Investigating Barriers that Prevent Students Attaining their Full Potential During their Science Degree

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Abstract

Social and economic barriers that students face during their studies can impact severely on their attainment and can be due to many factors. This study investigated how different socio-economic factors, with a focus on digital poverty and workspace availability may have affected students' attainment (during October 2021 - March 2022) at university post-COVID-19. Quantitative data collected during the first teaching block of the 2021-2022 academic year using specific questions in a paper-based questionnaire indicated that a good proportion of life science students did not have access to a home internet source (35%) or proper workspace facilities (34%) and had the requirement to work alongside their degree in order to fund their studies. In contrast to the lack of internet students experienced, many of the surveyed students did have access to a personal computer within their household. Possible reasons for some of the findings, and the implications of the findings, are discussed here.

Introduction

It has been known for quite some time in higher education that students from low socio-economic backgrounds can be adversely affected with respect to their potential attainment at university (Crawford, 2014). Some of the common barriers that have been identified over the years include commuting distance and financial constraints for students.

However, one striking observation that has been noted above all has been the issue of attendance and subsequent engagement (Martijn, et al., 2015; Aucejo et al., 2020). Students who have poor attendance are more likely to withdraw from university (Beggs & Smith, 2002), with a large majority being of a BME background (Kauser et al., 2021). At Kingston University, prior to COVID, many of the lectures within the School of Life Science (SoLS) ran at approximately half capacity with regards to attendance. It was thought that the move to online lectures during the pandemic would result in higher attendance and subsequent attainment by students. However, the opposite occurred with students, being found to have lower attendance than pre-pandemic levels. A study by Domina et al (2021) demonstrated that the COVID-19 pandemic regarding student attainment could have exacerbated this issue, mirroring what was seen in the SoLS after the pandemic. Various reasons may exist for student non-engagement and thus non-attendance, including a lack of belonging at university, the type of lecture (lectures based on assessment resulted in a higher level of attendance), requirement to supplement income and finally a lack of academic engagement with some lecturers mainly reading off slides (Oldfield et al., 2019).

Despite the fact that in some cases attendance was directly impacted by a student's

requirement to work alongside their degree, the main benefit of some paid work for university students is the development of key skills which could prove useful for careers post-graduation (Evans & Yusof, 2021).

A key barrier that has only recently been highlighted due to the COVID-19 pandemic has been IT poverty. This particularly has come to light recently due to the requirement for many higher education establishments to switch their teaching to an online platform. It has been shown that 17% of students in Irish higher education institutes, were in areas with weak broadband infrastructure and this correlated with the level of their family socioeconomically background, likely due to the poor housing they live in (Cullinan et al., 2021).

When the COVID-19 pandemic took hold, countries reacted differently. Most developed countries moved teaching to online delivery whilst developing countries moved only some of its teaching to online delivery (Crawford et al., 2020). This could be due to the population being disadvantaged with regards to accessibility to digital capabilities.

In the UK, students were specifically impacted regarding digital poverty, with 52% of students reporting that their learning was impacted during the COVID-19 pandemic due to slow or intermittent internet connection (Ofs, 2020). In addition, 71% of students reported no adequate study space, of which 22% were impacted severely. Although the report did not state the meaning of impacted severely, one can imagine this meant 22% of students had no study space at all to carry out their university work (Ofs, 2020). Workspace environment can be a critical aspect when it comes to student attainment, with students who use a shared workspace having the opportunity to make friends, share advice It also helps international students to form bonds on their course (Mulrooney & Kelly, 2020). During the COVID-19 pandemic, student households became their main workspace taking the form of a lecture theatre, a library, and dining hall (Gatlin et al., 2022). Students who had the space and the capabilities to form a workspace could adapt this to make this more supportive and thus increase their attainment. This would

primarily be for students from middle- or upper-class backgrounds, rather than students who are from quintile 1 and 2 of the index of multiple deprivation (IMD) and of a BME background, which constitutes the majority of students in the SoLS.

This project aimed to explore student perceptions about potential barriers which may affected their attainment during their science course, using a qualitative approach among the SoLS at Kingston University which composes a very diverse student body.

