

Article

“A World of Possibilities”: The Future of Technology in Higher Education, Insights from the COVID-19 Experience

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Abstract: During the emergency online pivot, two faculties (i.e., divisions) of a large Irish university aimed to document insights about teaching and learning in the context of the COVID-19 pandemic. An anonymous online survey of all teaching staff within each faculty was undertaken, some of the results of which are presented here. Key findings focus on the use of online technology in higher education, demonstrating the differential impacts on different disciplines and year groups, and pointing to levels of educator readiness and the need for focused professional development and training to prepare staff for integrating online learning to ensure satisfactory outcomes. The emergency online pivot led to significant progress in the use of technology in higher education, and greater academic staff recognition of the benefits and scope afforded by technology. Arising from their COVID-19 experiences, staff expressed a strong preference for blended learning as opposed to learning taking place either fully online or in-person. The potential role of hybrid learning in ongoing efforts towards sustainability was also noted. Many of our findings align with recent research, which is discussed throughout. We argue that a ‘one size fits all’ approach to online education is not appropriate, with greater nuance required and consideration of the rapidly changing educational landscape and issues of environmental sustainability.



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1. Introduction

The wholesale transition to online teaching and learning in the context of the COVID-19 pandemic has accelerated the adoption of technology in education at a rate and at a scale that was unimaginable before the pandemic [1]. Many higher education teachers identified gaps in their technological knowledge and skills as significant barriers to online teaching and technology. At the point of transition to what has been termed ‘emergency remote teaching’ (ERT), educators’ lack of preparedness was compounded by limited opportunities for professional learning [2]. This article draws on a survey of the experiences of 200 academic staff working in a large Irish university. Teaching staff were invited to reflect on, document and evaluate their experience of teaching online during the COVID-19 pandemic. Notwithstanding the challenges and unique circumstances of the pandemic, documenting and reflecting on the experiences and insights of faculty of the progress made at that time is important. This can support educators in envisioning how the benefits and positive elements of this experience might be harnessed to enhance future teaching and learning and contribute to the much-anticipated post-pandemic transformation of higher education [2,3]. As such, this paper responds to calls for “further research and

Scholarship to inform and strengthen future practices based on what has worked and what has not worked during this exceptional time” [4] (p. 138).

Drawing on extensive quantitative and qualitative data gathered in a survey of 200 higher education teachers from two faculties (i.e., divisions—a faculty of humanities and a faculty of education) in one Irish university, this article offers rich insights into higher education teachers' experiences of online teaching and learning in the eighteen months following the pivot to online teaching in the spring of 2020. In particular, the data gathered sheds light on a number of key themes in relation to the role of technology in online teaching and learning in higher education, namely: the level of experience staff had of online teaching and learning prior to the pandemic; the diversity of their experiences and the potential impact of factors such as the academic level, year of study and discipline or field of study; the importance of professional development and the need for training for online teaching and learning; the preference for blended learning as opposed to learning taking place fully online or in-person; and, finally, the role of hybrid learning in ongoing efforts towards sustainability.

The main aim of the study was to document insights about teaching and learning in the context of the COVID-19 pandemic. Following a brief consideration of relevant themes in the literature review that follows, we outline the methodology, present and discuss key findings as they relate to each theme, and consider the limitations of the study. Our key research question for the purposes of this article was to ask what lessons can be drawn from the experiences of emergency online teaching, as revealed in our survey, to inform debates about the future of technology in higher education. The article concludes by demonstrating the value of harnessing insights and learning from the pandemic experience, highlighting key implications which can inform international debate challenging existing higher education structures and practices relating to online teaching and learning.

2. Literature Review

Recent bibliometric analyses (see for example [5–7]) confirm the very large number of studies published on diverse aspects of online teaching and learning in higher education during the pandemic with Fauzi [5] having identified 1496 studies published in the period 2020/21 alone. While medical and/or surgical education and student mental health emerged as significant subthemes, it is notable that the broad construct of online teaching and learning is prominent, reflecting the strong pedagogical focus of much of the research. Studies have reported on the barriers and challenges encountered and on the pedagogical approaches and technologies adopted to mitigate these, and have called for investment in professional development in online pedagogies for academic staff and indeed students [2,8,9]. The need for professional development that not only builds educators' capacity for online teaching and learning but also challenges their pedagogical beliefs and assumptions has been highlighted since “educators' values, mindsets and underlying educational philosophies are key to unlocking the transformative potential of new online learning models” [10] (p. 133). Recent publications [11] have begun to focus more explicitly on implications for higher education pedagogy beyond the pandemic and there is an emerging focus on how some of the insights gathered and the challenges encountered might be addressed to support more equitable and sustainable online and hybrid teaching and learning in the longer term.

2.1. Variability in Preparedness for Emergency Remote Teaching

Many studies have reported on the online teaching and learning experiences during the pandemic of both higher education *students* (for example [12,13]) and higher education *teachers* (for example [11,14,15]). It is clear from the research that in early 2020 when higher education institutions began to transition to ERT, there was huge variability in terms of lecturer, student and institutional readiness for wholly online teaching and learning. Academic staff [7] and students [16] alike came to online teaching with very different levels of prior experience of teaching online and with different levels of confidence and competence in the use of educational technology together experiencing “a collective crash course in distance education” [7] (p. 94). Moreover, some studies have also demonstrated

that unsurprisingly academic staff who had not previously taught online also experienced additional stress [7]. Noting the very high levels of variability in reported experiences, Marek et al. [17] (p. 104) conclude that this “signals the considerably different levels of readiness to transition to distance learning of schools and faculty around the world, and the resulting widely varying contexts for distance learning”. The variability in readiness for online teaching and learning was compounded by and arguably ultimately exacerbated existing challenges relating to the digital divide, equality of access to technology and socio-economic and educational inequalities [7,18].

Key factors which have been identified in previous research as significant in determining educator readiness for online teaching and learning include prior experience of teaching online, academic discipline, institutional context support and culture, and gender [19]. In their study exploring the readiness of higher education teachers for online teaching and learning, Scherer et al. [19] investigated the impact of these variables in the first months of the pandemic at the time of the emergency transition to online teaching and learning. Recognising the heterogeneity of higher education teachers, Scherer et al. [19] argue that the factors determining readiness to teach online are multifaceted and interact in highly complex ways. There is a strong body of evidence that having previous experience of teaching online was strongly predictive of having a more positive experience of the ERT. Educators with prior experience of teaching online tended to demonstrate higher confidence, motivation and self-efficacy for teaching online in contrast to those with less experience. High levels of institutional support for online teaching and learning were supportive of greater educator readiness for quality online teaching and learning.

2.2. *Impact of Year, Level of Study and Discipline on Experiences of Emergency Remote Teaching*

Notwithstanding the large volume of research on teaching and learning during the pandemic, in the main we found very few studies which have considered the impact of variables related to either the year or the level of academic study (under- or post-graduate) or the nature of the discipline on teaching experiences. However, we found a small number of studies which report on the impact of these variables on student online learning and on teacher experiences during the pandemic, which we discuss below in turn.

2.2.1. *Student Experiences of Online Learning during the COVID-19 Pandemic*

A small number of studies have investigated the impact of both programme level and disciplinary related factors on students’ experiences of online teaching and learning during the pandemic. In a study of predictive factors posited as influencing student satisfaction regarding the effectiveness of learning online, Tsang et al. [20] found no evidence of impact related to academic discipline or indeed level of academic study or gender. However, in their study of online teaching and learning in business education, Chen et al. [21] identified that undergraduate students were more likely to prefer asynchronous than synchronous approaches while postgraduate students preferred synchronous approaches. While Chen’s study focused solely on business education, Farrell et al. [22] also reported students across diverse disciplines valuing synchronous approaches. Chen et al. [21] also identified differences in student preferences associated with the field of study within business education, drawing a distinction between masters’ programmes in terms of the extent to which the focus was on the development of students’ qualitative or quantitative skills. Interestingly, Chen et al. [21] conclude that students whose studies were primarily qualitative in nature were more satisfied with asynchronous modes of programme delivery characterised by self-paced flexible learning. In contrast they found that in programmes where there was a significant focus on the development of quantitative skills, students tended to prefer synchronous modes of delivery characterised by live interaction with their lecturers. Several studies have reported that during the ERT students appreciated the flexibility afforded by online learning and the provision of asynchronous materials such as lecture record-

ings [22] and welcomed not having to commute and the associated cost and time savings [7,23].

2.2.2. Teachers' Experiences of Online Learning during the COVID-19 Pandemic

To the best of our knowledge, few studies have considered the impact of the level of academic study on the experiences of higher education teachers of online teaching and learning during the pandemic. A humanities lecturer who participated in Ramlo's [24] study considered online teaching inappropriate for undergraduate students:

There is no online substitute. I don't think online courses are a good idea for undergrads. Most of our undergrads first need to learn to be students and that is best done in a face-to-face environment. I really value getting to know my students and also value their interactions with each other (p. 254)

Similarly, regarding year of study, higher education teachers in the study by Kovacs et al. [25] expressed concerns relating to the readiness of first-year students in particular, questioning their capacity to be autonomous and self-directed in their learning. Moreover, the pandemic placed a spotlight on issues pertaining to the digital divide and inequity in student access to technology to support online learning [11,26].

The pandemic has simply amplified these existing inequalities in ways that have yet to be fully understood. It has potentially, however, exposed these deep structural problems to a large portion of the population that would not have otherwise been aware of them [7] (p. 96)

Few studies have reported data relating to the differential impact of online teaching and learning during the pandemic across higher education disciplines. Other than a set of studies focusing on initial teacher education, and a small cluster of studies focusing specifically on medical education we found only four studies which explored the online teaching and learning experiences of higher education teachers from a disciplinary perspective. Abdulrahim & Mabrouk [27] reported positive impacts of moving teaching and learning online for students and academic staff in the humanities and sciences but acknowledged that their sample included few staff and students from the field of health. Language teachers who were able to use web conferencing platforms such as Zoom or Skype to facilitate interaction with, and provide feedback to, students were more satisfied with their online teaching experience while those who relied on asynchronous approaches and/or experienced internet access difficulties had fewer positive experiences [18]. Interestingly, a comparative study found that, for the most part primary, vocational and higher education teachers were able to get to grips with online teaching technologies but that maintaining social presence and facilitating quality interaction was challenging for educators across all the sectors, including higher education [25].

