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Exam Experiences, Motivational Beliefs, and Belonging in First-Year University Physics Students: Insights from the COVID-19 Pandemic

ABSTRACT

The COVID-19 pandemic provided an opportunity to better understand the transition from secondary school to higher education regarding students' assessment and written-exam experiences. We used mixed methods to investigate students' experiences of first-year university physics exams and cancelled secondary school exams, regarding their motivational beliefs (regarding themes such as self-efficacy and test anxiety) and sense of belonging. Questionnaire findings from 78 physics students suggest those who felt more negatively impacted by cancelled school exams felt less prepared, less self-efficacious, and more anxious in their university exams than students who felt more positively impacted. Follow-up focus groups with five students revealed they felt out of practice sitting high-stakes university exams and unprepared for the new open-book format, contributing to their test anxiety. Cancelled school exams also provided short-term relief, but belongingness uncertainty; students felt unable to prove themselves and questioned whether they had earned their place in higher education. Our findings suggest that the exam experience is central to both creating a sense of belonging for students and building mastery experiences in terms of self-efficacy and test anxiety.

KEYWORDS

summative assessment, transition to higher education, self-efficacy, test anxiety, belonging

INTRODUCTION

The first year of higher education is the most crucial in the transition from secondary school in terms of expectations, independent study, and challenges to overcome. Students must adapt to living independently and engage critically with their studies. This transition is well researched in terms of how well-prepared students are, their expectations, and how to support them (Gallimore and Stewart 2014; Meehan and Howells 2018; Suto 2012). Assessment expectations, experiences, and practices can be powerful in supporting the transition to higher education (Taylor 2008). Assessment experiences at school are important for shaping students' experiences and expectations of assessment at university; students bring practices, identities, and cultures with them from secondary-school assessment systems into higher education (Ecclestone 2007), prefer assessment methods they are familiar with

because these reduce stress and anxiety (van de Watering et al. 2008), and find frequent assessments to be a source of motivation to study (Vaessen et al. 2017).

This is particularly the case for physics (the focus of this study), due to similarities in assessment type (written exams) between secondary school and university. Written exams are the most common form of assessment for university maths and science (Goubeaud 2010; Lipnevich et al. 2020). This has implications for students' performance. Johnston et al. (2022) found a positive correlation between external school-exam performance and higher education performance in maths and science courses, but not for humanities and social-science courses, which use a greater variety of assessment types and practices (Wilson, Child, and Suto 2017). However, higher-education written exams can disadvantage underrepresented students, due to question style, for example, where scaffolded questions are more gender-equitable (Gibson, Jardine-Wright, and Bateman 2015), or their high-stakes nature (Malespina and Singh 2022; Simmons and Heckler 2020), resulting in implications for underrepresented students' continuation in physics.

It is therefore important to fully understand students' exam experiences and how they navigate this assessment transition. We investigated physics students' experiences of first-year university exams in England, specifically the cohort who had secondary-school exams cancelled due to the COVID-19 pandemic (Department for Education 2020). Secondary-school maths and science teachers believed students starting higher education during the pandemic lacked assessment experiences of practising exam-style questions and revisiting the content (Cottle 2021). We explored how the absence of school exams and then sitting university physics exams might be linked, in order to better understand the assessment transition to higher education. The pandemic provided a unique opportunity to learn what was missing for these students regarding assessment and why this was important to them. What happens when that "culture of assessment" (Murtagh 2012) is disrupted for a subject such as physics, where written exams have high value for students (Bøe 2023)?

To find out, we were interested in learning what students felt had affected their university exams and how it influenced them, such as impacting their motivational beliefs. STEM teachers in England felt students entering higher education struggled to cope with the workload after reduced workloads during lockdown and exhibited increased stress (Cottle 2021), suggesting they felt less prepared. Exam results are often a way to demonstrate success and build self-efficacy, which may have been disrupted during the pandemic (Marzoli et al. 2021). However, unfamiliarity with online or open-book exams may have also contributed to a decline in students' self-efficacy (Marzoli et al. 2021) and increased test anxiety (Arora, Chaudhary, and Singh 2021) during university exams.

