RESEARCH DIRECTIONS

Exploring Staff and Student Perceptions of Learning Resources in Physical Sciences

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Keywords: *Learning resources; Online Learning; Student Engagement*

Abstract

The COVID-19 pandemic necessitated a significant diversification of learning resources and teaching methods and in its aftermath different approaches have been taken across science education in HE. Within this work we explored staff and student preference for learning resources, using anonymous online questionnaires. It was found that a hybrid approach to resources was preferred, with in-person lectures rating higher than their online counterparts. Engagement emerged as the overarching theme, with differences between staff and student perceptions of student engagement identified; in particular, students consistently rated their own engagement with resources higher than what staff perceived.

Background

During the COVID-19 pandemic restrictions, university staff were obliged to rapidly create new resources and interact with students predominantly via online means. Initially staff found this difficult. Over 80% struggled to switch from offline to online, they experienced technical hurdles and increased workloads when creating new resources (Ní Fhloinn & Fitzmaurice, 2023; DeCoito & Estaiteyeh, 2022). Students found it challenging to switch from engaging in-person to online teaching, however, some started to appreciate the flexibility it offered (Lee, 2020; Rodríguez Núñez & Leeuwner, 2020). The negative, and occasionally positive, experiences of staff and students from around the world, are well documented for this period (Rodríguez-Rodríguez *et al.*, 2020; Ní Fhloinn & Fitzmaurice, 2023; Krishnamurthy, 2021). However, less has been said about what has happened in Higher Education post 2021, when restrictions were lifted, and academic life returned to a 'new normal'. In many universities this new pivot has meant offering a combination of in-person and online methods of engaging with academic material (Simmons and Mistry, 2023). What is perhaps less clear is what staff and students think about this and what their preferences are with respect to this hybrid approach in comparison to purely online or in-person.

Post 2021, staff at the School of Chemical and Physical Sciences at Keele University (SCPS) are expected to deliver the range of in-person teaching methods and learning resources that were available pre-pandemic, but also continue to make available a range of additional online options. These resources may include synchronous online access to in-person sessions, pre-recorded screencasts covering academic content and providing electronic access to all written resources. Students, which include cohorts who started university pre, during and post pandemic, have been shown to selectively engage (Barile, Elliot & McCann, 2022), particularly when a wide range of resources are on offer. These extra offerings imply added pressure on staff workloads (DeCoito & Estaiteyeh, 2022), so it is important to understand if this full range of resources is necessary.

https://doi.org/10.29311/ndtns.vi19.4468

Aims

The aim of this project was to explore the perceptions of staff and students (and alumni) towards learning resources, specifically those made available to the undergraduate students of the SCPS.

Methodology

The perceptions of SCPS students, alumni and staff at Keele University towards learning resources were evaluated through voluntary, anonymous, online questionnaires. Separate questionnaires were used for students/alumni and staff, both using a combination of Likert-style and free-text questions. Only a very small set of very general questions was asked in this exploratory study, to encourage participation and maximise the data obtained, which focused on asking participants to rank their preference for and perceived student engagement with the range of resources available in SCPS, as well as probe their general preferences for online, in-person or hybrid approaches. Questions were initially formulated by the first (student) author and discussed with the second author to ensure clarity and the absence of bias in the wording. The SCPS Student Project Ethics Committee favourably reviewed the ethical considerations for this project its undertaking. To ensure full anonymity, no identifiable data (*e.g.* ethnicity, disabilities, etc.) was sought, with the only demographic questions relating to aspects such as subject studied/taught or year of study/years of teaching experience.

Of the 55 staff invited via email to participate, 12 (22%) completed the questionnaire. There was representation from all areas of the School (Chemistry, Physics and Forensic Science), and most respondents teaching across more than one subject. The experience of the staff was also wide-ranging, from 1 to 28 years of teaching, with all but 1 teaching through the Covid-19 pandemic.

Of 523 students in SCPS invited to complete the questionnaire, 83 (16%) students took part in the study. All three subjects were represented by participants, with 18 of the students studying more than one subject through a Combined Honours course as Keele offers Combined Honours programmes. Participants were well spread through Years 1-3 of study, with 3 respondents on Year 4 of integrated Master's courses.