Ramlo's [24] Q sort study with academic staff is unusual in that roughly equal numbers of participants came from each of the faculties of Science, Technology, Engineering and Maths (STEM), Humanities and Social Sciences. Regardless of the discipline, once again, there was significant variability in lecturers' experience overall. Lecturers teaching in STEM disciplines noted the particular challenges in replicating laboratory work while a lecturer in fine art spoke of the difficulties replicating practical work. Academic staff who were teaching practical courses in mathematics and science interviewed by Ogebo & Tijani [11] identified the limitations of the online platforms for practical work across courses with some in fact choosing to defer practical components until these could be delivered in person.

The need for adequate teacher training to help deal with the pivot to online learning has been expressed in Oliveira et al. [28]. Moreover, language teachers who had received training in online teaching and learning had better experiences overall [18].

As authors such as Zhao & Watterston [26] have identified, the pandemic experience has also placed a spotlight on equity and the digital divide. Ramlo [24] (p. 257) writes that:

The design and implementation of online courses, even when done in a rush, should be differentiated based on discipline, course level, and instructor pedagogy. In other words, online instruction is not a one-size fits all model. . . faculty should be the judges about online instruction and its limitations based on their students, the learning environment, and the discipline.

3. Materials and Methods

The theoretical framework underpinning this research was that of pragmatic realism reflecting our intention to solve a practical problem in the real world [29]. We wished to document the experiences of academic staff of online teaching and learning during the pandemic and to gather insights from this to inform future programme design and development in the university. As such, in keeping with a pragmatic research philosophy, our methodological design decisions were based on choosing the most appropriate research methods to best answer the research questions posed rather than commitment to a purely quantitative or qualitative approach [30]. We were interested in capturing the experiences of individual faculty members in the context of the shared experience of pivoting teaching and learning online. Consequently, in designing the survey, we adopted a “mixed-model approach” [31] and combined quantitative and qualitative approaches using a quantitative rating scale in tandem with a series of open questions. This was most appropriate to uncovering patterns in shared experiences and concerns, while providing the flexibility required to uncover the diversity and complexity of individual experiences.

A major underpinning of pragmatist epistemology is that knowledge is always based on experience. One’s perceptions of the world are influenced by our social experiences. Each person’s knowledge is unique as it is created by her/his unique experiences. Nevertheless, much of this knowledge is socially shared as it is created from socially shared experiences [32].

We conducted an anonymous online survey of academic staff in the faculties of humanities and education. An email invitation to complete the survey was circulated to all full time and part time academic staff. A link provided full information about the research and potential respondents were asked to read this and indicate their agreement to participate before completing the survey. Ethical approval for the study was secured from the relevant university ethics committee. Participation was entirely voluntary; no personal data was collected and responses were anonymous. The survey was laid out in four main sections. Section 1 was comprised of introductory questions which asked respondents to identify their department, whether they were full- or part-time staff members and their degree of experience with online teaching prior to March 2020. This was followed by open text questions seeking general perspectives on advantages and disadvantages of pandemic-related teaching changes. Section 2 was comprised of 4 open text questions seeking information relating to the respondent’s personal experiences, views and perspectives of teaching and learning in the context of COVID-19. Section 3 was comprised of a short 5-point Likert scale with statements relating to student learning and engagement, online and blended teaching and approaches to assessment and feedback. Section 4 was comprised of 4 open text questions relating to implications and challenges for teaching and learning beyond the pandemic.

A total of 200 respondents completed this questionnaire, 69 of whom were members of the humanities faculty and 131 of whom were members of the faculty of education. The overwhelming majority (80.5%, $n = 161$) were full-time, while 19.5% ($n = 39$) were part-time staff members. Details of the response rates for different categories are provided in Table 1 below.

Data analysis was completed by two independent researchers who were not members of either faculty. Frequency counts were conducted on the variables: school, part-time/full-time and “experience of online teaching prior to March 2020”. This last variable was determined by the following options: ‘no experience’, ‘very little experience’, ‘some experience’ and ‘a lot of experience’. Responses to the 11 closed-ended items for which

respondents were invited to indicate their level of agreement with a given statement on a 5-point Likert scale ('strongly agree', 'somewhat agree', 'neither agree nor disagree', 'strongly disagree' and 'somewhat disagree') were examined (see Appendix B for details of these responses). Frequency counts were undertaken to calculate the frequency of each response option for each statement. Qualitative data were analysed using NVIVO. The analysis of the raw qualitative data in response to the open questions involved analysing responses to identify themes and subthemes that emerged. Once a list of themes and subthemes had been established, responses were analysed a second time and coded by theme and subtheme. Following this, the number of mentions for each theme and subtheme was calculated. For example, regarding responses to the open question "What elements of online teaching worked well for you?" the following main themes emerged from the data for the faculty of education: technology, delivery of learning content, student learning and professional development. The theme of student learning included 5 sub themes, with the number of mentions for each given in parentheses: engagement (16), attendance (10) and interaction (9) in small (8) and in large groups (2).

Table 1. Survey Respondents and Response Rates.

	Education Faculty		Humanities Faculty		Total	
	%	n	%	n	%	n
Full-time Staff	69.5	98	34	63	49.7	161
Part-time Staff	18.03	33	20	6	18.3	39
Total	100	131	100%	69	100	200

4. Results

A pivotal aim of the research was to provide an opportunity for respondents to discuss the elements they felt worked well or perhaps did not go so well after moving to online teaching and learning, the impact that moving online had on their workload and also to address whether the assumptions they initially had regarding the online facilitation of teaching and learning had changed at all as a result of experience. This data proved useful for identifying any commonality of themes or issues which had emerged amongst the wide range of respondents.

Some common themes appeared in our datasets upon reflection. Namely, the level of experience staff had of online teaching and learning prior to the pandemic, the importance of professional development and the need for training for online teaching and learning, the preference for blended learning as opposed to learning taking place fully online or in-person, the value of harnessing insights and learning from the pandemic experience and, finally, the role of hybrid learning in ongoing efforts towards sustainability.

4.1. Level of Experience of Online Teaching and Learning Prior to the Pandemic

As shown in Table 2, 39% of all respondents described themselves as having had *no* prior online teaching experience while a further 30% described themselves as having had *very little* experience of teaching online prior to the pivot online in March 2020.

One in five (20.5%) respondents reported having had *some* prior experience while only one in ten reported having had *a lot of* prior experience of online teaching. The pattern of responses to this question was broadly similar in both faculties. These results reflect previous findings of huge variability internationally in terms of academic staff readiness for wholly online teaching and learning [7,17] but also within individual higher education institutions and faculties. Given this apparent lack of experience of online teaching, it could be expected that the shift from classroom to online teaching and learning in March 2020 had considerable effects on many different aspects of lecturers' practice. Such effects are explored below.

Table 2. Extent of experience of online teaching prior to the pivot online in March 2020.

	Education Faculty		Humanities Faculty		Total	
	%	n	%	n	%	n
No experience	34	44	48	33	39	78
Very little experience	32	42	26	18	30	60
Some experience	21	27	20	14	20.5	41
A lot of experience	13	17	6	4	10.5	21
Total	100%	131	100%	69	100	200

4.2. Specific Impacts on Different Levels, Year Groups and Disciplines

Moving beyond the general level of preparedness for online teaching, data from this survey suggest that variations in experiences were related to different disciplinary areas as well as different year groups and other factors.

We asked respondents who taught across several programmes to specify the programme and/or module they believed to have been ‘most impacted’ by the COVID-19 restrictions and one in three (33%, $n = 66$) provided a response. Of these, just over 20% ($n = 15$) suggested that the impact of the COVID-19 restrictions was the same for ‘all’ programmes or modules. Concerning level of study, it appears that there was a greater impact on undergraduate than on postgraduate programmes. Respondents noted the impact on undergraduate programmes much more frequently than on postgraduate programmes with, for example, 17 references to undergraduate programmes but only 7 references to postgraduate programmes in the education faculty and 18 references to undergraduate and 6 to postgraduate programmes in the humanities faculty. The perception of undergraduate students and programmes being more affected than postgraduate students and programmes was expressed by many respondents throughout the open text questions. It is worth noting that a considerable number of responses actually concurred with the notion that “undergraduate modules were generally more adversely affected than postgraduate modules”, mentioning something of a sentiment similar to this if not in those exact words. Some responded with simply the word “undergraduates”, while others responded by naming “first year entry students” as those most deeply affected by the change from in-person to online teaching. Within the faculty of education, it is likely that this is because full time undergraduate programmes have been traditionally delivered face to face in contrast to part time postgraduate programmes many of which have a blended or online model of delivery. In terms of initial teacher education programmes respondents noted a larger impact on primary (63 mentions) than on post-primary (40 mentions) programmes. Although the humanities faculty did not have a similar contrast in delivery modes for undergraduate and postgraduate programmes, nevertheless there was a general sense among respondents that undergraduates were more likely to be negatively affected by the online mode of delivery. Further observations were made in relation to practice-based and language modules in the humanities, which were particularly difficult to replicate online.

These responses reflect findings from the (albeit limited) published studies in relation to the differential impact across levels of academic study (undergraduate versus postgraduate), year of study and nature of academic discipline/field of study. The findings lend support to the conclusion of a more adverse impact on teaching and learning for undergraduate students [24] and in particular first year students [25]. As noted previously, very few studies have reported data relating to the differential impact of online teaching and learning during the pandemic across higher education disciplines. Analysis of responses to the open questions in this survey also indicated that online teaching appeared to have greatly impacted certain curricular areas, notably those relating to science, the arts and languages. Survey data also reflect previous findings that certain areas, such as those that involve practical, hands-on learning, seem to have been more affected [11,24] than

more theoretical aspects. It is also important to note that some courses may have already incorporated carefully thought-out online elements and therefore required less redesign.