Researchers have also explored other effects of the pandemic, such as highlighting the importance students place on exams. In England, students felt that their hard work was wasted during the pandemic (Bhopal and Myers 2023; Mccarthy 2022) and believed exams were a chance to prove themselves and earn the next stage of their lives (Wenham and Lee 2022). This suggests these students were extrinsically motivated regarding school, believing the purpose was to pass exams, and suggests uncertainty regarding belonging. However, the specific education system can influence students' beliefs about the disruption. Secondary-school students in Norway, for example, which has a lower summative-assessment weighting for final grades than England, viewed cancelled exams positively, as they had more time for studying, felt less stressed, and experienced no decline in motivation (Sandvik et al. 2021). To therefore help frame our students' first-year physics exam

experiences, we focused specifically on motivational beliefs (self-efficacy, test anxiety, and perceived preparedness) and sense of belonging.

Motivational beliefs

Self-efficacy is defined as confidence in one's own ability to complete a task. It can be built through successful practice (mastery experiences), role models (vicarious experiences), and encouragement (social persuasion), and is mediated through the emotional and physiological state of the individual (Bandura 1977). Self-efficacy is strongly linked to academic performance in science (Andrew 1998; Multon, Brown, and Lent 1991). Mastery experiences typically include achieving high grades on exams (Dorfman and Fortus 2019) and achievements in teamwork, laboratory work, or homework (Hutchison et al. 2006). Mastery experiences significantly predicted self-efficacy in secondary-school science students (Britner 2008) and achievement in maths and engineering modules for students in Singapore (Loo and Choy 2013).

Test anxiety is a type of performance anxiety that consists of physiological responses, such as an increased heart rate, and cognitive responses, such as feelings of self-doubt, and it is important in understanding student wellbeing during exams. Test anxiety is also strongly linked to academic performance (Chapell et al. 2005; Eklöf and Nyroos 2013). In addition, test anxiety impacts female university students more than male students (Chapell et al. 2005). Test anxiety and self-efficacy are interdependent: an increase in self-efficacy decreases test anxiety, and vice versa, and self-efficacy can mediate the relationship between test anxiety and performance in high-stakes tests. When controlling for either, gender no longer significantly predicts high-stakes exam performance (Malespina and Singh 2022). Test anxiety and self-efficacy can be boosted by coping strategies (Arora, Chaudhary, and Singh 2021), and recalling mastery experiences mitigates the effects of test anxiety (Nelson and Knight 2010).

Preparedness is the perception of readiness; students who feel more prepared are more likely to have a better transition to higher education, persist in their studies, and are more motivated (Jansen and van der Meer 2012). Mastery experiences from exams also lead to feelings of preparedness (Jansen and van der Meer 2012). Furthermore, the emphasis on high-stakes assessment at secondary school, which influences curriculum, pedagogy, and results in educators "teaching to the test" (Au 2007), contributes to students' under-preparedness in higher education (Suto 2012).

Belonging

Belonging and its relation to assessment experiences is relatively under-explored and usually considered as a social process. A sense of belonging is defined in Strayhorn (2018) as feeling connected to, valued by, and important to faculty, staff, and peers. Academic belonging is feeling a connection to an academic community (Adler-Kassner et al. 2022), such as a class or programme, the university or faculty, or the discipline itself (Lewis et al. 2016; Meehan and Howells 2019). Feeling like they belong is important to students in higher education (Meehan and Howells 2018) and can mitigate the challenges of transitioning into higher education (Meehan and Howells 2019).

A sense of belonging can impact a person's behaviour, cognition, and functioning and is related to academic performance, motivation, and persistence with a subject (Lewis et al. 2016). Sense of belonging is a significant predictor of physics students' first-year academic performance (Li and Singh 2023) and is positively related to self-efficacy (Bottomley et al 2024; Whitcomb, Maries, and

Singh 2023). Role models, regular contact with support and pastoral staff, and support networks outside the academic environment can all foster feelings of belonging (Lewis et al. 2016; Meehan and Howells 2019). Conversely, being a member of an underrepresented group which experiences stereotypes (for example, that women are weaker than men at maths) can lead to a lower sense of belonging and can even impact performance via stereotype threat (Steele 1997).

Assessment plays an important role in a successful transition to higher education. Disruption to assessment may affect this transition and students' experiences of university exams: through a lack of mastery experiences, which build self-efficacy, or through uncertainty about belonging and earning a place, for example. Building a sense of belonging, as well as self-efficacy and preparedness, and decreasing test anxiety during exams are important for a successful transition into higher education. These concepts provide a useful framework for us to understand students' assessment experiences. We specifically wanted to understand their university exam experiences (for example, did they feel prepared; did they experience test anxiety?), whether they felt the cancellation of school exams played a role in this and how (for example, through a possible lack of mastery experiences impacting their exam self-efficacy), and how else the cancellation affected them.