Alumni were invited through social media, including LinkedIn and X, to complete the questionnaire and 17 responded; all subjects were represented, with 4 alumni having studied more than one subject.

A mixed methods approach was undertaken, using both quantitative and qualitative data analysis. As the Likert-style questions had numerical answers, they were analysed utilising quantitative methods. The staff and alumni/student data were initially analysed separately for relationships within each data set, and later reviewed for comparisons between them. The mean values were plotted through 2D clustered column bar charts, to enable comparison between:

- staff preference for resources and their perceptions of student engagement with resources.
- student preference for resources, and their perceived engagement with resources.
- staff and student perceptions.

Free-text questions were analysed using thematic analysis, initially as two separate data sets for staff and student/alumni responses. This method was chosen for its ease and reliability, (Barile, Elliot & McCann, 2022) with time dedicated to identifying and colour-coding themes by repeated studying of the data per question. Sub-themes were then combined into broader themes and representative respondent quotes were selected to aid understanding and validate the selected themes (Vaismoradi, Turunen, & Bondas, 2013). Some themes with limited support per question, were found to be representative when data from all questions were combined. Themes were then explored between staff and student data; some themes which had limited support within each data set were found to be representative when the sets were combined.

To maximise impartiality, and examine all relevant perspectives, occurrences of each theme were counted, and those with the highest counts were prioritised; additionally, independent validation of the themes was

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undertaken by the second author to limit bias and ensure all emerging themes were identified (Vaismoradi, Turunen, & Bondas, 2013; Nowell, 2017).

Results and Discussion

'Engagement' was the over-arching theme that emerged from the thematic analysis and although exploring student engagement was one of the project's main aims, it was not entirely expected for it to dominate the free-text results so significantly. Within the broad scope of engagement, key aspects were highlighted, such as the importance of student engagement, its links to student attendance and/or active learning and staff engagement with students.

Staff Perceptions

As seen in **Figure 1**, staff preferred resources that required higher levels of student engagement, such as in-person laboratory sessions, tutorials and problem classes, and Team Based Learning (TBL). When prompted to elaborate, over 70% noted they preferred resources which either encouraged active learning and/or enabled staff to engage directly with the students.

"*…because in those, students engage in active learning*" – staff.
"*I appreciate being able to "see" student's engagement*" – staff.

Active learning and team-based environments such as the ones preferred by staff are well researched and widely accepted approaches that compel student engagement and have positive effects on attainment (Richards-Babb *et al.*, 2014; Kandakatla *et al.*, 2020; Freeman *et al.*, 2014; Phattanawasin *et al.*, 2021). Staff have generally been shown to prefer these more interactive settings which enable them to gauge student understanding better (Ní Fhloinn & Fitzmaurice, 2023; Ranga, 2020; Deslauriers *et al.*, 2019).

For staff, in-person lectures rated only slightly higher than asynchronous screencasts as shown in **Figure 1**. Whilst previous research has found that staff generally prefer in-person sessions (Krishnamurthy, 2021), the small difference seen here could imply that some of

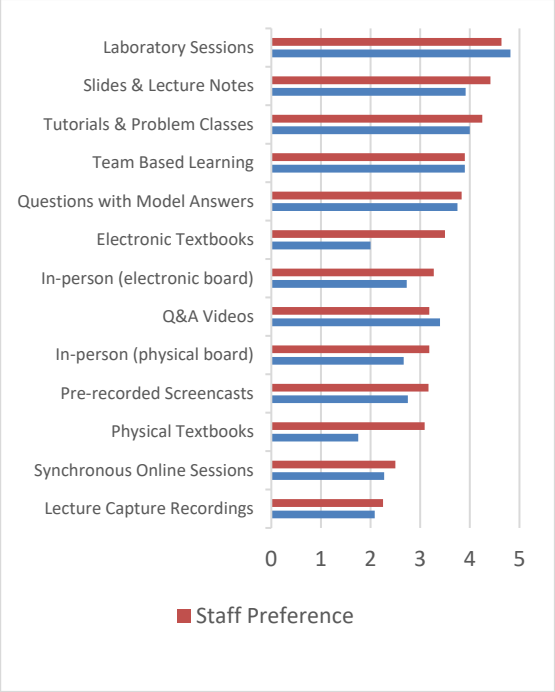

Figure 1. Staff preference for and perceptions of student engagement with learning resources, ordered by staff preference.