Methods

Project initiation

The project received funding as part of a Kingston University Student Academic Development Research Associate Scheme (SADRAS) project. This was advertised to undergraduates from all levels of three-year courses in the School of Life Sciences, Pharmacy and Chemistry on the Biomedical science and Biochemistry courses, via a Canvas announcement. In addition, 5 successful students were recruited to work along with staff partners from a total of 22 who were interviewed. The students recruited comprised a first year Biochemist, a second year Biochemist and three final year Biomedical Scientists.

Full ethical approval for the project was obtained from the Kingston University CHERP (Centre for Higher Education Research & Practice) in advance of the start of the project.

Questionnaire implementation

Student and staff partners worked in tandem to prepare a paper-based questionnaire to investigate barriers that prevented students from obtaining high marks in their science course. The questionnaire was divided into two main sections: Section 1 on student demographics and Section 2 on some of the potential barriers students may face. The types of questions in Section 1 included gender, age, ethnicity, qualification on entry, course of study, mode of study, accommodation, socio-economic group identification, disability status and finally first in family to attend university. For Section 2 the questions included commuting time, mode of commute, cost of commute, days

onsite, funding source, number of hours in employment, personal tutor support, university support, and integration with student societies, integration with the university, workspace status, "do you have access to your own PC" and source of internet. Finally at the end of the questionnaire there were some free text questions which again followed the theme of barriers and included 'elaboration of barriers students faced in learning', 'support that could be offered to students' and finally 'the biggest barrier to online learning'. The final check box asked if the student would take part in a small group interview session to expand upon the questionnaire answers. Students could not be identified by name and only the Kingston ID number was visible.

Questionnaire dissemination
Our project contained students from each year of degree courses in the school which included Biomedical Science, Biochemistry, Biological Science, Pharmacology, Forensic Science and Nutrition. The questionnaire was disseminated in a core module during the halfway break of lectures. We had access to 300 year one students, 200 year 2 students and 180 year 3 students. Every participant was provided with an information sheet explaining the information for the study with a clear consent form. All questionnaire completion was optional.

Small group interviews
The purpose of small group interviews was to supplement the quantitative data obtained from the questionnaire with some qualitative data. A list of questions (the majority of which are used in our study figures) to use within the interviews was devised by both staff and student partners and submitted for ethics approval along with the initial questionnaire. Seven questions were proposed including questions which expanded upon those in the questionnaire in more detail. All small group interviews were hosted online on Teams, recorded for thematic analysis and once all information was transcribed the recording was deleted.

Preparation and analysis of data
The data from the questionnaire allowed analysis of the barriers that students faced to be examined in more detail and to perform cross comparison with different demographics such as gender, age and ethnicity. The quantitative data was further analysed using SPSS and relevant statistical analysis tests. For qualitative analysis, small group interview and comments data were analysed using thematic analysis and word cloud-based software (Monkey Learn).

Results
Questionnaire distribution
The questionnaire was handed to over 300 students within core Biomedical Science and Biochemistry modules across all levels (Year 1-Year 3). 146 of these were completed in full with signed consent forms. This was carried out over a two-month period in the beginning of Teaching Block 1 (October-December 2022).

Demographics of student responses
Most student participants were females, who represented 71% of total participants (Figure 1). Participants spanned all degree year groups (1-3) with smaller numbers of second year students participating (Year 1: 38%, Year 2: 25% & Year 3: 38%). As expected in the SoLS, participants covered all ethnicities. Majority of participants were 25 years old or below (89%) (Table 1).

Responses to student barriers
Commuting
A generalised theme with regards to barriers was the observation of commuting time; 51% of participants admitted that they travelled a minimum of 60 minutes to get to university.

Financial commitments
37% of students identified themselves as working class, with 60% of participants living with their family. A large majority of students seem to have the requirement to work alongside their degree for possible financial reasons. 69% of students work a minimum of 11 hours along with their degree with 99% studying full time. Travel cost was also seen as a potential barrier with a large proportion of participants paying a minimum of £21 per week (48%).

Age			
18-21 Years	**22-25 Years**	**26≥ Years**	**PNTS**
98 (67.12%)	32 (21.92%)	14 (9.59%)	2 (1.37%)
Gender[1]			
Male	**Female**	**Binary**	**PNTS**
39 (26.90%)	103 (71.03%)	1 (0.69%)	2 (1.38%)

Ethnicity[1]					
White	**Black/Black British**	**Asian/Asian British**	**Mixed**	**Other**	**PNTS**
35 (24.14%)	24 (16.55%)	54 (37.24%)	9 (6.21%)	19 (13.10%)	4 (2.76%)

Table 1: Demographic characteristics of students completing questionnaires, expressed as numbers and a percentage of total (%). [1]One participant did not state gender and ethnicity (0.69%).

