



# Post-COVID-19 Adaptations; the Shifts Towards Online Learning, Hybrid Course Delivery and the Implications for Biosciences Courses in the Higher Education Setting

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The Covid-19 pandemic has created challenges and caused disruption across the Higher Education sector; university campuses closed, and face-to-face teaching and assessment shifted to an online format. Learning from our students' experience during this period will help us shape future hybrid delivery so that it best fits Bioscience students. This pedagogical study explored Aston University's Bioscience students' experiences of studying from home, and the impact of the lockdown on mental wellbeing and quality of life. 151 students completed an online survey during August 2020, which included open and closed questions. Analysis of survey data revealed that a majority of students reported positive experiences of online open-book assessments and most would welcome this format in the future. The majority of students faced no technical issues, predominantly stating that they also had good internet connectivity. Shifting to remote learning and online classrooms uncovered conflicting preferences; despite wanting more interactive lectures, only half of the students were comfortable interacting using video cameras. Free text responses provided an insight into how some students reported an inadequate home working space/environment and lacked necessary items such as a desk, highlighting how remote working may intensify social and digital inequality - particularly for students from more deprived households. Wider detrimental experiences of lockdown included dissatisfaction with access to healthcare, decreased concentration, sleeping difficulties and a decline in mental wellbeing. Education strategies going forward will need to address the mental health needs of students who have suffered during the pandemic. Our university, amongst others, is embracing hybrid course delivery, which could offer a solution to ensuring Bioscience students receive hands-on laboratory experience and face-to-face contact to remain motivated and benefit from the on-campus facilities and support, whilst allowing students some of the flexibility afforded by remote study. In the current competitive higher education market where student retention is key, it is important to consider student demographics and digital equity to ensure an appropriate approach is applied to cater for all students.

**Keywords:** hybrid course delivery, blended learning, online education, digital inequality, COVID-19

## INTRODUCTION

The higher education market has become increasingly competitive with the addition of distance and open education models (Cunha et al., 2020). Prior to the recent COVID-19 pandemic, many universities were already expecting their revenue to be reduced by issues such as Brexit and a shifting demography with fewer students of university age, and increased competition for students with the increasing number of University places. Any sudden decline in international student numbers would leave many institutions experiencing financial insecurity (Marginson, 2017). In light of the pandemic, student recruitment and retention has become even more crucial in ensuring the traditional university model remains sustainable long-term and to compete as a university, it is essential that student satisfaction rates remain high. The lessons learned by institutions and student experiences of remote delivery during the pandemic will shape students' future expectations of learning, teaching and assessments, emphasising the need for universities to focus on their unique selling points in a competitive market.

The pandemic has posed significant challenges in the day-to-day activities of education. The immediate impact has been lockdowns over the last year and the enforced closure of schools, colleges and universities (Watermeyer et al., 2020). However, this has not led to a cessation of learning, teaching and assessment; instead, online contingency plans were designed to continue teaching and assessment *via* a digital interface so students can progress with their studies (Rapanta et al., 2020). The emergency response from educational institutions during crises (e.g., pandemics or conflict) to shift teaching and assessments online is known as Emergency Remote Education (ERE) (Shin and Hickey, 2020). ERE can involve adapting content which would have traditionally been taught face-to-face as blended learning or as fully distanced learning (Shin and Hickey, 2020).

Many universities had already adopted practices to make their education delivery flexible and accessible to meet student needs. Whilst blended learning involves some aspects of course delivery online, other approaches include the hybrid model which is a combination of online course delivery with face to face sessions; however, all students need to attend both modalities (Meydanlioglu and Arıkan, 2014). The Hyflex model also combines face-to-face and online learning. However, each session and learning activity is offered in person, synchronously online, and asynchronously online giving students the freedom to decide how to participate (Beatty 2019, p.22). Although, the Hyflex model offers more student choice, it may create more disparity in student experiences, and may disrupt the experience of feeling part of a cohort, e.g., if one student wants to work remotely and the rest of the class select to work on campus.

At Aston University, some elements of blended learning were already adopted prior to the pandemic, for example our students used our Virtual Learning Environment (VLE) *Blackboard* to access learning materials, complete online quizzes and submit coursework. During exam revision sessions, practice multiple choice questions were provided and students used polling

software to submit their answers. Additionally, lecture recordings *via* Panopto have been available online to supplement synchronous lecture delivery and serve as a revision tool for students. Another online resource used to supplement students' understanding of laboratory techniques is the Learning Sciences tool (Learning Sciences, 2018), this provides practical simulations for scientific experiments. During the pandemic, traditional timed examinations in lecture rooms moved to an open-book online format using *Blackboard*. These consisted of multiple-choice/short answer questions, or essay-based examinations which were originally fixed-time for 1–2 h but became open book assessments, each held over a 12 h period.

This is the first global pandemic in recent times, disrupting higher education institutes (HEI) and the experience has certainly been challenging for both academics and students. It is essential to learn about student experiences during this period in order to be better prepared for subsequent disruptions to HEI and to understand how COVID-19 has shaped our students, particularly as research has shown the substantial impact on mental health and wellbeing across the general population (White and Van Der Boor, 2020).

This pedagogical study aims to explore the experience of Biosciences students studying during the first United Kingdom lockdown, including access to resources, barriers to effective studying, anxiety, healthcare and quality of life and to what extent they reflect the socioeconomic background of our students. This study has used the Index of Multiple Deprivation (IMD) defined as deprivation in terms of a range of living conditions. It is calculated by combining information on income; employment; education; skills and training; health and disability; crime; barriers to housing services; and living environment. This produces an overall relative measure of deprivation, from quintiles 1–5 (least to most deprived).