Certain teaching contexts appear to have been more effective online than others. For example, nineteen respondents referred to finding small group tutorials, workshops and supervision meetings to have worked well online in contrast to large group webinars which were cited by ten respondents as being less effective online. While overall, staff felt that online teaching worked better when groups were smaller, notably, five respondents reported finding large class teaching to have worked very well online, citing advantages such as better attendance, having time freed up and avoiding repeating lectures, reflecting similar findings relating to teaching large classes online reported by Farrell et al. [22].

Student-related factors may also have contributed to participants' diverse experiences of online teaching. Such factors may have included level of student interaction, engagement and motivation, whether or not students were struggling, student skills and ease with online learning, student access to technological equipment and internet connection as well as personal constraints experienced by students.

It is likely that staff-related factors also contributed to respondents' diverse experiences of online teaching. Such factors may have included their set up at home (such as internet connection quality, having two screens), their experience, skills and ease of teaching online, whether they worked part-time or full-time as well as their personal constraints and experience of COVID-19, for example, in relation to childcare. Furthermore, online teaching may have been easier for those who had taught students face-to-face prior to March 2020 and therefore already had a connection with the cohort. Indeed, respondents mentioned that various factors impact online teaching and learning, for example level of study (16 mentions), as well as course, module and teaching content (28 mentions) as captured by the following quotes:

Online is not suitable for large undergraduate groups. I have taught small post graduate groups online for many years and that can work due to their experience with academia, their commitment and also the convenience for those even working in different countries.

Many staff mentioned that it is important to consider these different factors going forward when making decisions relating to future teaching and learning online. Our findings suggest that use of technology and online or blended learning methods should not be implemented in a 'one size fits all' manner and that the disciplinary context and culture must be considered [19,24].

4.3. Professional Development/Training for Online Teaching and Learning

There was a common theme in our data that "appropriate tech support (such as easier access to technological support) for staff and students and training for staff" was required. Respondents said that any future introduction of online teaching and learning would need to be planned with more support in mind—particularly support for students who struggle with online learning either due to actual physical resources or for learning style-based reasons. Some respondents called for consistency across different modules/standardisation of planning so that teachers felt supported and could collaborate with each other within their schools. One concern that was expressed which contradicts a collaborative approach, however, was the idea that "online lessons require more working from scratch" because what works for one specific class on Zoom or in the Moodle Virtual Learning Environment (VLE) almost certainly would not work in the same way for another class. This was seemingly common in other studies of the experiences of teachers in emergency remote teaching. As previously noted, adequate training in online teaching and its positive outcomes in terms of better experiences have been noted in some studies [18,28].

The findings of the current study clearly illustrate that higher education teachers had reflected on their experiences and could identify the benefits and opportunities for the enhancement of teaching and learning. It was clear from both our research data and that of others (as outlined above) that teachers often felt more training would be required, with

24 mentions of the need for staff training and support and a further 21 mentions of the need for professional development among education faculty staff. We gave humanities staff (who were surveyed after the return to face-to-face teaching) the opportunity to discuss what training they felt would be necessary both in the immediate and long-term future. The overwhelming majority of the responses to this question centred around pedagogy. There was a consensus among staff of the need for effective training in teaching and learning techniques which were specific to the online learning approach. One particular response called for a pedagogy which was “direct” and “to the point”. A lot of respondents seemed to have more confidence in online teaching and learning after experiencing it themselves. Regardless of level of experience of online teaching prior to March 2020, the majority of participants in the education faculty (54%) agreed that their teaching had improved in the online space. This ranged from 42% of those who had no experience of online learning prior to March 2020 to 67% of those who had a lot of experience. By contrast, just 36% of humanities respondents agreed that their teaching had improved, with a further 44% being ‘neutral’ as to whether their teaching had improved. Among the positive changes, staff commented as follows: “I gained a better sense of my own identity as a teacher (I had greater reflexivity)”, that they developed “sharper, more refined lecture notes”, “very focused learning outcomes” and “clearer lectures”. Overall, however, there was a feeling among respondents that the teaching they did during the pandemic was rushed due to the unprecedented circumstances. One respondent called for an emphasis to be placed on “online teaching, not emergency teaching”. Another referred to what they had been working through during the pandemic as “challenge pedagogy”, noting that it would be timely to develop suitable and effective strategies to deal with ‘challenge pedagogy’ in the future.

A suggestion for moving forward with a hybrid pedagogical approach was that the university could perhaps expand its intake—particularly at master’s level—by offering an online degree course to students who cannot travel to/stay close to campus (mentioned by four humanities respondents). This would serve as an excellent opportunity to use the teaching methods which worked well during the pandemic in order to raise the university’s postgraduate student profile.

Some respondents (21 mentions) called for training which was specific to technology including specific technical skills such as video-editing or using named software, although one staff member in particular argued that the technology training should be centred on teaching as opposed to being “an obligation to use the latest tools and not adapting the teaching to the tools themselves”. Other suggestions raised here included the possibility for the development of templates and examples of engaging online content to help teachers who might be struggling with coming up with these resources on their own. Some respondents (9 mentions) observed a need for fundamental pedagogical skills rather than an emphasis on particular software, with one remarking that “A lot of training available... seems to be focused on elaborate exercises dependent on specific software or custom platforms.” In addition, other respondents noted that they were actually overwhelmed with workload, other time commitments and too much training, and what they actually needed was just more time (13 mentions). Perhaps the most interesting quote which summarised a lot of the uncertainty surrounding the online provision of teaching and learning is the following: “I think that it’s hard to say exactly what training I need because I don’t yet know what it is that I don’t know”.

4.4. Harnessing Insights/Learning from the Pandemic Experience

4.4.1. Elements of Online Teaching and Learning That Worked Well

In terms of the positives to be gained from the experience of online teaching and learning provision, a few themes emerged across the spectrum of different respondents. There was significant variability in views regarding the statement that ‘Student engagement was generally higher online than face-to-face’. While over half (51%) of respondents indicated that engagement was generally higher face-to-face than online, a further 19%

were undecided and 31% reported finding levels of student engagement to be higher online than face-to-face. These results point to the fact that academic staff had very different experiences regarding the engagement of students online compared to face-to-face. Some respondents (14 mentions) noted that attendance was better with online lectures than it had been pre-pandemic; possibly, some speculated, for reasons of convenience. The lack of having to travel was one factor for students which might have made it easier to attend lectures that they might not previously have attended. Moreover, there were 14 mentions of the fact that recordings of many lectures were now made available on-demand, and this helped both attendance and engagement. In addition to common mentions of the higher levels of participation there were 19 mentions of how students tended to work well and engage successfully in groups during online lectures and tutorials—one respondent added that *“having to be clearer and more structured about seminar activities to promote and maintain engagement not only between lecturer and students, but student to student engagement. The time management of this worked better than in person!”*.

Twenty-nine respondents mentioned the advantages of using “breakout rooms” in Zoom. These breakout rooms helped lecturers time manage in their lessons—one teacher even said they “would like to have this online format reintroduced as it is the most productive use of time for this particular module”. Respondents noted that the breakout rooms provided great opportunities for students to interact with their peers in useful ways before then convening as a whole group once more to report back on their discussions. Other group-working methods mentioned in the survey responses included the use of collaborative or shared documents (18 mentions). Another common theme among responses was the positive impact of alternative assessment brought about by the online facilitation of teaching and learning. There were 6 mentions of the ease of access of materials which made assessments through means such as presentations much easier for students to focus on and to complete to a higher standard than was perhaps possible before. A respondent commented that *“more varied forms of provision of materials, including videos, more accessible readings, discussion boards. I liked having videos for students to watch in their own time”*. Two other salient examples of this among the responses come from the subjects English and Music, respectively, in which there was a common agreement that giving students the opportunity to complete assessments from home allowed for a much higher standard of end product.

The final common theme among these responses came from lecturers who saw how the movement to online teaching and learning improved their own professional practice (31 mentions). There were multiple mentions of teachers feeling more confident in the use of technology and certain software such as Zoom and the Moodle VLE (18 mentions) which they may not have had to rely on quite so heavily before. The use of pre-recorded lectures as part of teaching delivery was also generally seen as favourable and advantageous.

4.4.2. Elements of Online Teaching and Learning That Did Not Work Well

With regard to the elements of online teaching and learning that did not work well, there were quite a few overlapping points among responses. In short, teachers found replicating the learning community they had experienced pre-pandemic and in-person to be a difficult task once classes moved online.

The respondents explained their own specific take on this wider issue. Twelve respondents suggested that feedback was harder to obtain than it would be in person. According to some respondents, both visual cues and verbal responses from students during lessons were more difficult to track—mostly owing to Zoom allowing students to turn off their cameras and/or microphones (27 mentions) if they so wished. This also meant that spontaneous input and more casual or ‘natural’ responses from students were much harder to come by in online classes than classes which took place in person. Some respondents described the outcome as ‘depressing’ and ‘emotionally draining’.

Particular challenges associated with moving teaching and learning for large classes online (16 mentions) were related to both the design and delivery of pedagogical content

and the management of student behaviour, reflecting the findings of previous research [9]. Staff expressed concerns that students (particularly undergraduate students) might not have been able to follow the learning material and that they had difficulty gauging students' levels of understanding. The concern that some students might not even be 'present' (i.e., a student might have logged into Zoom to join the class but thereafter be absent from the room/not paying attention) was also mentioned. Moreover, respondents who—it can be inferred—taught practical-heavy subjects such as performing arts, noted that the lack of availability of this practical work made teaching their modules extremely difficult (13 mentions). Overall, it is clear from the responses to this question that teachers generally felt a lack of a personal connection or a diminished relationship between themselves and their students (60 mentions). Although there were many (29) mentions of breakout rooms in Zoom working well, respondents (15 mentions) also observed the difficulty for students forming connections with their classmates. Finally, one respondent argued that 'sustained online delivery very definitely has a negative impact on mental and physical health'.