Digital/workspace requirements
34% of students did not have a dedicated workspace or were unsure if they had. Interestingly, 92% of students said they had access to their own PC or laptop, suggesting this did not seem to be a major barrier. In regard to sources of internet, worryingly, only 65% of students accessed home internet, with 35% stating their main source of internet was either the university Wi-Fi, mobile phone data or an internet hotspot (Table 2)

Comparison of teaching barriers: physical vs online
How students perceived barriers to their learning varied quite dramatically depending on the type of delivery. Students who attended on campus learning, surprisingly, seemed more affected by time management across all levels of their degree and increased in number through each year (Year 1: 19%; Year 2: 25% and Year 3: 37%). This did not seem to be the case when learning online with year one reporting this as a barrier slightly at 4% (Figure 1). It was quite evident student's saw online teaching as a barrier in the sense that distractions and engagement was much harder when online than on campus, a reflection on the fact that students potentially did not have a specific workspace to study within and may have been based in a bedroom or shared room. One main advantage it seems to online learning was with disabled students who found

online learning did not hinder them in any way (Figure 1).

Academic support and student perception
Using a Likert scale type question, we asked students to rate academic support on a scale of 0-10, 0 being no support at all and 10 being full support from academics. Those who classified themselves as not having a disability (n=104) felt they received adequate support with over half the responses being between 7-10 on the scale. Students who classified themselves as disabled (n=22) however were significantly less likely to receive support (ranging between 4-6 on the scale) p=0.028. This is of concern especially when disabled students seem to perceive that they are receiving less support than other students. (Table 3).

Student integration and on-site learning
Another barrier students face is their level of integration within the university and within their course. The COVID-19 pandemic has disrupted the making of the initial learning groups and allowing students to fit into a specific learning community. In the academic year 2021-2022, social and mental anxiety referrals were at an all-time high at the university, and this seemed to pose quite a large barrier when it came to course cohesion and course identity. Again, using a Likert scale type question, we asked students to rate

Dedicated workspace[1]			
Yes	No	Unsure	PNTS
85 (59.44%)	27 (18.88%)	21 (14.69%)	10 (6.99%)
Access to own PC/Laptop[2]			
Yes	No	Unsure	PNTS
132 (91.67%)	4 (2.78%)	7 (4.88%)	1 (0.69%)
Main source of internet[3]			
University	Home	Mobile	Hotspot
34 (18.48%)	119 (64.67%)	29 (15.76%)	2 (1.09%)

Table 2: Demographic characteristics of students digital and workplace needs, expressed as numbers and a percentage of total (%). [1]Three participants did not state workspace situations (2.1%). Two participants did not state access to PC/Laptop situation. [3]Participants may select more than one option.

Learning Barriers (%)	Level 4	Level 5	Level 6
Disability	9.67%	12.50%	7.41%
Workload	12.90%	18.75%	3.70%
Financial Issues	9.67%	6.25%	3.70%
Student Engagement	0%	6.25%	7.41%
Lectures	29%	12.50%	22.22%
Distractions	3.23%	0%	3.70%
Time management	19.35%	25%	37%
Personal development	16.10%	18.75%	14.81%

Online Learning Barriers (%)	Level 4	Level 5	Level 6
Disability	0%	0%	0%
Workload	0%	7.14%	0%
Financial Issues	0%	0%	0%
Student Engagement	17.86%	28.57%	28.57%
Lectures	14.29%	7.14%	10.71%
Distractions	60.71%	50%	42.86%
Time management	3.57%	0%	0.00%
Personal development	3.57%	7.14%	17.86%

Image 1: Heat maps to illustrate the barriers seen with on campus and online learning. Colours are represented by green to red with green representing no barriers and red indicating a high % of students reporting an issue.

university integration on a scale of 0-10, 0 being no integration at all and 10 being full university integration (and one would assume course integration), this was compared to the number of days students were required to be on campus for their degree, it was significantly noticeable that those students who were present less (3 days a week, n=54) did not feel as integrated as those present for on-site sessions more (4/5 days on-site, n=58/n=7) p=0.037 (Table 3).