Moving forward, we need to ensure higher education delivery is well-equipped to transition to changing circumstances and future restrictions to students accessing the university campus. It is crucial to understand any barriers students have faced during this period so HEI are more inclusive and can meet student needs. Most institutions shifted all teaching online in response to the pandemic, therefore, implementing the most appropriate teaching model (all on campus, hybrid, or hyflex, all distance learning) is essential not only to inform future teaching practice but also to ensure universities retain student numbers and remain financially sustainable in a competitive market.

## MATERIALS AND METHODS

Student experiences of their online courses and associated lifestyles before lockdown and during the first United Kingdom lockdown (March 23, 2020–June 15, 2020) were collected. The study was conducted via a 40 item questionnaire, which included demographic questions, in addition to questions about university online assessments, access to healthcare and physical/mental wellbeing. Answers included Likert scales and free text options. The survey used

**TABLE 1** | Student demographic data including course of study, year of study, student status and employment status.

Year of study	Percentage	Number
First year	33	50
Second year	23	34
Placement year	15	23
Final year	29	44
Course of study		
Biomedical Science	63	95
Biological Science	26	39
Biochemistry	7	10
Life Sciences Foundations	4	7
Student Status		
Home	94	142
EU	2	3
Overseas	4	6
Employment status prior to United Kingdom lockdown		
Employed	45	68
Unemployed	55	83
during the United Kingdom lockdown		
Continued to work and received usual salary	15	22
Remained employed but received reduced salary	21	31
Became unemployed losing main source of income during lockdown	11	17
Remained unemployed	53	81

**TABLE 2** | Information on number of students by IMD quintile.

Information on students	IMD quintile					Total
	1	2	3	4	5	
Number (%) of students	11 (8.1%)	14 (10.4%)	25 (18.5%)	31 (23%)	54 (40%)	135 (100%)
Number with caring responsibilities	0	0	1	1	8	10
Number struggling financially to pay bills	1	0	2	3	5	11

**TABLE 3** | COVID-19 symptoms in students and in family members.

Experience with COVID-19	Number of students (%)	Number of family members (%)
Students who did not experience COVID-19 symptoms	128 (84.8%)	
Symptoms in students confirmed by positive COVID-19 test	3 (2.0%)	
Symptoms in students but no confirmation via test	20 (13.2%)	
Family member displayed symptoms confirmed by positive COVID-19 test		15 (9.9%)

**TABLE 4** | Challenges faced by students during examination period by IMD quintiles.

Challenge faced completing online assessments	IMD quintile 1–3	IMD quintile 4–5	Total (%) from 151 responses
Poor working conditions/environment	12 (26.6%)	33 (73.3%)	45 (29.8%)
Slow laptop	3 (21.4%)	11 (79%)	14 (9.27%)
Poor internet connectivity	4 (19%)	17 (81%)	21 (13.9%)
Intermittent access to a laptop	2 (18.1%)	9 (82.9%)	11 (7.3%)
Uncomfortable seeing self on camera	22 (31.9%)	47 (68.1%)	69 (46%)

**TABLE 5 |** Of those reporting social media use, breakdown of additional hours spent on social media during the lockdown.

Number of additional hours	Number of respondents in IMD 1–3	Number of respondents in IMD 4–5
0	0	1
0.5	1	0
1–2	14	25
3–4	18	16
5–6	5	8
7–8	0	11
9–10	0	1
12	0	1
<b>Total</b>	38	63

the Bristol Online Survey (BOS) platform (Jisc, Bristol, United Kingdom). Participation was anonymous and voluntary. The study was approved by the Aston University Research Ethics Committee (UREC, ethics number 1673).

The survey was available for 3 weeks during 1st - August 30, 2020. The link to the survey was circulated to all students via email, weekly reminders were sent out by the programme administrator. The postcode data was analysed in terms of the Teaching Excellence and Student Outcomes Framework (TEF) metrics; Participation of Local Areas (POLAR) and Indices of Multiple Deprivation (IMD). Where appropriate, we used the IMD measures determined from student household postcodes in the analysis of responses. We used the National Perinatal Epidemiology Unit IMD Postcode tool to determine the IMD scores and quintiles.

To account for participant attrition, the number of respondents that completed the question has been specified. We have included the raw data as the study population is small, so there is not always statistical significance. Fisher's exact test was used to determine whether there were statistically significant differences between the expected frequencies and the observed frequencies in one or more categories of questionnaire responses in contingency tables.

The free text responses were analysed using Thematic Analysis (Braun and Clarke, 2006). The procedure was as follows: the researchers read the data multiple times for familiarity and generated initial codes; the codes were then collated to form initial themes; the themes were then reviewed against the data set for plausibility; and finally, the themes were refined. This process was repeated by multiple members of the research team

individually for triangulation and then agreed collectively to produce the final analysis.

## RESULTS

### Demographics of the Student Population

We were especially interested in how students from more deprived backgrounds fared during the pandemic, so the survey included questions on demographics. Aston University is a mid-entry qualification, vocationally orientated institution located in Birmingham, United Kingdom. The survey was released over the summer break and students were invited to complete the survey, no incentives were offered, the final year students had already graduated. A total of 151 Biosciences students completed the survey and a breakdown of course, year, fee status, employment prior to the lockdown and employment during the lockdown is shown. The response rate was 21%; considered to be a reasonable return under the circumstances (Table 1).