the negativity towards screencasts, prevalent in the early stages of the pandemic (DeCoito & Estaiteyeh, 2022), has decreased in later years. Synchronous online sessions and lecture capture recordings, on the other hand, were consistently the least preferred resources for teaching staff.

Staff perceptions of student engagement with resources is also shown in **Figure 1**, where perceived engagement somewhat mimics staff preference, albeit being lower for almost all resources. The most significant difference relates to textbooks (both physical and digital), where staff preference for these resources is significantly higher to what they perceive student engagement with them to be.

"*Textbooks are especially good … but they seem to be very rarely used by students*" - staff

More generally, 100% of staff agreed that they were concerned about current issues with (lack of) student engagement.

"*I am concerned with student lack of engagement full stop*" - staff

"*I think we've got clear evidence of a general drop in the average engagement*" – staff

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Student Perceptions

As seen in **Figure 2**, students also generally showed a preference for resources that typically require higher levels of active engagement, with the highest rated in terms of their reported-engagement being laboratory sessions and tutorials and problem classes.

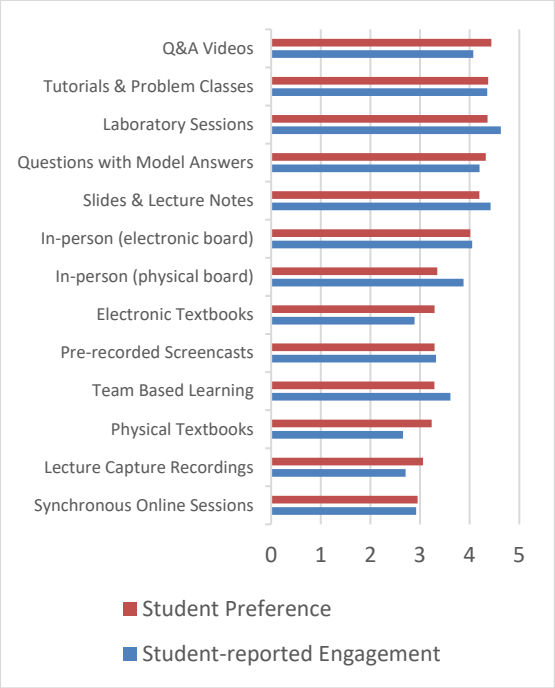

Figure 2 Student preference for and self-reported engagement with learning resources, ordered by student preference.

Interestingly, students rated questions with model answers and Q&A videos very highly. Whilst neither of these are necessarily "active resources", they could be perceived by students as directly linked to assessment, leading to this high rating.

"I also think more question and model answers should be accessible to students…" - student

"…a degree is based on how well we understand and can answer questions on a given topic, and with the lack of model answers how can we be sure we understand the material" – student

These perceptions are validated by previous research, which found that students who watched Q&A videos had higher attainment in assessment (Richards-Babb *et al.*, 2014).

Similarly to staff, some of the largest differences between student preference and their reported engagement relates to textbooks, both physical and electronic.

Student engagement with physical textbooks appear to be on the decline and it was found that during COVID-19 restrictions, students were concerned about accessing online textbooks, as this resulted in more screen time (Krishnamurthy, 2021). Although this was not specifically mentioned by students in this study, some did imply that engagement would improve if staff referred to specific sections of textbooks.

"*Specific chapters in textbooks help as I'm more likely to read sections rather than a whole book*" - student

When students were asked for their preferred style of teaching, 47.5 % selected hybrid resources, 45.5 % in-person resources, and 7.0 % online resources (see **Figure 3**). A preference by students of a hybrid selection of resources, over purely in-person or online, as found here, has previously been reported (Kandakatla *et al.*, 2020).