Qualitative data
Students who took part in small group interviews (2-5 students) were asked three key questions:

- What barriers do you experience in your learning?
- What changes do you think could be made to support your learning?
- What are the biggest barriers to online learning?

In regard to the first question 'What barriers do you experience in your learning?' some of the biggest fears students face is the confidence to ask for help without feeling stupid with an illustrative comment such as' Unwilling to ask for help, thinking I am able to do it on my own and it will work out'. Or 'Afraid of asking stupid questions. (Table 4)

Support from Lecturers												Signficance Yes vs No, p=0.028
Disability	0	1	2	3	4	5	6	7	8	9	10	
Yes (n=22)	1	0	1	1	4	5	4	0	2	0	1	
No (n=104)	0	2	1	0	11	14	22	24	10	9	10	
PNTS (n=4)	0	0	0	1	0	1	0	0	2	0	0	

Level of Integration within University												Signficance 3 Days vs 5 Days, p=0.029; 4 Days vs 5 Days, p=0.037
Days on site * / week	0	1	2	3	4	5	6	7	8	9	10	
1 (n=1)	0	0	0	0	1	0	0	0	0	0	0	
2 (n=9)	0	0	1	0	1	2	3	2	0	0	0	
3 (n=58)	6	1	5	3	10	9	12	4	6	1	1	
4 (n=54)	4	4	5	7	5	4	11	5	8	1	1	
5 (n=7)	0	0	0	0	0	1	0	1	1	2	1	

Table 3: Qualitative data to illustrate academic support and student integration at Kingston University.

Small group interview question	Illustrative comments
What barriers do you experience in your learning?	'Unwilling to ask for help, thinking I am able to do it on my own and it will work out. Afraid of asking stupid questions'. 'Mental health issues, long commutes that are almost 20% of my day'. 'New culture, social elements, use of technology'. 'I have anxiety and low confidence so I find it difficult to approach my lecturers if I need support so consequently go without'.
What changes do you think could be made to support your learning?	'Provide more material for visual learners, eg. recordings to watch back later , have subtitles, caption's during online lesson'. 'I would like to see more livestreamed lectures via teams,. 'Having lectures streamed live would really help me to minimise my travel time and costs and maximise my study time'.
What are the biggest barriers to online learning?	'Its counter productive, both students and educators become disengaged. It negates the acquisition of skills like accountability, time keeping, communication, and group engagement'. 'Loss of concentration, internet issues'. 'Losing focus, technical issues, less interactive delivery'.

Table 4: Qualitative data responses to small group interview questions.

Other issues seem to centre on mental health and commuting, which has considerably increased since COVID-19.

In terms of what support measures, we could offer to overcome barriers, a large number of students have suggested a hybrid teaching approach in which lectures can be delivered face to face as well as online simultaneously. This would suit students from the faculty of life sciences as we have some of the highest level of commuting students as well as the majority of our students being from IMD 1 and 2 quintiles.

Finally, when asking what barriers students faced with online delivery, it was found that students faced similar issues with a representative comment being 'Losing focus, technical issues, less interactive delivery' (Table 4)

Considering all the qualitative data, we devised a word map to summarise some of the issues students faced with university teaching (See Image 2)
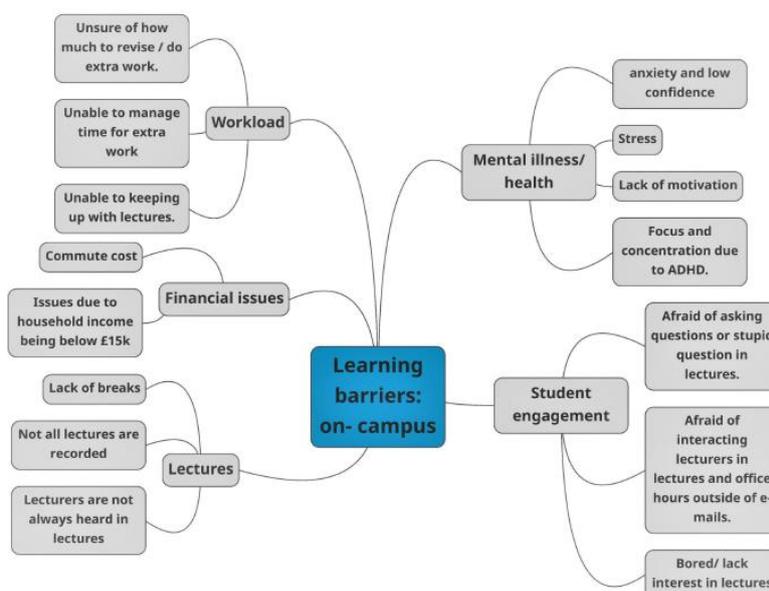
Image 2: University teaching word map to illustrate learning barriers from questionnaire and small group interview comments.