A total of 135 students completed the question related to their postcodes and data revealed that 8.1% of students lived in quintile 1 (least deprived; see above for explanation of quintiles), 10.4% in quintile 2, 18.5% in quintile 3, 23% in quintile 4 and 40% in quintile 5. Postcodes for 16 students could not be matched (Table 2). Eleven students had caring responsibilities; 8 of these students were from IMD quintile 5 and 1 student each from IMD quintiles 3 and 4. For the analysis of the survey results quintiles 4 and 5 were compared to quintiles 1–3. 44% of students were employed prior to the lockdown and 7% struggled financially. Of the 11 students who struggled to pay their outgoing bills, 8 were from quintiles 4 and 5.

84.8% of students did not experience COVID-19 symptoms. 2% of students reported experiencing symptoms and were confirmed COVID-19 positive by a test. During this period there was limited access to testing facilities nationally. 13.2% of students displayed symptoms but did not confirm via a test. 9.9% of students had family members displaying symptoms and were confirmed COVID-19 positive by a test (Table 3).

### Home Working and Online Learning and Assessment Work Well for Most Students

Knowing how well students can work remotely is key in choosing an appropriate style of delivery, so data was

**TABLE 6 |** Reported feeling about health before and during lockdown by IMD quintiles plus *p* values.

Feeling about health	IMD quintiles 1–3		IMD quintiles 4–5		<i>p</i> Value
	Pre- lockdown	During lockdown	Pre- lockdown	During lockdown	
Very dissatisfied	0	0	0	6	>0.9999
Dissatisfied	2	6	6	17	>0.9999
Neither satisfied nor dissatisfied	8	8	19	19	>0.9999
Satisfied	23	21	51	38	0.7109
Very satisfied	12	10	16	12	>0.9999

**TABLE 7 |** Stress experienced by students.

Type of stress	Pre-lockdown % of students	During lockdown % of students
Inability to concentrate	32.4	71.4
Poor sleep	22.2	44.6

collected on students' experience of online working. 71% of respondents reported they had a quiet place to study during lockdown; the remaining students struggled to obtain a quiet place to study. 33% of students faced issues with their working environment being too noisy, too dark, poorly lit and/or subject to temperature fluctuations. Further analysis, grouping individuals based on their postcode IMD quintiles, showed 8/46 students who lacked a place to study lived in areas that were classified as quintiles 1–3 and 29/89 such students lived in areas that were classified as quintiles 4–5. The differences observed by IMD quintiles were not significant ( $p = 0.0692$ ). 61% of students were able to study uninterrupted during the examination period.

60% of Biosciences students reported they did not face issues completing their online assessments. Overall, 83% of students reported having good internet connection on their laptop/PC. Poor internet connection was not significantly linked to IMD quintile ( $p = 0.1396$ ). Of those that struggled, reasons included issues with internet connectivity (15%), issues with IT equipment e.g., laptop being too slow (11%) and a high proportion of students from IMD quintiles 4 and 5 reported technical issues during the examination period. **Table 4** shows a breakdown of the issues faced by struggling students and is split by IMD quintiles. 53% (80/151) of students reported they felt uncomfortable interacting in university online learning sessions which require them to turn their video cameras on, we note that 69/151 (46%) students could be matched by IMD quintile and 31.9% belonged to IMD quintiles 1–3 and 68.1% belonged to IMD quintiles 4–5. 11 of these students, did not complete the postcode data so we were unable to determine the IMD quintiles for these participants.

Despite challenges faced by some students completing online assessments, 91% either “agreed” or “strongly

**TABLE 8 |** Reported negative feelings before and during lockdown by IMD quintiles plus  $p$  values.

Negative feelings	IMD quintiles 1–3		IMD quintiles 4–5		$p$ Value
	Pre lockdown	During lockdown	Pre lockdown	During lockdown	
Never	2	2	15	9	>0.9999
Seldom	25	13	45	24	>0.9999
Quite often	11	16	17	27	>0.9999
Very often	6	14	12	19	0.5645
Always	1	2	3	13	0.4052

**TABLE 9 |** Reported feelings regarding access to healthcare before and during the lockdown by IMD quintiles plus  $p$  values.

Feelings regarding access to healthcare	IMD quintiles 1–3		IMD quintiles 4–5		$p$ Value
	Pre lockdown	During lockdown	Pre lockdown	During lockdown	
Very dissatisfied	0	1	0	4	>0.9999
Dissatisfied	2	4	5	22	0.5843
Neither satisfied nor dissatisfied	7	11	19	26	>0.9999
Satisfied	27	21	41	21	0.3263
Very satisfied	9	8	27	19	0.7772

**TABLE 10 |** Number of weekdays students exercised at least 10 min a day by IMD quintiles plus  $p$  values.

Number of days	IMD quintiles 1–3		IMD quintiles 4–5		$p$ Value
	Pre lock down	During lock down	Pre lock down	During lock down	
0	6	3	15	16	0.4570
1	2	4	6	4	0.6084
2	4	4	11	8	>0.9999
3	7	4	14	12	0.7228
4	6	2	6	7	0.3666
5	3	9	16	11	0.0824
6	2	5	0	6	0.4615
7	3	4	2	5	>0.9999

agreed” that online open book assessments were an appropriate way of assessing modules during the lockdown. 85% of students would like to see more online open book assessments in the future.