4.5. Did Respondents' Assumptions about Online Teaching and Learning Change as a Result of Moving to Online Learning?

Data from this study supports the notion that the pandemic caused many higher education teachers to change their assumptions about online teaching and learning. Teachers' own considerations of pedagogy came to the fore during this period of change. When asked if their assumptions about teaching and learning had changed in any way as a result of their experience of online teaching, 88 respondents indicated that their assumptions had changed while 29 indicated that their assumptions had not changed, and 48 participants did not indicate or mention any change in assumptions in their response. Responses to this question were varied in their foci due to the individual nature of how the question was asked: "Have your assumptions about teaching and learning changed in any way as a result of this experience?".

Respondents seemed to confirm that their assumptions had changed for the better, i.e., some teachers once held negative assumptions about using technology as a main tool and teaching remotely, but these assumptions were often proven wrong. The responses to this question could be placed on a spectrum ranging from those very enthusiastic about online teaching and learning as a pedagogical approach—"I now believe in the power of online T&L", "Online teaching should now be a bigger part of [the university's] offering"—to the responses which are vehement in their opposition to online learning—"it feels empty at times", "the sudden switch to online and the lack of a sense of pace and time due to the ever-changing delivery . . . compounded my loss of belief in online as a primary source". Most responses fell in the middle of this spectrum. Moreover, many respondents commented positively on the use of online tools, technology and resources and/or indicated that they would like to continue with related aspects going forward (32 mentions). For example, one stated "I would like to see the online tools used as tools to support teaching and learning where appropriate and relevant. They also have a place in terms of efficiency for communication". Similarly, 34 participants provided positive comments regarding hybrid teaching and/or asynchronous elements of online teaching and/or indicated that they would like to continue with these elements going forward.

Responses also pointed to the importance for a balance to be struck between in-person and online teaching—"In future I am likely to incorporate some online aspects into my teaching because it has the potential to help some students". Others noted that "I now see many more positive aspects in mixing online and on-site teaching" and "I strongly believe we should retain an element of online and hybrid teaching into the future".

Twenty-five participants appeared to have appreciated the flexibility offered by online teaching to both staff and students. Some mentioned benefits stemming from this flexibility, notably relating to geographic location, accessibility and personal commitments; some considered that flexibility is particularly important for postgraduate students. One stated:

Postgraduate research students benefited greatly from the flexibility and would gain enormously from a hybrid model going forwards. The nature of their stage of life dictates that they have myriad responsibilities, so being able to ‘dial in’ really suits them.

Six respondents mentioned that online teaching was more economical in terms of time, noting that they had more time to attend meetings and plan and prepare their lectures while two mentioned that online teaching and learning was more economical in terms of reusing learning material such as videos and in reducing photocopying. In contrast, some (2 mentions) felt that the increase in electronic communications was detrimental: *‘The additional volume of email and Zoom meetings to provide student support was unsustainable’*.

Two interesting points of note from each side of this spectrum emerged. In opposition to online learning, one respondent noted that *“we have lost the possibility of engaging in further debates and critical thinking that take place during the classes more often than in an online environment”*. An interesting statement in favour of online learning was the following, which recognised its value for access and equity:

Particularly in relation to educational access and equity—many more mature students, students with professional or family or caring commitments outside college, etc. reported positive experiences with online learning. [They] . . . had not appreciated how much of a barrier in-person classes (in Dublin, paying rent in Dublin, or commuting to and from Dublin) was for some students who were happy to avail of online formats.

One quote from a staff member summarises quite aptly the huge change to not only assumptions but to future pedagogical practices that our datasets have shown:

My assumptions about teaching and learning have been impacted, it has changed everything. We cannot return to 2-hour lectures with a PowerPoint and students engaged in passive learning. I am reshaping everything I know about teaching, and I feel this is a good thing. We need to move towards active participation, developing critical thinkers, we want students to challenge. My vision for the future of teaching face to face is now completely different and I feel we need to use the best of online with face-to-face to really support learning.

Understandably, most respondents were focused on the pedagogical implications of online teaching and learning, but the free-form nature of the responses allowed scope for other elements to also come to the fore. The benefits of avoiding commuting by students were noted, e.g., *‘[online learning is] particularly useful where students are travelling long distances to campus currently to get to 9 am lectures already tired before they begin facing a long commute home’*. Another respondent again differentiated between undergraduates and postgraduates in this respect: *‘Online has a place. Forcing MA students to attend lectures that could be delivered online is not sustainable. Bringing people together should be for discussion and interaction’*. One respondent paid specific attention to the ‘green’ aspects of the move away from campus-based teaching:

I think that as a dynamic university operating in the 21st century, we should be seen to be harnessing the benefits that this new, rapid learning has offered us. From a climate protection perspective, the reduced travel, the reduced paperwork, the reduced heating and maintenance of the university should not be discounted. From a personal perspective for staff, increased time at home with young children has been incredibly invigorating and much appreciated. I think this has given me a new-found appreciation of my job and made me work harder for the University. For students, money saved on accommodation and a decrease in logistical considerations must have been a significant benefit. A move towards a blended approach that would harness the benefits of both contexts should be considered.

5. Discussion

As our survey results demonstrate, the emergency online pivot led to significant progress in the use of technology as lecturers were forced to engage in new ways of working in order to continue teaching during the pandemic. This resulted in a greater academic staff recognition of the benefits and scope afforded by technology, as well as some concerns as to its limitations. This ‘favourable side effect’ of ERT, whereby higher education institutions (HEIs) were forced “to study, test, apply, and evaluate the benefits and drawbacks of online education and assessment methods” has also been recognised in previous studies published in this journal [16].

Many respondents mentioned aspects of online teaching and the use of technology that they would like to retain, and many would be favourable to blended or hybrid approaches providing these were adequately funded and resourced. A key theme emerging was that teaching staff believed that programmes, modules or elements should only be offered online or as part of a blended learning approach when the learning content is conducive to online teaching and learning and when resourced appropriately and that lecturers and teams should have the academic freedom to make judgements and decisions regarding online or face-to-face delivery. Some of the key factors which might usefully inform such decision-making could include: the academic level (undergraduate or postgraduate) and year of study, the nature of the discipline, subject and the learning content, and the size of the cohort as well as the lecturers’ level of experience and opportunities for professional learning in relation to online teaching and learning. Different combinations of online and face-to-face teaching and learning could work well for different programmes and content areas. Respondents mentioned elements that would require more thought and reflection if online teaching were to continue, notably attendance versus engagement, large class sizes, equity and inclusion, and, in the faculty of education, school placements. Given the huge diversity of experiences with academic staff often having starkly contrasting experiences of online teaching and learning, collaborative reflection and discussion may be required going forward. It is also important to note that most participants experienced a significant increase in workload following the move to online teaching and learning. Given that respondents seem to have had diverse experiences, collaboration and sharing of experiences could help to make online teaching and learning more effective for all teaching staff. Some ideas and initiatives that could usefully be shared include organising peer support sessions on Zoom, hosting Q&A sessions to answer students’ questions particularly after asynchronous sessions and large group lecturers, organizing meetings to check in with students and providing students with explanatory videos, for example, regarding assignments and using tools such as polls to monitor engagement on Zoom. In terms of lecturers’ set ups at home, having two computer screens seemed to be particularly helpful.

Emerging literature suggests that the use of technology in higher education offers many possibilities, but also may give rise to a new range of problems. Our findings discussed above must be considered within the context of a rapidly changing educational landscape and one of the major issues of our time, namely environmental sustainability.

In addition to offering educational possibilities as outlined by our respondents, the use of technology in blended learning could potentially improve environmental sustainability within the third level sector. Universities are increasingly concerned with the reduction of their carbon footprint in order to address climate change, as seen in a bibliometric study by Da Silva et al. [33]. This article found four key foci of publications looking at HEI efforts to reduce greenhouse gas emissions and become ‘greener’: campus for decarbonisation, assessment of Greenhouse Gas (GHG) emissions and calculation of Carbon footprint (CF), the impacts of academic air travel and sustainable food systems. One such study which attempted to calculate the carbon footprint for Delft University of Technology noted that commuting by staff and students accounted for a modest 4% of emissions, though this was within the Dutch context of a biking nation [34]. This article also noted the goals and measures identified by the 2019 ‘Climate Letter’, which was officially supported by all Dutch universities, namely “reducing energy consumption, cutting back

on flights, promoting sustainable modes of commuting, disinvesting in the fossil fuel industry, supporting environment-friendly food options and reviewing educational offers concerning energy efficiency" [34], (p. 24). Interestingly, the prospect of eLearning as a means to reduce emissions from commuting does not appear to be high on the agenda in these studies, although it was identified by respondents in our survey.

An older but highly cited study of the environmental impacts of providing higher education (HE) courses by campus-based and distance/open-learning methods may be instructive [35]. Compared to full-time campus-based courses, it was found that distance learning HE courses involved 87 percent less energy and 85 percent lower CO₂ emissions, largely due to reduced student travel, elimination of much energy consumption of students' housing and economies in campus site utilisation, despite the energy and emissions costs associated with computing. This environmental audit was based on 20 UK higher education courses and was the only existing quantitative study of this issue at the time of publication. The potential for energy (and thus CO₂) savings from reduced commuting by staff and students, as well as reduced on-site energy costs, are also relevant where blended learning becomes more prevalent. In their 2019 meta-analysis of eLearning sustainability issues based on a literature review of 124 papers, Alharthi et al. [36] propose a number of features which could enhance the environmental sustainability of eLearning, focused on the engineering aspects, including use of green data centres, use of metrics and tools by developers to encourage green behaviour, and use of green and sustainable software development processes.

A small number of respondents to our survey recognised the potential of blended technology for improving environmental sustainability, in addition to its educational possibilities. Attempts by universities to measure and reduce their carbon footprint in order to address climate change have been explored in a number of studies [33,34], while the reduced environmental impact of distance or online learning relative to campus-based learning has also been studied [35]. However, limited attention has been paid to the environmental costs of data centres and software development processes which facilitate eLearning [36] and generative AI [37]. Further research is required into this rapidly evolving area.