Discussion

Project findings

The main subject of this project was to explore student perceived barriers to learning, with a particular emphasis post COVID-19 on digital poverty and workspace availability. Some of the key barriers that came out of this study included some historic barriers with a few newer ones arising. Typical historic barriers to learning which resulted from this study were commuting time and financial difficulties with student requirements to work simultaneously with their degrees in order to fund themselves. New more prominent challenges which have arisen include digital poverty issues with internet access and connection problems being the main ones, limited workspace capacity, a lack of support for disabled students and course or university cohesion a prominent issue. Social and mental anxiety has also been pointed out as a key factor here with record numbers of students seeking help in that regard. All these factors mentioned have one overriding issue; they affect students' attainment at university.

Digital poverty

Digital poverty is an important aspect when it comes to barriers to learning. There were several instances where students were watching lectures on their phones as well as attempting assessments on the same device due to not having an internet connection at home. Despite 91.67% of students stating that they had access to their own PC or Laptop, what the project did not consider was the students who did not complete the questionnaire. The total respondents to the survey (n=146) represent ~18% of life science and around 29% of the department of Biomolecular Science (~500 students) so we could be missing out on the group of students who actually are financially constrained and could also have severe data poverty issues. This is touched upon when asking about current sources of internet. 35% accessing internet outside of home internet suggests that data poverty does seem to be a real issue when it comes to student learning and is something that needs to be thought about when designing online sessions.

Mental health and social anxiety

Mental health is a big issue in the sector when it comes to student attainment. This has increased significantly during and post COVID as students have tried to adapt to a new medium of learning during COVID with the

sudden switch to online learning, and during the transition back to university face to face teaching. Students have struggled to adapt to the stresses of on campus learning as well as reintroduction to social situations. Students seem required to adapt again to social situations with many students seeking help for extreme anxiety.

Several comments received during the small group interviews hosted also referred to mental health issues such as:

'Mental health issues, long commutes that are almost 20% of my day'.

'I have anxiety and low confidence, so I find it difficult to approach my lecturers if I need support so consequently go without'.

The issue with disabled students stating that they felt less supported from academics is an interesting finding. Disabled students could be categorised between those with physical disability and those with mental disability, so some of the findings from this study could be due to students feeling that academics were not helping them with their mental anxiety and depression exacerbated due to COVID-19. It is something the sector needs to look into especially with some universities reporting student suicides increasing since the COVID-19 pandemic.

Course cohesion
Course cohesion is a very important point when it comes to course planning. Students who feel like they belong to their course will perform better than students who feel isolated and not part of their course. Students also do not engage as much when they do not become integrated with their course with fewer friends being made. Another key observation which could impact on course cohesion is the structure of a student's timetable. The data from this project significantly raised issues with students who spent less time on campus (3 days) than those who spent slightly more (4/5 days) with students who spent 3 days feeling their level of course and university integration to be significantly lower than those who spent longer on campus. The school of life science, pharmacy and chemistry has the highest level of commuting students in the university, as well as a high proportion of students in Q1 and Q2 of the IMD who may choose not to attend all sessions especially if single lectures are on some days, in order to save time and money. Timetables must be adapted to the demographic of the students. Students are finding it difficult to balance their studies with work commitments.