## Social Media, Quality of Life and Exercise

We wanted to understand more about quality of life under lockdown so we could address issues that students were likely to bring back with them to campus. 93% of students reported an increase in their use of social media during lockdown compared to pre-lockdown. **Table 5** shows the increased time ranged from 30 min to 12 h per day.

The survey revealed that student quality of life expressed as “feelings of health” decreased during the lockdown. Pre-lockdown 74% of students were either “satisfied” or “very satisfied” with their feelings of health compared to only 59% during the lockdown ( $p = 0.0101$ ). 6% of students selected the “very dissatisfied” or “dissatisfied” categories before lockdown however, 21% of students selected these categories during the lockdown ( $p = 0.003$ ). **Table 6** lists the responses on feelings of health grouped by student IMD quintiles. There were no statistically significant differences across the responses based on IMD quintiles ( $p > 0.05$ ).

The level of stress students experienced as a result of the lockdown was evident. 32% of students reported they had trouble concentrating pre-lockdown compared with 71% during the lockdown (**Table 7**).

We analysed the frequency of negative feelings such as blue mood, despair, anxiety and depression before and during lockdown. The responses showed a significant increase in frequency of negative feelings expressed as “quite often”, “very often” or “always” from 40% pre-lockdown to 65% during lockdown ( $p < 0.0001$ ). To further explore this, **Table 8** reports the effect of negative feelings based on the IMD quintiles the students belong to. There were no statistically significant differences across the responses based on IMD quintile ( $p > 0.05$ ).

Pre-lockdown only 5% of students reported being “dissatisfied with access to healthcare compared to 23% during the lockdown. The responses observed pre- and during lockdown were statistically significantly different ( $p < 0.0001$ ). To further explore this, **Table 9** reports the feelings regarding access to healthcare based on the IMD quintiles the students belong to. There were no statistically significant differences across the responses based on IMD quintile ( $p > 0.05$ ). For both **Tables 8, 9** the other 14 students could not be categorised into an IMD quintile as they did not provide this information.

79% of students responded to the exercise duration questions; we note that the pre lockdown total is 103 and the during lockdown total is 104: this is because one student failed to answer the pre lockdown question but answered the during lockdown part of the question. Responses showed that lockdown did not significantly alter the mean number of students exercising for at least 10 min per day. However, there was an increase in the number of days per week that students exercised for at least 10 min per day. During lockdown, there was

a significant decrease in the number of students exercising for 1, 2, 3 or 4 days per week (56 pre-lockdown and 45 during lockdown) and a corresponding increase in those exercising for 5, 6 or 7 days (26 pre-lockdown and 50 during lockdown),  $p = 0.0061$ . To explore the effect of exercise pre and during lockdown, the responses were split by student IMD quintile and **Table 10** shows that there were no statistically significant differences across the responses based on IMD quintile ( $p > 0.05$ ).

## Free-Text Responses; Thematic Analysis

A thematic analysis was conducted of the responses to the questions: *what would have helped students to better complete online assessments? is there anything we could do to improve online provision of learning and teaching?* In total, 40% ( $n = 61$ ) students chose to answer the free-text question. The three main themes were as follows; (1) Pre-exam support and preparation; (2) Concerns about online exam duration; (3) Student discomfort being seen on camera and (4) Home working environment.

### Theme 1: Pre-exam Support and Preparation

Fourteen students reported they would have liked more pre-exam support, some specified they wanted extra resources on this examination method. The majority of responses indicated it was the unfamiliarity of open book examinations which concerned students; some reported they were anxious about sitting an open book exam for the first time and others reported they would have liked mock examinations. Interestingly, some students were concerned whether these assessments would require more effort and revision to do well.

“Some more guidance and support on how to revise for an open book exam. I found it challenging to essentially relearn a new method of revising 2 months before exams, which added another element of pressure to final year exams.”

“...how it differs from the usual one we would’ve sat. i.e., is more expected from us? More extra reading?”

The extracts above indicate the novelty of an open book examination posed many questions for students who already felt nervous about sitting an exam. Some students made suggestions for things they would have found useful.

“Provided timed practise examination sessions.”

“More zooms sessions would have helped”

In summary, students were given online revision sessions prior to the exam, these included a recap of the material, opportunities to answer interactive polling question based on the material, composing answers to mock exam questions, data analysis practice and opportunities to ask questions across modules, some students expressed an interest in receiving additional support.

## Theme 2: Concerns About Online Exam Duration and Submission

The analysis revealed students wanted a 24 h duration for the open book assessments instead of the 12 h provided by the Biosciences department. The reasons provided for this varied from fears about losing internet access, difficulties typing quickly compared to writing by hand and comparing their exam duration to other courses who had longer. Sixteen respondents voiced similar experiences to the extracts below.

“12 h timer was quite stressful, I am aware other department students were given 24 h. As this did not account for any lunch breaks/caring responsibilities.”

Three students specifically highlighted technical issues with submitting their online exam.

“The submission portal for one of my online exams would not work which meant I could not submit my work in time. I emailed my lecturer and the issue was resolved ... this was a very stressful experience given it concerned exams”

Some students noted the exam date itself was problematic as it was either too close to other examinations or conflicted with Ramadan, a period where Muslim students fasted and were waking up around 2am and abstaining from food and water for around 18 h a day, thus disrupting their sleep and nutritional intake during the examination hours.