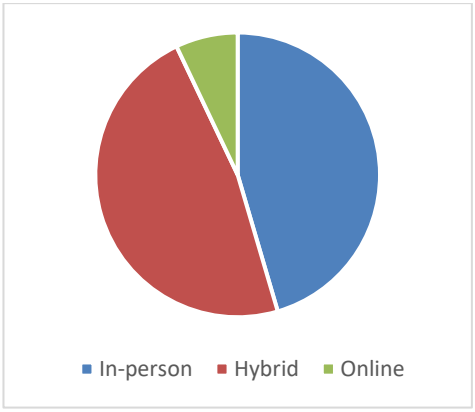

Figure 3. Students' preferred style of teaching resource.

Students who expanded on their preference for in-person teaching sessions expressed that attending in-person helped them improve engagement and understanding.

"*In-person resources are more preferable to me as I find it easier to engage with the content while being physically present*" - student

"*As someone who suffers from procrastination in person helps a lot more in the learning and understanding*" - student

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Students who have been taught in-person have been shown to have greater self-discipline and time management than students being taught online, leading to less procrastination, which is reflected in the student comments in this study (Jensen *et al.*, 2012).

Some students also explored disadvantages of in-person teaching, related to poor timetabling, anxiety about attending in person or not being able to keep up with sessions or peers.

"*I also find that I am anxious during in person, hence for the low engagement*" - student

"*Sometimes lectures go by too quickly so I can't catch everything the lecturer said*" - student

Conversely, students commented on the flexibility of asynchronous online resources including enabling them to re-watch content, work when and where they chose and at a pace that enabled maximum engagement. These attitudes, shared by students and staff, have been recorded numerous times by previous research studies (Ní Fhloinn & Fitzmaurice, 2023; Vaismoradi, Turunen, & Bondas, 2013; Reyes et al., 2022; Lee, 2020).

"*I engage better with online (asynchronous) lectures because I am able to slow down the playback speed if necessary and can also pause in order to process the information / write it down. And the freedom to watch these at a time during the day when I know I am most motivated*" - student

A hybrid approach, offering a combination of online and offline resources, had positive comments from students who appreciated being able to attend in person and review materials via asynchronous online content, mirroring findings from previous research (Reyes et al., 2022).

"*I understand content first by attending lectures, then going over the screencasts*" - student
"*I do find it helpful to refer back to if I need to, I like a balance between online and in person material*" - student

An interesting theme that emerged from the qualitative analysis of student responses was that the quality of the resources significantly affected their engagement, particularly in terms of online recordings.

"*My low engagement can be improved by more of them being uploaded and a better quality of recording from any sessions*" - student

"*Recordings fail to ensure engagement as the quality is often poor*" - student

"*Instead of Reading off the slides as delivery method of learning… preferably just to sum up of each slide*" - student

This is an area that could be further investigated, as resource quality was not specifically probed in this study, which could lead to recommendations for improving resource development by staff.

Engagement between staff and students was probed primarily through asking students about their preferred medium for asking staff questions. Asking questions develops higher order thinking and students that interact with staff are linked to higher attainment (Jensen *et al.*, 2022). Previous research has indicated that staff believe that asking questions in person is easier for students than sending emails (Jensen *et al.*, 2022) and to some extent that was confirmed by what students noted in this study. Over half of participants related that they preferred to ask questions in-person (26% during a teaching session and 26 % in one-to-one meetings with staff); a further 46% noted email as their preferred method to raise questions, with only 3% choosing text-based chat during online sessions.

The reasons provided by students as to their preferred method of asking questions varied, with some stating that it depends on the kind of information they are asking for. Some mentioned that their preferred method was linked to anxiety (*e.g.* speaking in front other people) or specific disabilities. As discussed in the methodology, no specific information regarding disabilities was asked for in this study, to ensure full anonymity of responses; however, it is clear from mentions in free-text comments that there are links between disabilities and students' preference for, and engagement with, resources and learning.