Research questions and SoTL

Our research questions (RQ) are as follows:

- RQ1: What were students' experiences of university exams (in terms of their motivational beliefs)?
- RQ2: What factors (including the cancellation of school exams) affected their university exam experiences?
- RQ3: In what other ways did the cancellation affect them?

These questions are pertinent for our research-intensive institution. Admission is highly competitive due to high entry requirements and a large international intake. As a result, students are familiar with doing well on exams and see their high grades as markers of success and a way in which they are recognized as physicists (Bøe 2023).

Our study was rooted in the principles of scholarship of teaching and learning (SoTL), and we followed Felten's (2013) principles of good SoTL practice. This included focusing on a well-defined aspect of student learning (motivational beliefs and belonging around assessment), being grounded in context (physics is written-exam-dominant and our institution requires high grades), and appropriately public (our findings were shared at a relevant conference). We used relevant social-science research methods (parallel mixed-methods, utilising a questionnaire and follow-up focus groups). Personal interactions with students highlighted cancelled exams as an interesting phenomenon to research. We implemented pedagogical changes based on the findings, such as a welcome booklet (described in the Discussion section) to aid first-year students' assessment transitions. Our research study was part of a wider project in the department investigating physics students' sense of belonging to deliver research-informed teaching and learning. Alongside exploring the under-researched school-to-higher-education assessment transition, our study may help educators at universities identify ways to support students during exams, potentially improving retention, which is particularly important for underrepresented groups in physics.

METHOD

Background

Our context was an urban, research-intensive university in England. There were 280 students (28% female and 52% overseas, including from the European Union) who started their undergraduate physics degree in the 2020–21 academic year. The physics degree programmes usually take either three or four years to complete. Students were taught conventional university physics modules, and 60% of their grade for their first year was assessed via written examinations. During the pandemic, learning and exams moved online. All students sat for at least four online, open-book exams (of varying contributions to their final grade): one in January and the remainder in May and June of 2021. Ethical approval for this study was obtained from our university's board for education research ethics.

Staff-student partnership

In line with Felten's (2013) good practice principles of SoTL, our study was a staff-student partnership, involving two more experienced researchers (a PhD student and a staff member) and two undergraduate students. We were all interested in supporting students and promoting their sense of belonging. One student had experienced cancelled school exams, and both had sat in-person and online exams. Cook-Sather, Bovill, and Felten (2014) highlight respect, reciprocity, and responsibility as the three guiding principles for the students-as-partners model. Therefore, the two student partners were involved in all decision making, from methodological design to data collection and analysis. Specifically, they helped with the questionnaire and focus-group questions, led the focus groups, helped with data analysis, presented a poster of their findings at a relevant conference, and designed and created the transition resources.

Data sources and collection

Our parallel, mixed-method study involved collecting both qualitative and quantitative data from the questionnaire and qualitative data from the focus groups, with all data interpreted together. A voluntary-response sampling method was used, where a questionnaire and invitation to attend a follow-up focus group were sent out to all first-year physics students. There were 95 students who completed the questionnaire (34% response rate) and 78 of these had cancelled school exams. All subsequent questionnaire results are based on these 78 students only. Five of these 78 students took part in two follow-up focus groups (three students online via Microsoft Teams and two students in person). The questionnaire and focus groups took place immediately after the summer exam period.

Most students had experienced A-level exam cancellations. The Advanced Level (A-level) is the main upper secondary level qualification for students aged 17–18 years old in England, Wales, and Northern Ireland (as well as other countries). A-levels are specialised courses lasting on average two years, and students typically study three or four subjects. In England in 2020, school students' grades were based on coursework and practice exam results instead (Department for Education 2020).

Questionnaire

The questionnaire probed students' perceived preparedness, self-efficacy, test anxiety, factors that contributed to their university exam experiences, and how else the absence of exams affected them. We did not collect exam performance data as exam results typically take several weeks to be ratified, and we wanted the questionnaire to be administered as close as possible to the exams. In addition, motivational beliefs are known to correlate strongly with academic performance. Table 1 shows a list of the questions along with which RQ and the type of response (either a five-point Likert scale or free-text entry).