“However, we should have been given a whole day to complete online exams rather than 12 h which was difficult for those fasting through Ramadan, as well as slow laptops/internet connections”.

The university guidance was that module leaders should choose a timeframe for the exams that was appropriate for their subject area. There was not a university standard allotted time.

## Theme 3: “Student Discomfort Being Seen on Camera”

Some students were uncomfortable being on camera and felt self-conscious, expressing a preference to remain unseen.

“Not ask us to turn on the camera”

Some students wanted more interactive lectures and sought the opportunity to be involved. However, they also did not want to have their camera on.

“I would like if the lecturers were more interactive and didn't require us to have to turn our cameras on while doing that”

For students who reported they previously struggled to learn in person due to peer disruption, there were some benefits to moving the learning environment online despite their reluctance to turn their cameras on.

“I hate turning my camera on, but I think I was more involved in uni when it all moved online than I ever have been in person, I wasn't trying to hear over people chatting next to me and I could ask questions as I felt like it in the comments box”.

## Theme 4: Home Working Environment

For some students, their home was not the best environment to facilitate their studying for many reasons, such as it being a social space for their household or because their family members interrupted them whilst they studied. They wanted a dedicated space to study which would have helped their motivation. For these students the on-campus learning environment was important and they would have preferred to sit their exams in a traditional examination hall.

“Being able to leave the house and study in a place where there was no fun. It's difficult to stay motivated to work/study when others around you are enjoying themselves”

“Members of family often interrupted”

“There wasn't much that could have been done. Perhaps with further planning, students could book private rooms in the library or something alike to complete the alternative assessments”

A few students said their homes were unsuitable spaces to study/undertake examinations, therefore the physical environment is crucial for these students, particularly those from low-income households who do not have good quality laptops, fast internet connection or basic items such as a desk to study at.

“I come from a low-income household so I didn't have a comfortable desk and chair to sit at to complete my online assessments”

“A better quality laptop, a desk to study on”.

## DISCUSSION

The current study has explored the impact of the COVID-19 pandemic on the educational and personal experiences of United Kingdom-based Biosciences undergraduate students during the first United Kingdom lockdown. The results have revealed differences between the student experiences before and during the lockdown. This includes the delivery of the course, their health and quality of life. This study was designed to address the paucity of research with bioscience undergraduates so we could tailor our course delivery and provision to enhance

future student experiences and maintain high student satisfaction scores.

## Impact of Covid-19 on Students' Physical/Mental Wellbeing and Access to Healthcare

Physical activity has been found to reduce levels of anxiety in people with mild symptoms and may also be helpful for treating clinical anxiety. Exercise is listed as an empowering approach that can support self-management of mental health (Conn, 2010; Asmundson et al., 2013). Our results show that during the lockdown the number of days per week students exercised increased. During the lockdown, there was also an increase of nearly 20% in students who reported experiencing blue mood, despair, anxiety and depression during this period and a 39% increase in students who reported their concentration levels decreased. Contrary to the expectations derived from the literature on exercise and mental health, the increase in exercise observed during the lockdown did not prevent participants from suffering low mood, highlighting that mental health is complex and likely to be multifactorial. The national lockdown undoubtedly led to social isolation, perhaps worsened for those already living alone or shielding. National data showed that the number of payroll employees fell by 649,000, during the first lockdown (Office for National Statistics, 2020a), although this only affected a small proportion of our student respondents (11%), the survey did not account for parental or household income and 61% of survey respondents lived with their parents/relatives who may have been affected financially. Therefore, it is likely that a combination of factors led to worsening mental health. Delivering a hybrid course could benefit isolated students by providing access to on-campus facilities such as gyms and sports society events whilst they are attending the face-to-face elements of their course. The hyflex model, in contrast, would give students the choice to continue to work remotely as distance learners, which for some students would be a continuation of their isolation.

Our results show that there was a significant increase in the number of students who reported being “dissatisfied” with access to healthcare during the lockdown compared to pre-lockdown. This finding is consistent with recent research which showed inequalities in healthcare access increased across the United Kingdom—especially amongst women, those with a pre-existing condition and ethnic minorities. Young people experienced appointment cancellations and increased care needs during the lockdown which Topriceanu et al. (2020) attributed to the impact of the lockdown on education, housing, relationships, employment and finances. Furthermore, difficulties in accessing mental health services during the lockdown were reported in the Community Mental Health Survey, including support and wellbeing, crisis care and access to care (Clinical Care Commission, 2020). Pre-lockdown, these services were already stretched and under pressure (The Kings Fund, 2015). More recently, 43% of psychiatrists reported an increase in urgent and emergency cases following the lockdown, especially crisis care services, as a result of the pandemic (Royal College of Psychiatrists, 2020). Whilst delivering a hybrid or hyflex approach, institutional delivery strategies need to include

improving staff training in supporting students experiencing mental health difficulties. Signposting to mental health support should be easily accessible e.g., through department/module intranet pages. Students should also be offered training in supporting their peers in a safe way.