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Perceptions across Different Student Populations

There was no appreciable difference identified between alumni and student responses as to their preferences or reported engagement with the various learning resources. Additionally, no significant differences were observed when comparisons were made between current student cohorts. This is an interesting result which may indicate that student preferences and their perceived engagement have not changed as significantly as may otherwise be assumed during and after the COVID-19 pandemic, particularly with respect to online vs in-person. A recent overview of post-pandemic chemistry teaching in UK HE suggests that whilst some online resources have been maintained, particularly in the form of asynchronous screencasts, teaching and assessment has by and large pivoted back to in-person, especially for laboratory sessions, tutorials and workshops/problem classes (Simmons & Mistry, 2023). This mirrors both staff and student preferences, as well as perceived relevance of in-person, active learning in chemistry or science subjects more widely.

Comparisons between students studying the three key subject areas in SCPS showcased that the trends in preference for and engagement with various resources was largely consistent across the sciences. However, physics students on average rated engagement with in-person teaching higher than other students, whereas forensic science students rated engagement with online resources higher than other students in the School. This may be related to the subject-specific aspects which may warrant further probing but could be simply linked to a higher proportion of content delivery remaining online (flipped classroom style, with screencasts followed by in-person active learning sessions) for forensic science students in the 2022/23 academic year than for other areas in SCPS.

Comparison of Staff and Student Perceptions

The highest ranked resources in terms of student engagement, both self-reported and perceived by staff, are laboratory sessions. As seen in **Figure 1** and **Figure 2**, these were also some of the highest ranked in terms of preference for both groups. This emphasises the well-known importance of the practical aspects of science courses, and the value staff and students place on the opportunity to develop practical skills (Rodríguez-Rodríguez *et al.*, 2020). In fact, throughout the COVID-19 pandemic and as restrictions were lifted in the UK, there was significant emphasis in these subjects to prioritise practical aspects and the return to in-person laboratory sessions (Simmons & Mistry, 2023).

The most significant differences between student-reported and staff perceived engagement was linked to in-person lectures/seminar style sessions; as seen in **Figure 4**, whilst preference for these sessions was relatively high by both groups, staff considered student engagement to be significantly lower than students reported. It would be interesting to further probe this discrepancy of views with real attendance data, for example, and perhaps use focus groups to try to understand why there is such a different perspective and what could be done to improve attendance if this is in fact needed; this may lead to a wider discussion on whether attendance is a good proxy for engagement, or even what engagement actually means to staff and students.

In-person sessions were closely followed by textbooks in terms of staff underestimating student-reported engagement. As seen in **Figure 4,** the two groups report similar preference for textbooks, whether electronic of physical, but staff believe students engage less with them than students report doing. As discussed above, students suggest that improved guidance on specific areas of the textbooks that are relevant to the topics being studied could further improve their engagement with these resources (Turner, 2022).

The most significant differences in terms of preference, rather than perceived engagement, between staff and students relate to Q&A videos and lecture capture recordings. These are less active learning resources than many others discussed here, which may be why staff have low preference for them; resources that lead to active learning or allow them to gauge student engagement directly were preferred by staff, encouraging deeper learning and further understanding. Students

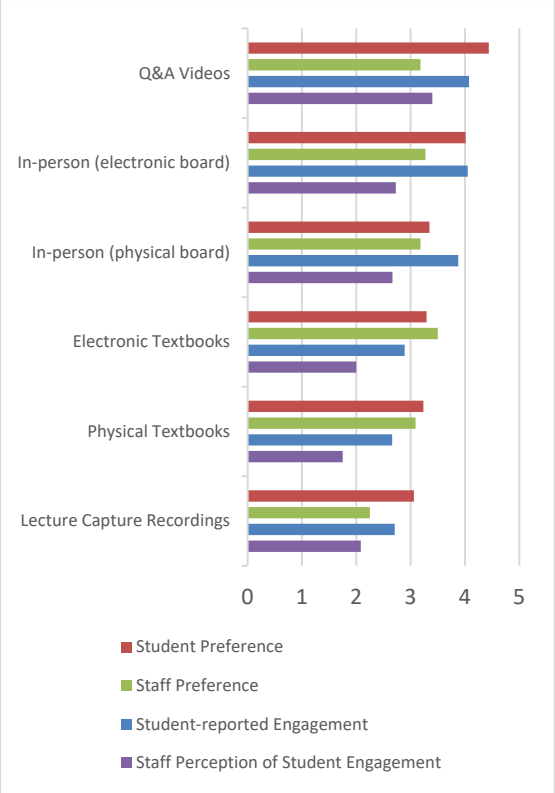

Figure 4. Comparison of staff and student preferences for and perceived engagement with various learning resources.

