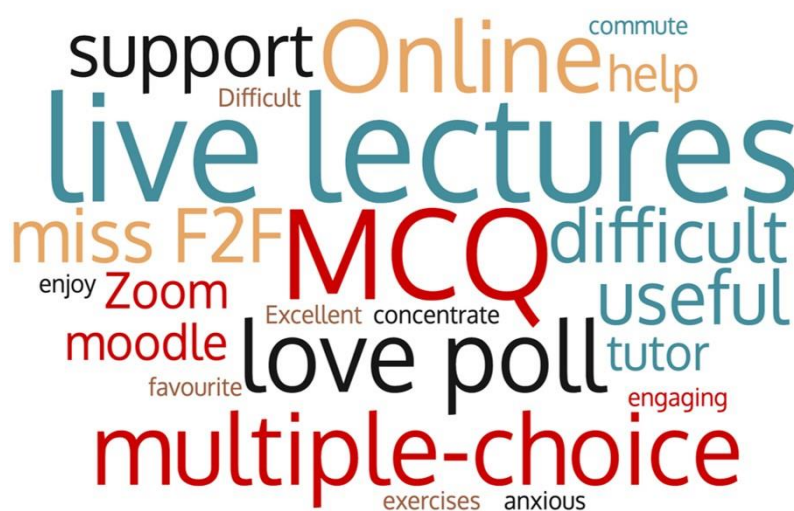


Figure 3 Student perception of ERT: the top 30 terms used by students to describe their blended learning experience during the COVID-19 academic period

Midterm feedback results for emergency remote learning (Figure 3) indicated that students preferred 'live lectures' (synchronous) to pre-recorded lectures (asynchronous) but felt it was 'useful' to have access to recorded lessons for exam revision purposes. Students responded well to 'MCQ' and 'polls' which they felt enhanced their 'engagement' online and provided insight into any knowledge gaps they experienced. Students felt a sense of 'support' using online chats, emails with course lecturers and the aid of 'personal tutors.' 'Moodle' was deemed a 'useful' platform. The negative aspects of emergency remote learning experienced by students were predominantly internet connectivity and technological issues. Students missed face to face interaction and practical skills. They found it 'difficult' to focus and 'concentrate' and at times felt 'anxious'.

SAMT data and academic outcomes were compared for pre-COVID-19 and COVID-19 academic years (Figure 4). Four first year and three second year Life Sciences modules were analysed that had corresponding SAMT data for both years. SAMT data class representation averaged 41% for pre-COVID-19 period versus 29% during the COVID-19 period. The average class size for pre-COVID-19 modules included in the analysis was n= 34 and n= 52 for COVID-19 respectively. SAMT data was further subdivided into student perception of the coursework assessments and overall satisfaction of modules (Figure 4).

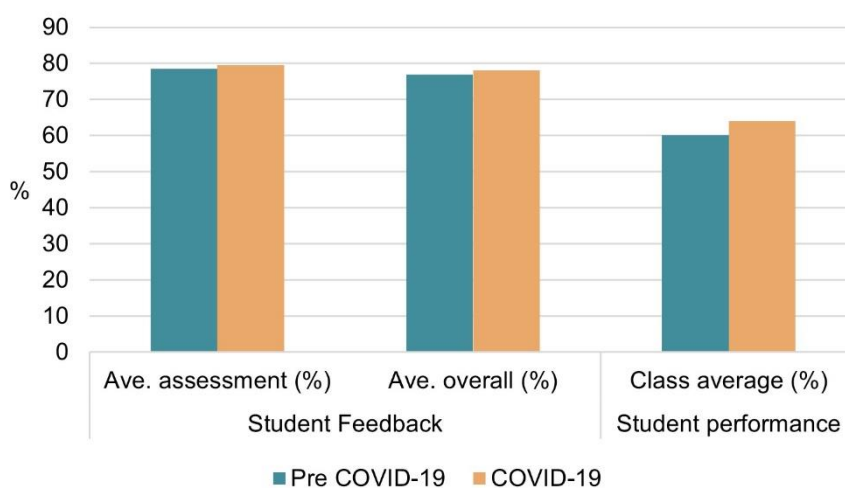


Figure 4 Average SAMT (Student Assessment of Module and Teaching) scores (%) for assessment and modules along with student outcomes for pre-COVID-19 (2018-2019) and COVID-19 (2020-2021) period