## Social Media Usage

The increased time students spent on social media may have impacted mental health during the lockdown, 93% of students reported an increase during this period, which ranged from 30 min to 12 h, and in addition, there was a 15% increase in students who reported poorer sleep during this period. Research has demonstrated time spent on portable electronic devices, especially in the evening, has been linked with both shortened sleep duration and poorer sleep quality (Carter et al., 2016; Twenge, et al., 2019a; Twenge et al., 2019b). Prior to the pandemic, a review found a weighted mean prevalence for insomnia of 18.5% among university students, compared to 7.4% in the general population (Jiang et al., 2015). Global trends during the pandemic show that the Covid-19 lockdown has been linked to poor sleep quality in China (Xiao et al., 2020) and Italy (Casagrande et al., 2020). Stress is an important factor associated with poor sleep quality and disrupted sleep (Sanford et al., 2014). A recent United Kingdom study, reported that those who were shielding during the COVID-19 lockdown were experiencing poorer sleep quality; these individuals also reported higher levels of negative mood (Ingram et al., 2020).

Some studies reported that individuals who spend more time on social media and less time interacting in person, report lower well-being and are more likely to be depressed (Lin et al., 2016; Shakya and Christakis, 2017). These findings are reflective of United Kingdom national trends which showed an increase in internet usage during the lockdown period, for example, in April 2020, 18–24 year-olds increased their time spent online by an hour. Due to social distancing restrictions people used online services to communicate and the use of video calling also dramatically increased during the lockdown. Reports show 35% of adults used video calling at least weekly in the 12 months prior to February 2020, however, in May 2020 this had doubled to 71% weekly and 38% video calling at least daily (Ofcom, 2020). Given that social media usage increased during the lockdown period, there is clear scope for universities to effectively utilise the increased use of social media to promote communication and dialogue with students via the University social media accounts. For example, a number of online exercise classes/videos to promote better health were released by professionals e.g., Joe Wicks and Bhangracise (Malcolm and Velija, 2020; Points of Light, 2020). Universities could embrace promoting wellbeing (including importance of sleep and exercise) by distributing these videos more widely through university social media platforms to increase student and staff participation. A rapid grasp of the latest social media trends could be useful in aiding universities to market their courses, strengthen their own brand identity online and attract future students. Importantly, the data suggests we should also be ameliorating harm caused by extended screen time and social media. There should be balanced campaigns aimed at both staff and students promoting



individuals to switch off their phones when talking to others or turn it off an hour before bedtime to avoid ruminating on it, in addition to raising awareness of how social media could lead to body dysphoria.

## Lessons Learned From Online Teaching and Learning: Adopting Hybrid or Hyflex Delivery?

HEI have been severely impacted by the pandemic; a major challenge universities have been faced with has been managing the transition from face-to-face to remote learning, without diluting the student experience. We recognised there was a rapid shift to move undergraduate learning and teaching online due to the pandemic and we were keen to ascertain from students how we could improve their experience. We explicitly asked students for ways to improve the provision of online learning and teaching, and what would have helped them to better complete online assessments *via* free-text questions.

During the first lockdown, the majority of the core teaching within Biosciences had already taken place. Synchronous, revision sessions in preparation for the online exams were held on Zoom, Microsoft Teams and Blackboard collaborate. In preparation for the live sessions, students were asked to listen back to the lecture recordings on Panopto. Some modules also provided “chunked-lectures” of digestible material, interwoven with short tasks, i.e., watching a video, reading a paper, examining clinical cases. During the synchronous revision sessions, quizzes and polls were included to encourage student participation. Assessments were open book and designed to be completed within their original duration of 1–2 h. However, students had 12 h to submit assessments to account for the shift to working from home. It is likely many students used the full 12 h window to complete their assignment as students expressed they would have preferred a 24 h assessment window to further address issues of caring responsibilities, internet access and religious observances such as Ramadan. To reduce student anxiety mock online examinations could have been made available, along with explicit advice on how to prepare for open book exams.

Bioscience students performed well in the final year online exams during the first lockdown, achieving on average a 5% improvement in module exam scores compared to the previous academic year. The proportion of students scoring less than 50% declined from 16 to 11%, suggesting that the benefits extend to lower attaining students. The proportion of students earning good degrees (2.1 or 1st) increased by 7%. Bioscience students also experienced the assessment positively in their reflections. Although the distribution improved with the online format, individual students may still not have been achieving their full potential. We do not know whether IMD quintile was associated with belonging to a tail in exam performance prior to the pandemic. Our university currently provides module leaders information regarding academic performance in terms of gender, ethnicity, disability, proportion of mature students, and entry qualifications, but it does not include IMD quintiles

in the analysis. In the future where there is likely to be a mix of on-campus and remote exams, it may be possible to identify specific students who perform better on remote exams by IMD quintile.

60% of our students reported they did not face any technical issues and 91% agreed that online open book assessments were an appropriate way of assessing modules during the COVID-19 lockdown. Most importantly, 85% of students would like to see more online open book assessments in the future—positive findings which universities could take forward for planning future exams. Brightwell et al. (2004) also found no significant differences in student results between a multiple choice and open book test on campus; they drew on previous research which showed students often do not prepare sufficiently for open book examinations and report feeling a reduction in anxiety in their preparation and completion of such assessments. Therefore, some students may perceive the open book examination to be easier, or as seen in the current study, query the amount of revision/studying they will need to undertake in order to achieve their desired grades. Additionally, adopting the hybrid or hyflex approach could allow universities to host more examinations online, which could address the issue of limited examinations halls for increasing student numbers and allow for more authentic assessments.

The observed student satisfaction with online assessments may stem from both students scoring well and good teaching practice inculcated into degree programmes from previous years, instilling independence into students and teaching them to engage using online tools. Arguably, the students were, to a certain extent, familiar with contingency plans put into place to tackle remote learning. This preference for online learning has been conditioned with effective use of VLE tools (e.g. Panopto, learning sciences and LaunchPad). Previously small-scale teaching practices involving online teaching tools such Kahoot, Vevox, screencasting software and illustrative teaching were widely adopted across modules.