on the other hand, make a direct link between these resources and revision/preparation for assessment, rather than learning more generally, something that may be overlooked by staff. Assessment literacy is clearly an important area for HE student development, which may be affected by their Covid-19 impacted school experience. Further staff consideration for formative assessment or better/more obvious links between resources and assessment may help students feel better supported and increase engagement.

Whilst not specifically asked about, some students disclosed that their preference for online resources was linked to disabilities or health issues, which may make in-person attendance more difficult. The requirement to cater for the diversity of student needs was recognised by some of the staff surveyed, with an emphasis on the benefit of a hybrid approach, allowing for learning to be reinforced.

"*I prefer online resources due to my health making attending lectures difficult at times*" – student

"*A smaller group of students are directly disadvantaged by resources not being in a format that enables them to engage*" - staff

Limitations

Whilst high response rates to survey-based studies (over 80%) are generally viewed as preferable, response rates as low as 25% have been claimed as acceptable to exclude bias in results (Richards-Babb *et al.*, 2014). Low uptake is fairly common for voluntary, online educational studies such as this and it has been acknowledged that this usually favours staff and students who check emails, have time availability and an intrinsic motivation for the completion of the surveys (Simmons & Mistry, 2023); in this case only 22% of staff and 16% of students in SCPS responded, so bias in the results need to be acknowledged. As seen through the free-text comments, the questionnaires appear to have appealed to respondents who had strong emotionally charged views.

Whilst significant consistency was found across different student populations, in terms of subject studied, year of study and even taking alumni views, this research is limited to SCPS at Keele University. It could easily be extended to include other schools and other universities, to ascertain if these views are consistent across the sector.

Conclusions and recommendations

Whilst engagement was the overarching theme in terms of perceptions by staff and students, it is clear that there are significant differences in views between the two groups.

There was alignment between staff and students, both groups generally reporting a preference for active learning resources – those that require higher levels of student engagement, such as laboratory sessions and tutorials/problem classes. Whilst in-person sessions were mostly favoured over online resources, a hybrid selection of resources was preferred overall by students, confirming that the combined approach currently adopted by many universities is probably the right one (Simmons & Mistry, 2023). The benefit of a flexible, approach with a variety of learning

resources for students with specific needs or disabilities was highlighted, unprompted by both students and staff.

Staff are clearly concerned about a lack of or decrease in student engagement; however, students consistently rated their own engagement with resources higher than staff did, indicating a significant disparity between the two views. Finding ways to objectively monitor 'engagement', such as perhaps attendance or views in terms of online resources and correlating them with attainment may provide further insight and allow the development of approaches that can better support students and target the concerns felt by staff.

The emerging links between perceived resource quality and student engagement with them would be interesting to explore further, including relationships between quantity and quality of resources and the strain between student wishes and staff workload burdens. Could there perhaps be a need for staff training and development of better resources to bring these aspects together? Focus on specific types of resources favoured by students, such as Q&A-style resources as noted in this study, especially if these can be linked to tangible benefits such as improved attainment, could also limit the amount of resources developed, and thus staff loads, whilst improving perceived support by students.

In terms of specific resources, some of the biggest discrepancies in views were around the use of textbooks, both digital and physical. Staff have a high preference for them but believe that students do not engage with these resources, whilst students report a relatively high preference for textbooks and a much higher engagement than staff perceive. A better weaving of the textbooks into other resources (e.g. lecture notes) with specific reference to chapters or sections would perhaps improve student engagement with these resources.

Acknowledgements

We would like to thank the staff, alumni, and student participants of the School of Chemical and Physical Sciences at Keele University for completing the questionnaires and including such rich free-text comments. DP acknowledges CPS-WRITE for ongoing support.

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