Differences in student perception of assessments and modules between pre-COVID-19 and COVID-19 were found to be insignificant ($t=22$, $p=0.1$). Similarly, no statistical difference was found for the class average outcome for in-person (60.1%) versus emergency remote learning (64%) COVID-19 ($t= 1.8$, $p= 0.1$).

Two voluntary non-assessed summer schools (n=99 students) were due to be held in June 2021 to provide a face to face experience all year 2 students. One summer school covered Biomedical Science and the other covered Environmental degrees. Unfortunately, the Environmental summer school was cancelled due to a further COVID-19 outbreak. Assessments had already been completed online during term time, so the purpose

of the summer schools was to incorporate the key practical and laboratory skills that had been missed during the COVID-19 period.

However, a field work module which was compulsory and assessed for environmental students (n=52), did take place under eased government restrictions during the summer period as the weather was more suitable for fieldwork. The survey feedback data for the alternative format of these in-person field/lab work sessions are summarised in Figure 5, with student feedback for the non-assessed summer school (laboratory practicals) in teal and student feedback for the assessed fieldwork course represented in orange.

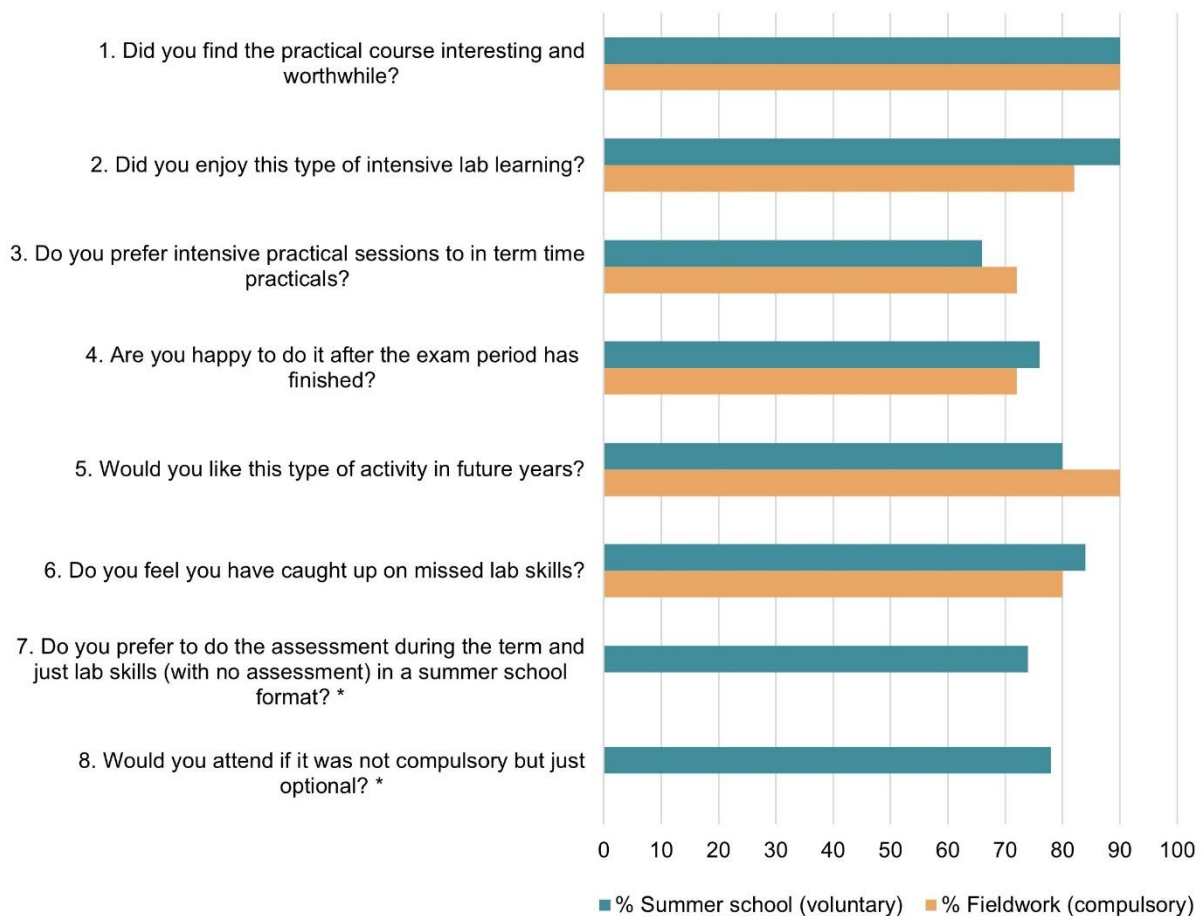


Figure 5 Feedback for the voluntary, non-assessed summer school n=99 (teal), versus feedback from the compulsory, assessed fieldwork course n=29 (orange). *Questions 7 and 8 did not pertain to fieldwork course participants.

On average, the two cohorts indicated that 72% of the students preferred the alternative format of intensive back-to-back practicals and fieldwork compared to in-term practicals. Though this may seem favourable, it is worth noting that the students' responses to these questions (3 and 4) were the lowest compared with the other feedback questions, indicating that students did not actually agree as strongly with these statements as they did with the other remaining feedback questions. The scheduling of these courses, held after the exam period