Interestingly, although students wanted more interactive lectures, more than half did not want to turn their video cameras on. Previous research has identified a number of issues with mobile video calling including; feeling obliged to leave the room, being mindful of poor lighting, background noise, others intruding on their call, struggling to maintain the privacy of other household members and wanting to control their appearance on camera (Pikoos et al., 2021; O’Hara et al., 2006). For some people, video calling highlighted bodily features they were unhappy with which is known as dysmorphic concern, this was exacerbated for those who fixated on their own face during the call. Additionally, some participants reported adjusting their camera position to achieve a more flattering angle, and nearly a third reported undertaking grooming activities such as hair/makeup prior to a video call (Pikoos et al., 2021). Other United Kingdom research also reported women and young people were increasingly concerned about their appearance during the lockdown (Robertson et al., 2021).

A comparison of the IMD data in the current study identified a subgroup of students from the more deprived quintiles who

reported being less satisfied with their living environment and internet connectivity. This included inadequate working space, e.g., desk, during the revision/examination period which caused them issues. Currently there is no option to change/blur the background on Blackboard Collaborate. Collecting demographic data across the cohort revealed pools of students who struggle academically due to remote working. Shin and Hickey (2020) reported some students were reluctant to turn their cameras/microphones on as their home environments were noisy, whilst others felt academically disadvantaged by unreliable internet connection. Limited access to technology for educational purposes has been documented elsewhere (Reich et al., 2020). Institutions should be recognising and taking the necessary steps to ensure digital equity amongst students and staff; this is crucial for hybrid, hyflex and distance learning (Dhawan, 2020). In the current competitive higher education market where student retention is key, it is important to pay attention to student demographics to ensure a universally appropriate approach is applied to cater for all students across a course. In future, universities could support these students by reducing their levels of digital poverty and consider providing internet access, basic equipment and furniture to aid studying from home to ensure equal learning experiences across the student cohort (Pentaris et al., 2020). In addition to using hardship funds to support students, universities could consider providing free internet access.

Online learning makes higher education more accessible to a wider range of individuals as it creates educational opportunities that are free of time and geographic constraints (Varty, 2016). HESA data shows overall a higher number of females enroll on higher education courses; this trend is also seen in online providers e.g., The Open University, who reported a higher proportion of female to male students ratio in 2019/20 (The Open University, 2021). The accessibility of online courses attracts those who would not be able to participate in traditional learning, for example the Open University reported 26% of their United Kingdom undergraduates lived in a quarter of the most deprived areas (The Open University, 2021). Thus, online courses allow institutions to appeal to and educate a more diverse student population.

Prior to the pandemic, Aston University made all lecture recordings available after the lecture via Panopto; this allowed students to repeat the live lectures at their leisure. However, these recordings were not intended to replace the synchronous (live), on campus lectures and sound quality was occasionally compromised. Contact hours increased after the first lockdown and delivery consisted of asynchronous (pre-recorded) lectures in shorter chunks and synchronous interactive lectures using platforms such as Blackboard Collaborate and Microsoft Teams. The pre-recorded lectures offer better sound quality as the audio is not compromised with the background noise of a full lecture theatre. Lecture recordings give students the flexibility to pause, rewind and digest the material at their own pace; this has been suggested to be helpful for students who are not

native English speakers (Hall and Villareal, 2015; Riffell and Mirell, 2005). These benefits could be used to market biosciences courses to international students who pay higher fees and are a crucial source of revenue for universities. Furthermore, some previous studies suggest that student engagement and information retention declines with the length of the activity, therefore material delivered in shorter chunks maximises attention and retention (Risko et al., 2012; O'Hare et al., 2017). In many modules, the synchronous lectures were used to test understanding of the asynchronous chunked material and provided an opportunity for students to ask questions with a view to promoting deeper learning. The approach taken at Aston University was well received by students who enjoyed learning online; however, a lack of universal satisfaction with their home learning environment suggests that a fully asynchronous delivery would not cater to all students, particularly those experiencing higher deprivation. This also suggests that students who are unable to study at home because the environment is not suitable or due to digital poverty will need a place on campus to work in which laptops and internet access are provided, whether in the library or other student-focused spaces.

In the past, fewer online courses were available for science, technology, engineering, and mathematics (STEM); however, the pandemic led to an increase in online learning. The most common barrier to offering STEM subjects online was the need for laboratory practicals. Due to the lockdown restrictions it was not possible to conduct laboratory sessions, which offer students vital hands-on experience on campus for the biosciences courses and students were signposted to online simulation software which demonstrated basic laboratory techniques. The drawback of this is that students do not get the hands-on exposure they need to acquire the skills they would need for experiments. Post-lockdown, students were offered on-campus laboratory practicals to consolidate their learning and address concerns about limited exposure to the laboratory.

Moving forward, Aston University's educational strategy has highlighted that a hybrid teaching approach will be delivered with dynamic and stimulating learning environments comprising physical and virtual learning spaces that are designed to support diverse learning needs and enable the adoption of flexible pedagogies. The hybrid approach allows universities to develop high-quality and employable biosciences graduates. It is important to include compulsory face-to-face laboratory sessions to ensure graduates are equipped with the core skills required in industry and laboratory settings. Our study results reinforce the need for both online and campus learning for biosciences courses, including laboratory practicals, in addition to face-to-face case discussions based on the online asynchronous taught materials. Our results show that on average students achieved higher grades with online assessments. Although the hyflex model gives students the choice to study the entire course remotely, it

would not provide the required hands-on laboratory experience.