Online education has the potential to offer environmental but also societal benefits. Arango-Urbe et al. [38] have highlighted the potential of technology to address Sustainable Development Goal (SDG) 4 of Quality Education which emphasises the importance of "inclusive and equitable quality education and promotes lifelong learning opportunities for all". One of their key findings showed that the benefit provided by online courses in terms of SD is 62.99% higher than that of offline courses in aspects such as transportation, photocopies, printouts, books, food, clothing, enrolment fees and connectivity.

Although the role of e-learning was not specifically mentioned in current studies, Da Silva et al. [33] identified new technologies as an aspect requiring future research. They called for a broader analysis including "relevant studies on new technologies, such as artificial intelligence", further noting that:

The changes in attitudes of people and on the university campuses during the COVID-19 pandemic in relation to the calculation of the CF [Carbon Footprint] is also a point that can be investigated, as well as the reflection of the reduction of air travel and the "forced" occurrence of online events during the same period. (p. 598)

Despite the likelihood that eLearning and blended approaches could offer environmental benefits, it should be acknowledged that the hidden costs of the push towards online technology are under-researched. A recent newsletter from the Guardian highlighted the need to address the environmental impact of Artificial Intelligence and the challenges facing researchers attempting to quantify this impact, which includes water use (deployed to keep the computers powering the AI tools cool) in addition to energy use and the resulting carbon footprint [37].

Limitations

It is important to consider a number of limitations when interpreting our survey findings. While the response rate for full-time staff was relatively high at 49.7%, the findings may not accurately represent the views and experiences of academic staff who did not respond to the survey. With a very low response rate of 18.3% for part-time staff, the findings may not be representative of the experiences of part-time staff and cannot be generalised. A very striking theme was the great diversity of experiences and opinions among respondents, reflecting the pattern reported in previous studies [19,24] and we acknowledge that the findings may not accurately represent the experiences of academic staff who chose not to respond to the survey. When interpreting these findings, it is important to remember this study was conducted in a particular context, where students are likely to have had less distractions due to COVID-19 restrictions and where students and staff members may have felt under more pressure.

A number of different approaches could have been taken in order to gather academic staff input. Given the large number and diversity of programmes and the very wide range of disciplinary and curricular areas represented within the two faculties which were studied, the research team concluded that an anonymous online survey was the most appropriate research method. While conducting a series of focus groups was considered and might have enabled a richer and more in-depth analysis, this would not have captured the breadth of experiences of academic staff and so an anonymous survey was chosen as best fit for the research purpose.

It is possible that some staff responded to questions with certain cohorts of students in mind. For example, one respondent stated, “My responses here have been based on my experiences of working with very large classes of undergraduate students”. Although respondents were asked to respond to certain questions with the programme they felt was most greatly impacted in mind, it is not clear that all followed this instruction, and others may have answered these questions based on their overall experience of online teaching, including more than one programme. While two of the researchers carried out the data analysis, because of the slightly different timing of the administration of the surveys in the two faculties intercoder reliability was not verified.

Finally, this study reports only the perspectives of teaching staff and as such is an incomplete picture of teaching and learning in the context of the COVID-19 pandemic. It is very important that the experiences and perspectives of students under these unique circumstances are also documented. The researchers noted the importance of documenting student experiences of teaching and learning during the pandemic but because of resource limitations it was decided to begin by exploring the experiences of academic staff. It is important that student voices are heard, and their experiences of online teaching and learning are considered when making any future decisions regarding online or hybrid/blended learning models.

6. Conclusions

The move to online learning was very quick or an “emergency” solution in response to the COVID-19 pandemic and the resulting restrictions. Academic staff had to deliver modules initially intended and designed for face-to-face learning in the online space with little or no time to prepare and acquire the necessary skills in advance. The immediate pivot in March 2020 resulted in all teaching and interaction being online, even when it was not adapted or optimal for student learning and respondents reported experiencing a significant increase in workload following the move to online teaching and learning. While arguably this finding could be associated with the sudden pivot to emergency remote teaching, further research might usefully explore the impacts of online teaching and learning on staff workload generally.

Notwithstanding the significant increase in workload, respondents recognised that the pivot online constituted a valuable learning experience and that insights from this could be harnessed to enhance future teaching and learning. However, a key theme emerging was

that staff believed that programmes, modules or elements should only be offered online or as part of a blended learning approach when the learning content is conducive to online teaching and learning and when resourced appropriately. Different combinations of online and face-to-face teaching and learning could work well for different programmes and at different levels of study. Some of the key factors which might be helpful in informing such decision-making include the year and academic level of study (undergraduate or postgraduate), the nature of the learning content including, whether theoretical and/or practical, as well as the teaching context and cohort size. Further research investigating the impact of these variables and of the influence of student and lecturer readiness for online teaching and learning is warranted. It will also be important to hear student voices and consider students' experiences of online teaching and learning when making any future decisions regarding online or hybrid/blended learning models.

As articulated by Brown et al. [10], successful adoption of online learning technologies in education is contingent on educators and on the provision of appropriate professional learning opportunities that serve to build their capacity, skills and understanding and challenge their pedagogical beliefs and assumptions about online teaching and learning. One key takeaway message that emerged strongly from this research is that there is no one size fits all. Furthermore, decisions about using online learning technologies need to be considered in the context of and informed by wider social, cultural and environmental considerations, in particular the critical issues of our time, namely environmental sustainability and generative AI.

Educators' values, mindsets and underlying educational philosophies. . . influence how teachers respond to new learning opportunities and untangle inherent tensions as they navigate through competing change agenda. While the mediating influence of teachers' beliefs is crucial, we cannot underestimate other structural barriers arising from traditional learning cultures and wider socio-political constraints. If we want to challenge these barriers, then educators need a critical multifocal lens with the ability to see different viewpoints and competing images of the future [10] (p. 474)

While the data from this cross-faculty study was gathered during the unique circumstances of the pandemic following the emergency pivot online, we argue that the insights garnered are helpful in a broader educational context in identifying both problems and possibilities for the future. As such, these experiences are relevant to and can inform the development of higher education pedagogy post-pandemic. As noted by a respondent in our study, the pandemic experience had the effect of *'Opening a world of possibilities to our students in terms of the potential of online learning and face to face learning [which] will be very important for all of us for the future'*.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the DCU Research Ethics Committees (confirmation number DCUREC/2021/084 approved on 12 April 2021) and the DCU Humanities & Social Sciences Faculty Research Ethics Committee (confirmation number DCU-FHSS-2022-008 approved on 11 November 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Appendix A. Survey Instrument-Questions

1. General Information (5 Questions)

1.1 In which School in the faculty are you based?

- [Names of Schools withheld for review]

1.2 Are you a full time or part time member of academic staff?

- Full time
- Part time

1.3 If teaching across several programmes, specify the programme most impacted by the COVID-19 restrictions.

1.4 How much experience of teaching online did you have prior to March 2020?

- No experience of online teaching
- Very little experience of online teaching
- Some experience of online teaching
- A lot of experience of online teaching

1.5 Have you programme-specific (or module-specific) advantages to the pandemic-related changes which you would like to raise? Please be as specific as possible.

1.6 Have you programme-specific (or module-specific) disadvantages to the pandemic-related changes which you would like to raise? Please be as specific as possible.

2. Personal experiences of teaching and learning in the context of COVID-19 (4 Questions)

2.1 What elements of online teaching and learning worked well for you? (For example, what have you gained in terms of teaching and learning? In particular, what would you like retained into the future? This might also include elements which don't specifically relate to the online environment, such as alternative forms of assessment)

2.2 What elements of teaching and learning did not work well online? (For example, what have you lost in terms of teaching and learning? What would you like to not have to experience again?)

2.3 Have your assumptions about teaching and learning changed in any way as a result of this experience? (For example your belief in the effectiveness or not of online learning, your expectations/understanding of student engagement online, your vision for the future of online teaching related to the courses that you teach).

2.4 How did moving online impact your workload during the course of the pandemic?

3 Please indicate your response to the following statements (13 Questions)

In relation to your experience of teaching since March 2020, please indicate your responses below (Likert Scale) Strongly Disagree; Disagree; Neutral; Agree; Strongly Agree

- Student engagement was generally higher online than face-to-face
- Provision of asynchronous materials was effective for student engagement
- Provision of asynchronous materials was effective for student learning
- All programmes should explicitly incorporate some asynchronous teaching and learning

- All programmes should have the option of providing a blended approach (i.e., have both face-to-face and online engagement)
- My teaching improved in the online space
- Students did not learn as well online as they do face-to-face
- It was easier to provide feedback online
- It was difficult to implement assessments online
- Most assessments had to be altered to suit the online environment
- I would like to revert to teaching online only
- I would like to revert to regular face-to-face teaching only
- I would like to employ a blended element in my teaching (i.e., a mix of online and face-to-face engagement)

4 Implications for teaching and learning in the Faculty post COVID-19 restriction (4 Questions)

4.1 What lessons can be learned from the pandemic teaching experience at faculty level? (For example, in what ways (if any) do you think the skills and pedagogies developed over the last 18 months should impact on teaching and learning post-pandemic?)

4.2 What training would you need if you were to continue with some online teaching and/or other new pedagogies into the future?

4.3 If you are interested in employing a blended element in your teaching, what percentage of your module would you like to undertake online (e.g., 20% online, 80% face-to-face)?

4.4 Any other specific comments e.g., in relation to context, cohort, curriculum, engagement, assessment, support (e.g., large classes, practical engagement, subject-specific requirements, under/post-grad, full/part-time programmes etc.)