(question 4), was less well-received by the fieldwork cohort compared to those who participated in the non-assessed summer school.

Of the feedback comments of the survey for the summer school participants, 82% of the students felt that they had caught up on missed skills and only 14% felt that they had missed certain skills that were part of the original curriculum.

The assessed fieldwork course was curtailed to a certain extent due to the COVID-19 restrictions that were in place at the time the course ran (i.e., boat work which did not allow for social distancing) with over half the participants (52%) commenting that they felt they had missed a few skills and possibly fell short of the outcomes of the course, whilst 34% wanted skills that were generally not offered as part of the curriculum (i.e., drone flying) but could be considered for future fieldwork courses.

Discussion

Overall, this study was very useful in providing reassuring evidence that we had managed to successfully mitigate some of the major effects of the pandemic during ERT on assessment, skills/learning outcomes and student performance. This study also unveils interesting evidence of student perceptions of both assessed and non-assessed (skills catch-up) summer schools, adding some weight to discussions around flexible modes of learning.

Despite the pandemic, 90% of field work-based practicals took place virtually and 88% of laboratory-based practicals, either virtually or as summer schools and alternative assessments were largely in line with pre COVID-19 assessment number and types. However, it should be noted that ERT and assessment require creative problem solving and we used various alternative solutions to meet the needs of our students. Our students preferred live teaching events rather than pre-recorded overall (82%), this in contrast to Bacon and Peacock (2021) where a brief straw poll of Ecology and Conservation students (final year; 42 students) indicated a strong preference for asynchronous delivery. Hodges et al. (2020) discuss the need to understand that well planned, in advance, online learning experiences are meaningfully different from what is offered in response to a crisis and it is important to remember this when evaluating ERT.