How can this study be taken forward?
This study has raised several common barriers which have historically posed issues for students such as commuting, and financial constraints while introducing new barriers which developed further due to the global pandemic such as digital poverty and course integration or cohesion. There have been studies which have touched upon digital poverty and how this affects student attainment. Although students have a personal computer or laptop (92% of respondents), a concerning factor is the number of students who access internet sources outside their home (35%). Previous studies have linked digital poverty with low attainment. This strengthens the argument that we need to be providing more support such as loan laptops, internet packages and peripherals for students on low income. In regard to course integration, some ideas could be to initially look at the timetable. It should be the case that the timetable is adapted to cater for commuting and students with a requirement to work or financial constraints, by possibly having lectures starting late during off peak times to save on travel cost, having lectures streamed and presented in person to also cater for students who want to work at home or cannot come in due to family or anxiety issues. For course and university cohesion, the difficulty of life science courses is that they are shared across multiple courses, so having more course events and activities may encourage course cohesion. Also having regular course specific meetings would allow students on the same course to bond and get to know each other to increase this cohesion. This project should be expanded to target key learning sessions where an assessment is linked to attendance, to expand the numbers of respondents and to obtain more data.

References

Aucejo, E. M., French, J., Arya, M. P. U. & Zafar, B. (2020). *The impact of COVID-19 on student experiences and expectations: Evidence form a survey*. Journal of Public Economics.191.
doi.org/10.1016/j.jpubeco.2020.104271

Beggs, B. J. & Smith, E. (2002). *Optimally Maximising Student Retention in Higher Education*. Paper presented to the Society for Research in Higher Education Annual Conference, Glasgow, December.

Crawford, C. (2014). *Socio-economic differences in university outcomes in the UK: drop-out, degree completion and degree class*, IFS Working PapersW14/31, Institute for Fiscal Studies.

Crawford, J., Butler-Henderson, K., Malkawi, J.R.B., Glowatz, M., Burton, R., Magni, P.A., Lam, S. (2020). *COVID-19: 20 countries' higher education intra-period digital pedagogy responses*. Journal of Applied Learning & Teaching, 3, 1.
doi.org/10.37074/jalt.2020.3.1.7

Cullinan, J., Flannery, D., Harold, J. Lyons, S. & Palcic, D. (2021). *The disconnected: COVID-19 and disparities in access to quality broadband for higher education students*. Int. J. Educ. Technol. High. Educ., 18, 26.
doi.org/10.1186/s41239-021-00262-1

Domina, T., Renzulli L., Murray B., Garza A.N. & Perez L. (2021*). Remote or Removed: Predicting Successful Engagement with Online Learning during COVID-19*. Socius, 7.
doi.org/10.1177/2378023120988200

Evans, C. & Yusof, Z. N. (2021). *The importance of part-time work to UK university students*. Industry and Higher Education, 35, 6, 725–735.
doi.org/10.1177/0950422220980920

Filippin, A. & Paccagnella, M. (2012). *Family background, self-confidence, and economic outcomes*. Economics of Education Review, 31, 5, 824-834.
doi.org/10.2139/ssrn.2154969

Gatlin, A. R., Swearingen, S. A. & Tan, L. (2022). *COVID-19 Study Spaces: Supportive Adaptation of Home Learning Environments During the Pandemic*. Journal of Learning Spaces, 11,1.

Kauser, S., Yaqoob, S., Cook, A., O'Hara, M., Mantzios, M. & Egan, H. (2021). *Learning from the experiences of Black, Asian and Minority Ethnic (BAME) university students who withdraw from their undergraduate degree*. SN. Soc. Sci., 1, 121.
doi.org/10.1007/s43545-021-00115-8

Kobus, M. B. W., Van Ommeren, J. N. & Rietveld, P. (2015). *Student commute time, university presence and academic achievement*. Regional Science and Urban Economics, 52, 129-140.
doi.org/10.1016/j.regsciurbeco.2015.03.001

Mulrooney, H,F. & Kelly, F A. (2020) 'The university campus and a sense of belonging: what do students think', New Directions in the Teaching of Physical Sciences, 15, 1.
doi.org/10.29311/ndtps.v0i15.3590

Oldfield, J., Rodwell, J., Curry, L. & Marks, G. (2019). *A face in a sea of faces: exploring university students' reasons for non-attendance to teaching sessions*. Journal of Further and Higher Education, 43, 4, 443-452.
doi.org/10.1080/0309877X.2017.1363387

Zhou, Y. & Hua, Y. (2021). *The role of shared study space in shaping graduate students' social networks*. Journal of Facilities Management, 19,1, 92-110.
doi.org/10.1108/JFM-08-2020-0060