Appendix B. Histograms Reporting Responses to Likert-Scale Questions

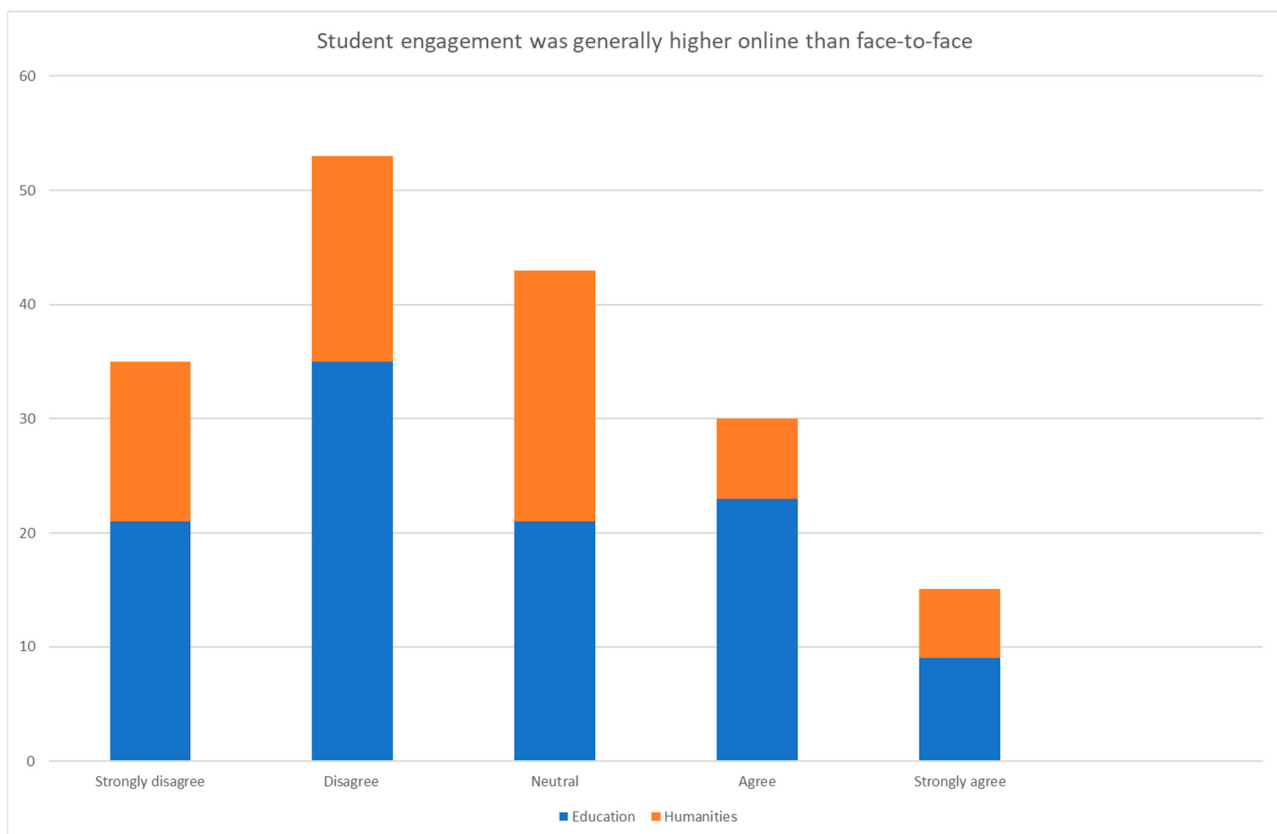


Figure A1. Student engagement was generally higher online than face-to-face.

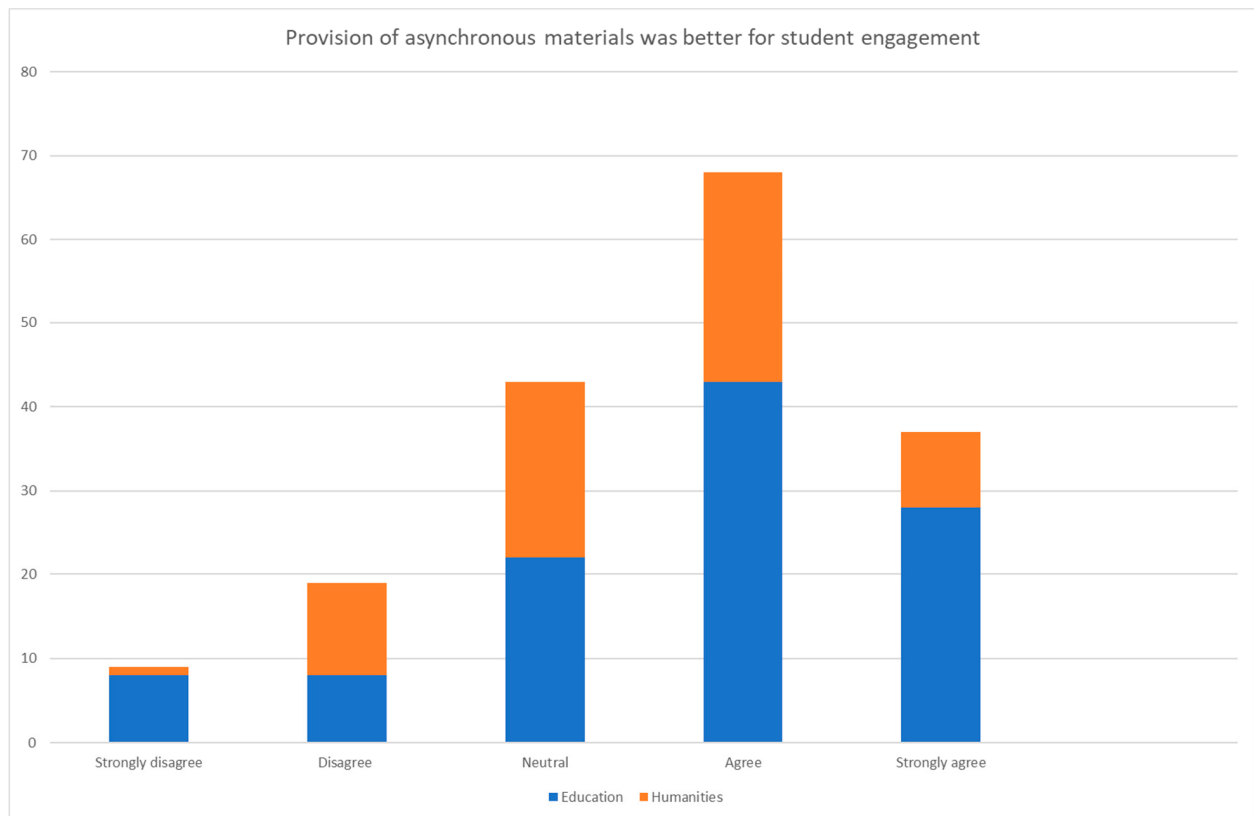


Figure A2. Provision of asynchronous materials was better for student engagement.

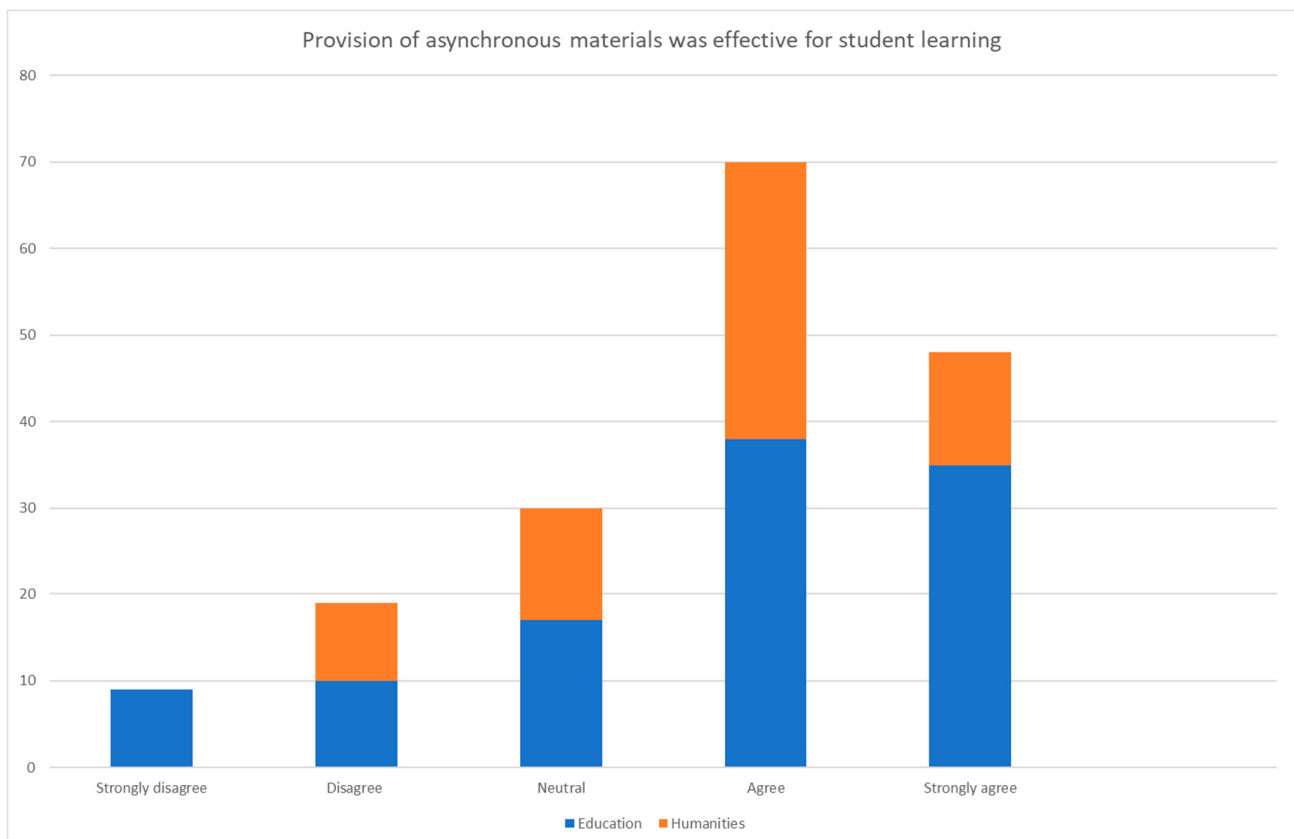


Figure A3. Provision of asynchronous materials was better for student learning.