We also found that the number and types of assessment decreased by only 9.6% and 12% respectively. In this type of analysis, it is also important to consider the ongoing debate in the literature around assessment load and quality vs quantity (Tomas and Jessop 2018). We used summative assessment for 161 (16 types) pieces of coursework across 240 credits (2 years) of higher education pre COVID-19 and 151 (14 types) during COVID-19. It should be noted that some of these assessments are very small, such as Mastering Biology quizzes (Urry et al. 2020), which are used as ongoing learning checks in year 1 modules. Tomas and Jessop (2018) examine assessment loads across teaching and research-intensive Universities. According to their categorisation, we use a high variety of assessment methods. This is more inclusive in theory, potentially enabling students with learning differences to achieve better outcomes. We have a low number of formative assessments, a high percentage of marks from examination but also a high number of summative assessments. Evidence presented by Harland et al. (2015) argues that high numbers of summative assessments, albeit varied in type, along with the modular system of study creates 'an assessment arms race' which encourages students to

work by ‘pedagogies of control’ - effort in return for grades, rather than ‘deep learning’. More is not always better and finding a balance between formative and summative assessment to create overall lighter assessment loads may enhance slower and deeper learning.

Student feedback on modules using SAMT did not differ significantly between the pre-COVID-19 and COVID-19 year for assessment and overall experience of the module. This was once again, reassuring that we had enabled students to meet the learning outcomes of the module and their perception of the experience had not changed significantly. However, these results do mask the reality that it just was not possible for students to have the same experience doing a science degree during COVID-19 compared to pre-COVID-19. There was also a decline in response to the surveys which may be due to the change in format from hard copy surveys completed in-class to online surveys, the latter being more dependent on student compliance. Nonetheless, the results were surprising and encouraging.

Student outcomes improved by nearly 4%, with a class average of 64% per module during COVID-19. However, it should be noted that there was a ‘no detriment’ policy in place and examinations were conducted online so it is likely the effect of this resulted in overall slightly higher marks. It is important to note that it is unlikely the University will return to large in-person closed book summer exams, as has been the examination mode of assessment for decades. Indeed, the University has conducted a review of the future of assessment, and it is likely that large exam hall in-person closed book exams are becoming redundant. How we assess students’ needs should be considered coherently, ensuring each student is fairly and appropriately assessed and that assessment load at both module and degree level is fair and standardised to some extent.

Students enjoyed and performed well in the summer schools, although the cohort who were assessed for a compulsory field course may have experienced fatigue by having an assessed module so soon after the final exam period. Surveys of student experience in summer schools indicated that 82% students felt they had caught up on missed skills. Once again, this enforced change to our usual timetabled format has opened discussions around the possibilities of flexible modes of learning. This is in line with the current government initiatives on Lifelong learning promoting flexibility through online and blended learning (Skills for Jobs, 2021).

Reflecting on this, we have considered more deeply how we should be assessing our students in the future, in a way that is fair and appropriate to the associated credits, content, materials and required skills.

There is strong evidence for a mental health crisis among higher education student populations (Office for National Statistics, 2021) and there is consistent feedback from our students that they struggle to meet deadlines (SAMT), whilst staff complain of too much marking. We have considered whether our students are over assessed and these data and comparisons in the literature herein confirm our thoughts.

We reflect that our 15-credit module structure and associated assessment loads are too high and that this likely obstructs deep learning and leads to ‘pedagogies of control’. We also reflect that our trust in students’ ability to learn without being assessed has been eroded over the years. Therefore, a comprehensive assessment review at both module and degree level is underway. This will ensure a variety of assessment types, both formative and summative, at appropriate stages with meaning and relevance to both academic learning and future employability skills, which should not be mutually exclusive.

The non-assessed summer schools were highly successful, and this has encouraged deeper consideration of these more flexible modes of learning. These enforced changes have facilitated the development of an apprenticeship scheme for Biomedical Healthcare Practitioners which we plan to run as asynchronous online sessions with an assessed summer school for intensive learning and skills. In addition, we are reviewing how block teaching could work in the timetable rather than the current 'long, thin' modular format. We would like to enable increased accessibility to our degree programs for part-time, career change individuals and to provide lifelong learning opportunities.

In conclusion, COVID-19 has enforced deep changes in how higher education is delivered and it is our intention to take the positive perspectives from these changes and ensure students are fairly and appropriately assessed. This could also improve access to higher education in more flexible formats to enable widening participation and provide a truly valuable and transformational educational experience.

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