If it is generally true that students perform better on remote assessments, then both hybrid and hyflex models may benefit from remote exams. Both models require a significant investment in staff training to develop online sessions or combined on-campus/online sessions. For both, the curriculum and the technology need to be in alignment. Maintaining asynchronous content in both models, will allow students flexibility in terms of when they study, flexibility that students value. For Bioscience, on campus laboratories are a key component of the curriculum so a strict hyflex model won't work. On the surface, delivering hybrid lectures appears more challenging with a split audience, but lecturers and students are adaptable and the technology in the average lecture theatre may improve.

There are also practical and managerial implications that need to be considered, especially in sessions where class room discussions around case studies are required: it requires a greater level of staffing numbers to effectively deliver teaching to larger cohorts of students given that at least two staff members are required in these sessions; one to respond to students in the class room setting and one to monitor the chat from the remote students: having one academic monitor both is challenging. In light of the existing workload pressures academic staff face due to high student numbers, designing engaging material and increasingly high marking loads, models incorporating remote students into a live on campus session could pose further significant challenges and potential burnout for staff.

The hybrid model provides a balance of core face to face activities such as laboratory practicals and opportunities to attend online teaching sessions. Attending campus activities also allows students to access social, fitness and leisure facilities. In a recent poll at Aston University, 49% of first year undergraduate biosciences students said they would like a blended teaching approach (incorporating both face-to-face and online teaching for content delivery). Furthermore, in the current study, 44% of the first year students reported they worked part-time, and these students may value the flexibility offered by the hybrid delivery of their course. For the benefits of hybrid to be realised, consistent timetabling which meets the needs of students is essential and is often a challenge to universities.

## Limitations

One of the limitations of the current study is that the data collection was conducted over the summer period (August) when the majority of students had already finished the university term and were not engaging with emails. Thus, the survey is a snapshot of responses as students reflect back on the first lockdown period rather than eliciting responses as lockdown progressed. Survey return is difficult in the HE setting, especially as students are encouraged to fill in numerous surveys per module and course and it is not clear if the student sample is biased relative to the whole cohort. Furthermore, in order to grasp a true picture of the impact of

the pandemic on the student experience, this survey was lengthy and included 42 questions; perhaps if the survey was designed with fewer questions and the wording of each question had been streamlined it would have increased the survey return rate.

## Future Work

This study clearly highlights pockets of students that were more negatively affected by the move to remote online learning and teaching. A more detailed study is required into the effects of remote learning and digital poverty. Universities should aim to bring in initiatives to address these issues and the success of any initiatives should be monitored and evaluated. More generally, initiatives to improve mental health across the student cohort need to be evaluated. Online live teaching does not suit all staff or students, in order to give students more control as to who sees them, experiments with avatars and game set-ups such as Topia might allow for more natural interactions and should be explored."

## CONCLUSION

In summary, we are committed to improving the experiences of individual students at our university and feel pleased to report that the trends we observed were not IMD specific (Tables 8–10). The key messages from our study are trends that we have observed across the student population irrespective of IMD. The IMD quintile is just one way of characterizing student's backgrounds and it does not necessarily mean that students from lower quintiles report poorer experiences.

In light of the unique needs of biosciences students to receive hands-on laboratory experience and the positive views of students in the current study towards online assessment, we would suggest a hybrid approach would be beneficial for biosciences courses to adopt in future. It is important that HEIs closely examine their student demographics; whereas a hyflex approach may initially seem attractive, as it would offer students the choice to undertake their studies in a fully distanced mode if they wished, our data clearly demonstrates that students benefit from the university on-campus environment which facilitates their motivation to study and can overcome the challenges of learning from home. Moreover, in uncertain economic times, resourcing a hyflex model would be challenging for many HEI. Existing research demonstrates that preparing content for online teaching was more time consuming than teaching face to face (Cavanaugh, 2005). Furthermore, attention must be paid to the technological burden of maintaining devices and equipment, and ensuring the appropriate online tools and platforms are available to facilitate student interaction and engagement (Dhawan, 2020).

The pandemic has highlighted the adaptability of both academics and students in the higher education setting to continue with online learning and assessment, but also an increased need to be mindful of digital poverty and issues

affecting student wellbeing. The pandemic has prepared students to work remotely, which is a crucial aspect of delivering a successful hybrid model and reflects the global adaptations made by many organisations to adapt to evolving laws, restrictions and guidance. There are clear advantages to online learning, and opportunities for universities to benefit from increased social media usage. However, our study has identified a clear challenge associated with online learning: ensuring our students are comfortable interacting and engaging online. Universities may see video cameras as a way to replicate the classroom interactions online, but educators should be aware of students' preferences regarding camera use. Education providers need to embrace the lessons learned from online teaching and create opportunities for a hybrid teaching, learning and assessment approach.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Aston University Research Ethics Committee (UREC, ethics number 1673). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

This study was lead, designed, analysed and written by AB, SB contributed towards questionnaire design, thematic analysis and writing of the manuscript. PL played a major role in analysing the results and presenting them appropriately. KR contributed towards analysis of results. AV had input in the analysis of the results and write-up of the manuscript.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2021.711619/full#supplementary-material>

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