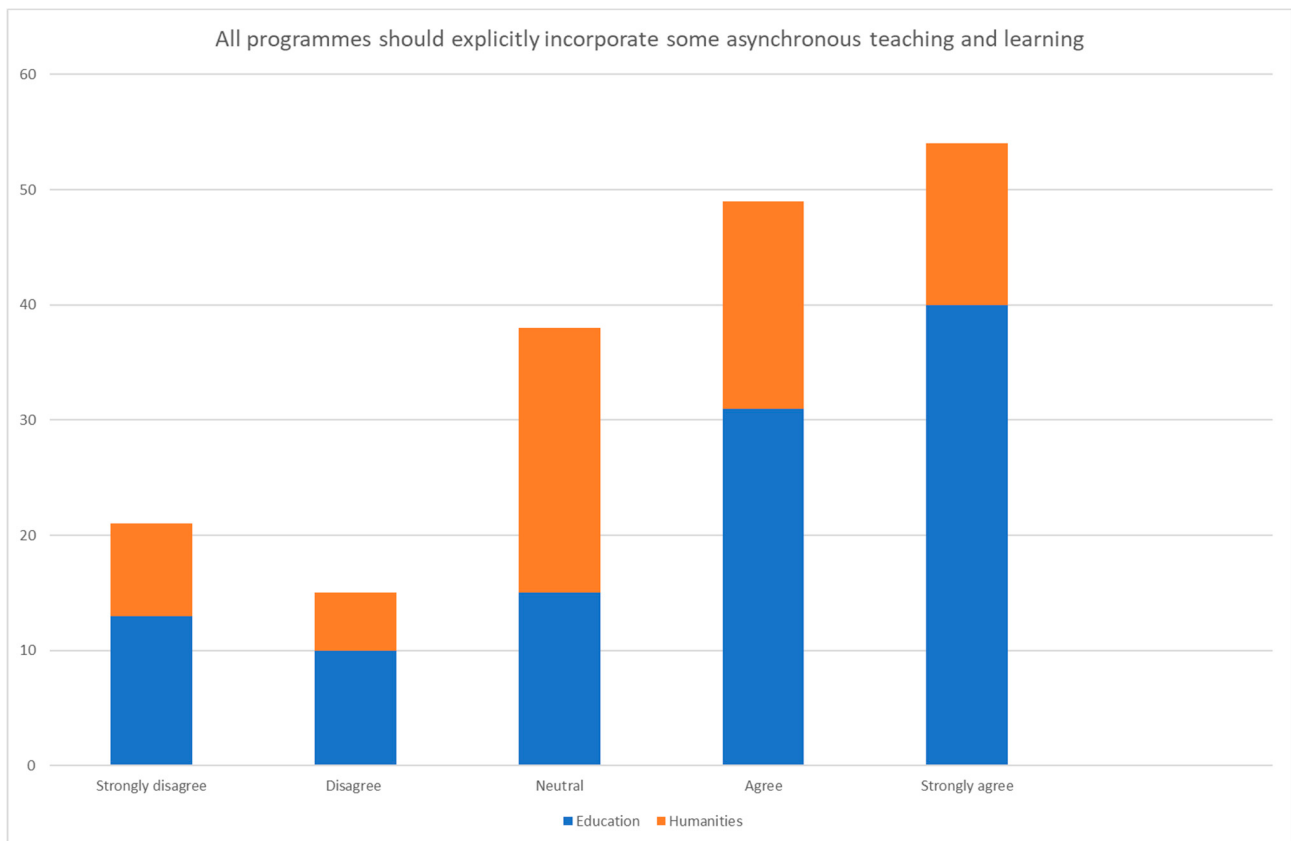


Figure A4. All programmes should explicitly incorporate some asynchronous teaching and learning.

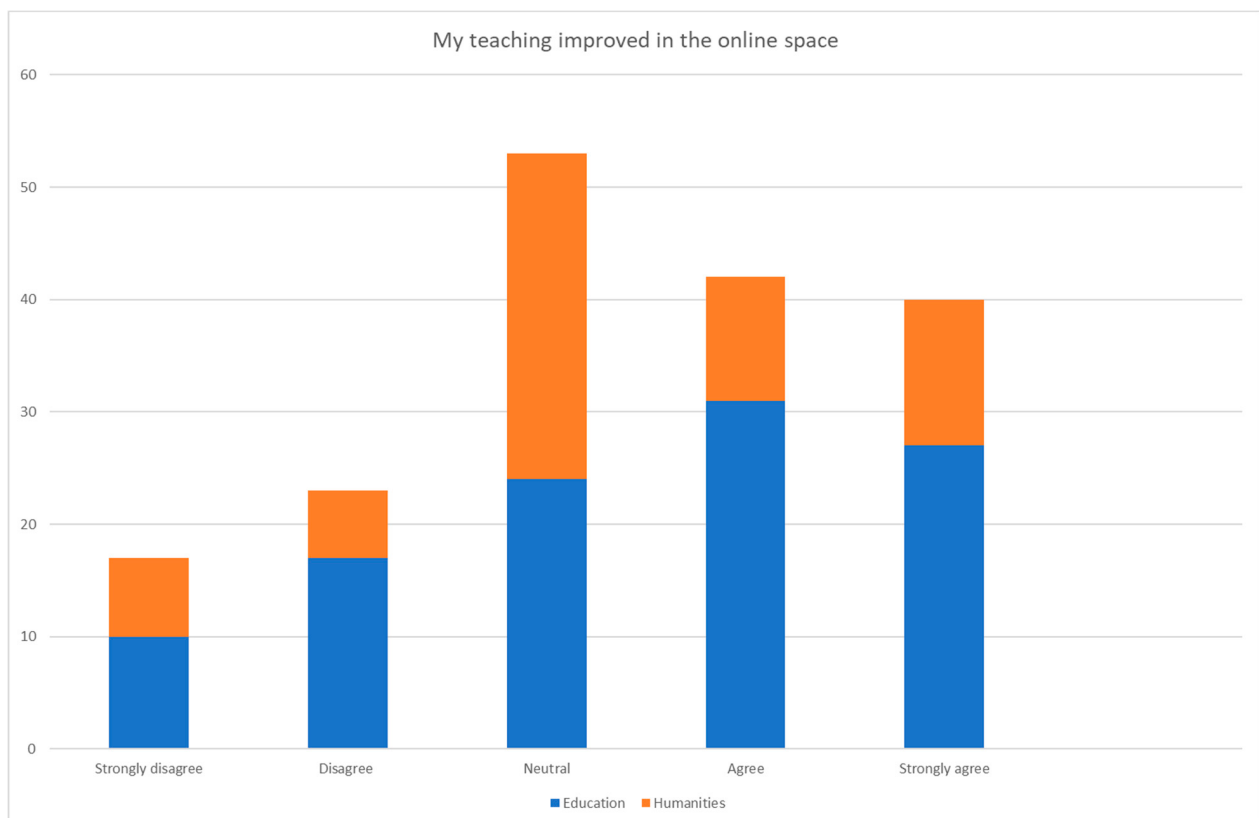


Figure A5. My teaching improved in the online space.

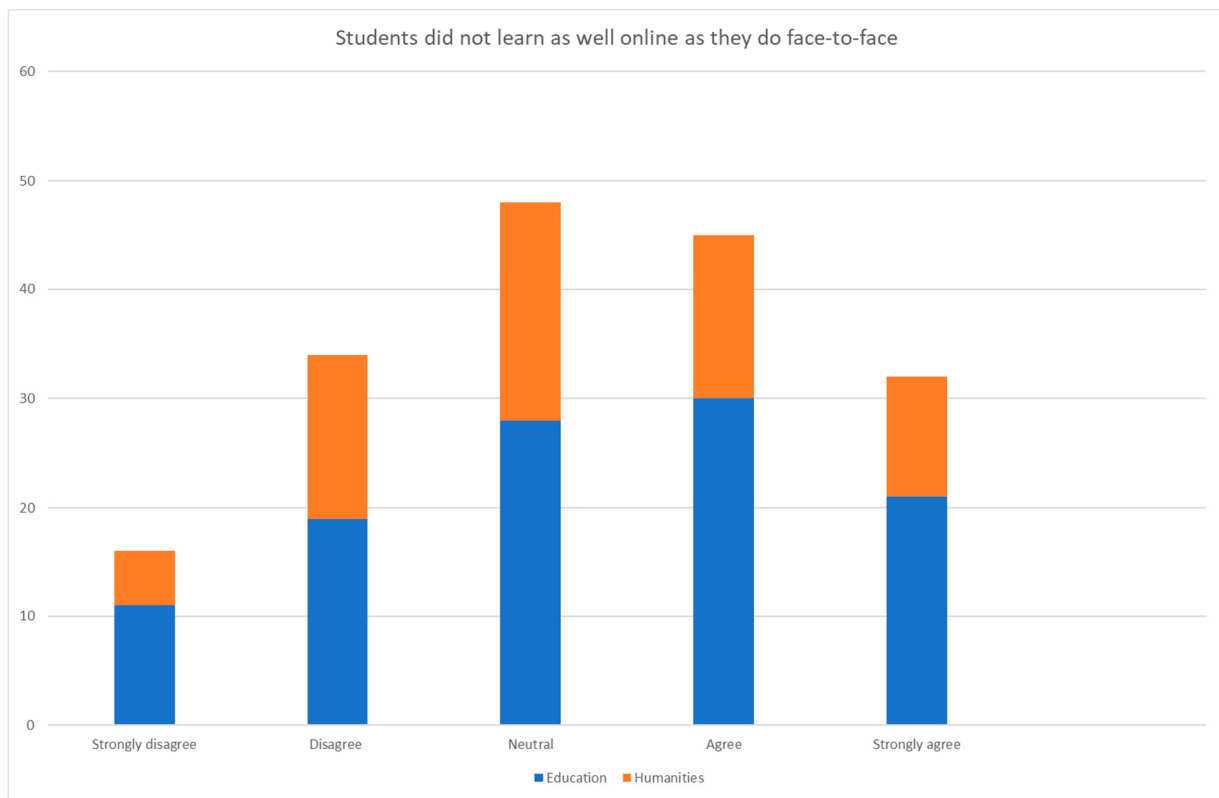


Figure A6. Students did not learn as well online as they do face-to-face.

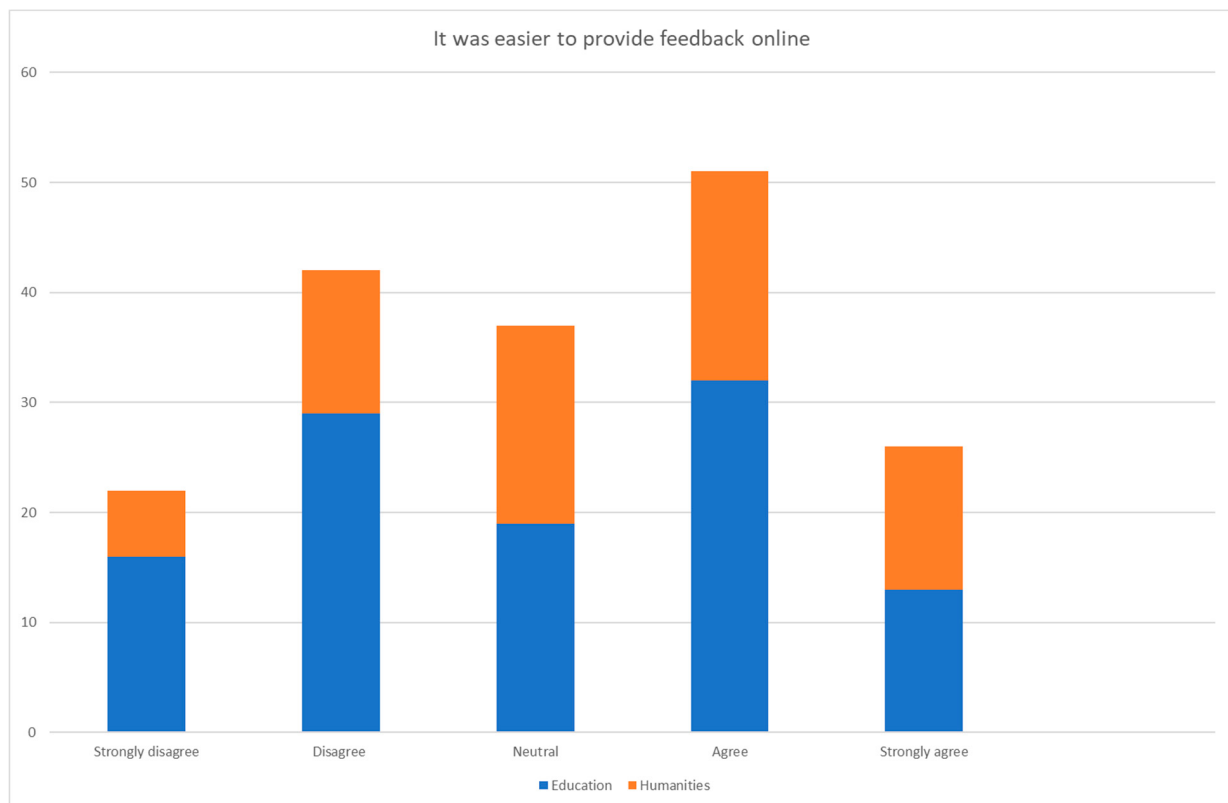


Figure A7. It was easier to provide feedback online.

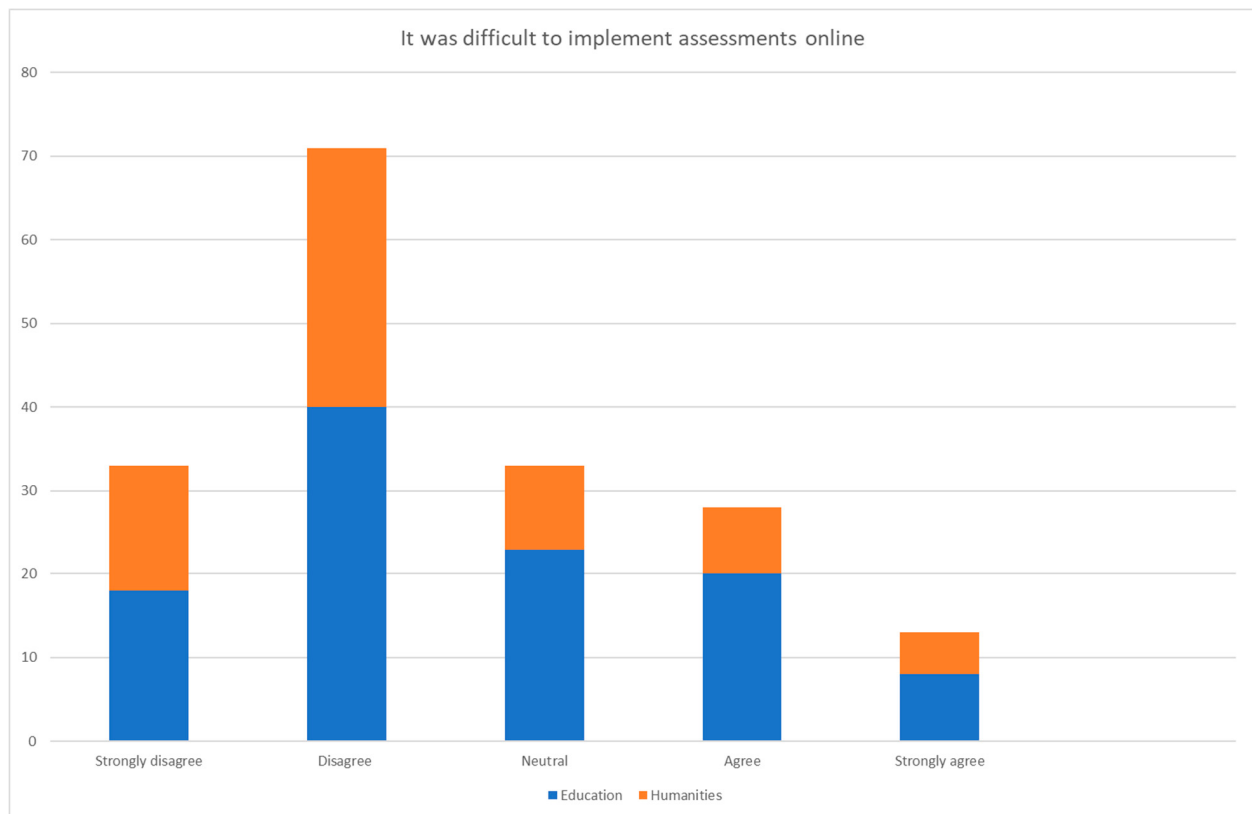


Figure A8. It was difficult to implement assessments online.

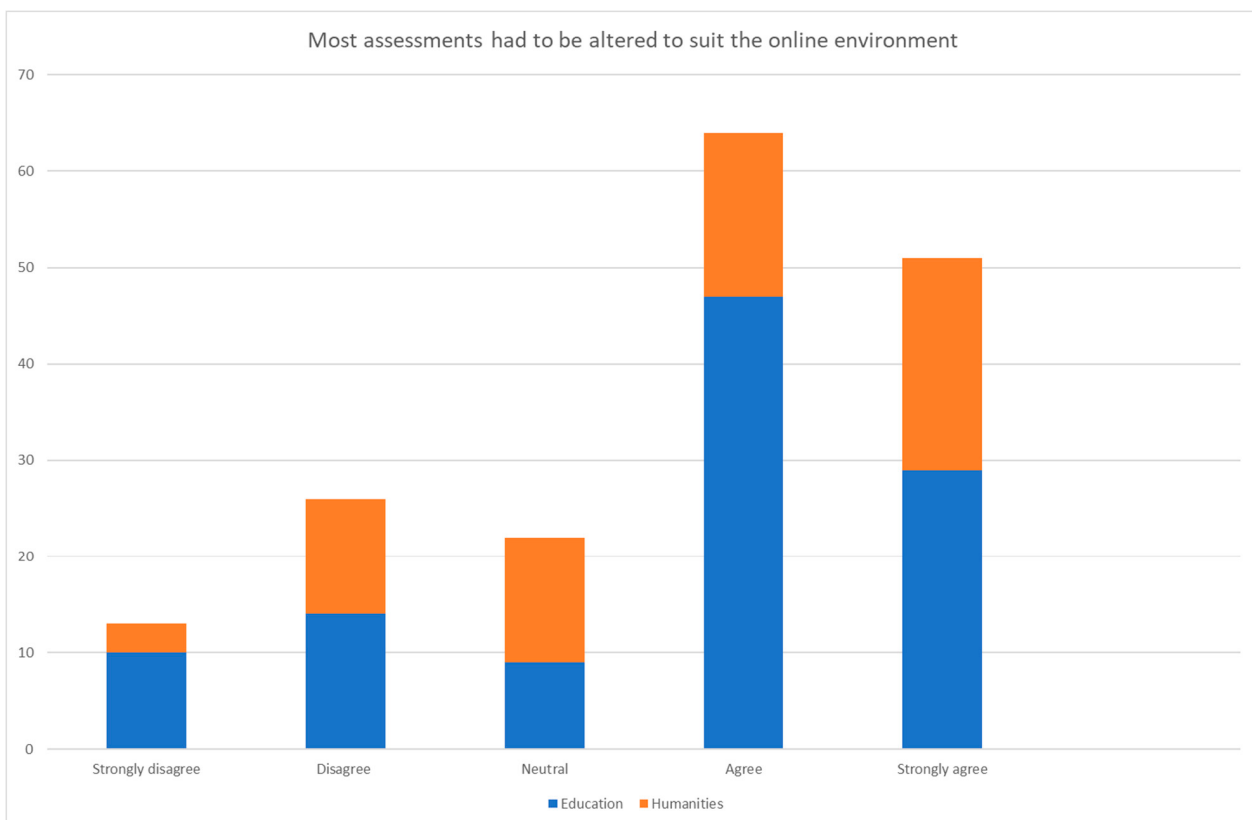


Figure A9. Most assessments had to be altered to suit the online environment.

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