The self-efficacy and test anxiety questions were adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al. 1991). We used the four most appropriate and relevant of the eight MSLQ self-efficacy items in order to balance conciseness and a need to capture enough self-efficacy items in the questionnaire. These items were asked in terms of confidence, from "not at all confident" to "very confident." We adapted the five MSLQ test anxiety items by using the preamble "Whilst sitting your first-year university summer exams. . ." and then altering the wording so that the items were in terms of a frequency, from "none of the time" to "all of the time." This was to probe students' specific test anxiety during their exams. Cronbach alpha values for the self-efficacy and test anxiety items were calculated for reliability, and all were above the acceptable value of 0.7 (Taber 2018). No single questionnaire item produced a higher Cronbach alpha value if removed, so all five test anxiety items and all four self-efficacy items were used in our analysis.

The questionnaire also asked about students' perceived preparedness on a five-point Likert scale, from "not at all prepared" to "very prepared." We then asked students to rate their overall exam experience from "not at all positive" to "very positive." The questionnaire then asked how students thought the cancellations had impacted their university exams (exam impact) and whether there were any other factors that also affected their exams (other factors). The final section asked how else the cancellation had affected them (general impact) and how they felt upon hearing school exams would be cancelled (reaction). The exam impact and general impact questions were asked using a qualitative, open-ended question first about positive or negative impacts (removing any leading-question bias) and then with a quantitative Likert-question from "not at all positive" to "very positive."

Table 1. Questionnaire questions by category, RQ, and type of response

Category	Research Question	Question	Type of response
Preparedness	RQ1	After having sat your exams, how prepared would you say you were?	Likert
Self-efficacy	RQ1	How confident were you that you understood the basic concepts in the courses?	Likert
		How confident were you that you understood the most complex material presented by the instructors in the courses?	Likert
		How well did you expect to do?	Likert
		How much do you agree with the following statement? "Considering the difficulty of these courses, the lecturers, and my skills, I think I will do well in these courses."	Likert
Test anxiety	RQ1	How often did you think about how poorly you were doing compared with other students?	Likert
		How often did you think about questions on the test that you couldn't answer?	Likert
		How often did you think about the consequences of failing?	Likert
		To what extent did you have an uneasy, upset feeling during the exam?	Likert
		To what extent did you feel your heart beating fast during the exam?	Likert
Overall exam experience	RQ1	Overall, how would you describe your experience of sitting your first-year university summer exams?	Likert
Exam impact	RQ2	Did the cancellation of school exams impact on your ability to sit exams in first year, either positively or negatively? Please give details.	Free-text response

		Overall, how do you think the cancellation of school exams impacted on your ability to sit exams in first year?	Likert
Other factors	RQ2	Were there any factors impacting how you felt about your exams? If so, please briefly explain your answer.	Free-text response
General impact	RQ3	Other than the impact on sitting first year exams, were there any other benefits or drawbacks from having school exams cancelled? Please give details.	Free-text response
		Overall, what impact did the cancellation of school exams have on you generally?	Likert
Reaction	RQ3	How did you feel when you found out your school exams would be cancelled?	Free-text response

Focus groups

The focus groups were semi-structured and began with an opening question (Krueger 2002) that asked students about their experiences with university exams. Due to the parallel nature of the mixed-methods study, the questions were largely similar to the questionnaire, e.g. "How did you feel when you heard your school exams would be cancelled?" While the questionnaire reached more students in order to obtain more generalisable results, the focus groups probed students' experiences in more detail. The focus groups were led by the student researchers, which enabled trust and rapport with the participants, leading to insightful, honest responses. The one-hour-long focus groups were audio recorded for transcription and analysis and anonymized to prevent identification.

Data analysis

We calculated each student's mean self-efficacy and test-anxiety ratings by summing the individual item ratings and dividing them by the number of items (Pintrich et al. 1991), resulting in continuous data. For RQ2, as the data were not normally distributed, we used the non-parametric Spearman's rho correlation test.

For the qualitative data, we used the six-step thematic analysis framework (Braun and Clarke 2006; Braun and Clarke 2019), which began with familiarisation of participants' responses on the questionnaire and in focus groups. Initial noteworthy comments were identified and defined as individual codes. These codes were applied across all qualitative responses, following an iterative process of refining and discussing the codes. Once we were satisfied that the codes best represented the students in the data, we made sense of the patterns in the codes by constructing themes. The frameworks of motivational beliefs and belonging guided the analysis while also allowing space for themes to be constructed around students' exam experiences. One undergraduate student researcher and one researcher experienced in qualitative methods carried out the analysis, allowing for an authentic interpretation of the responses. This student partner was trained in conducting and analysing focus groups by the more experienced team member.

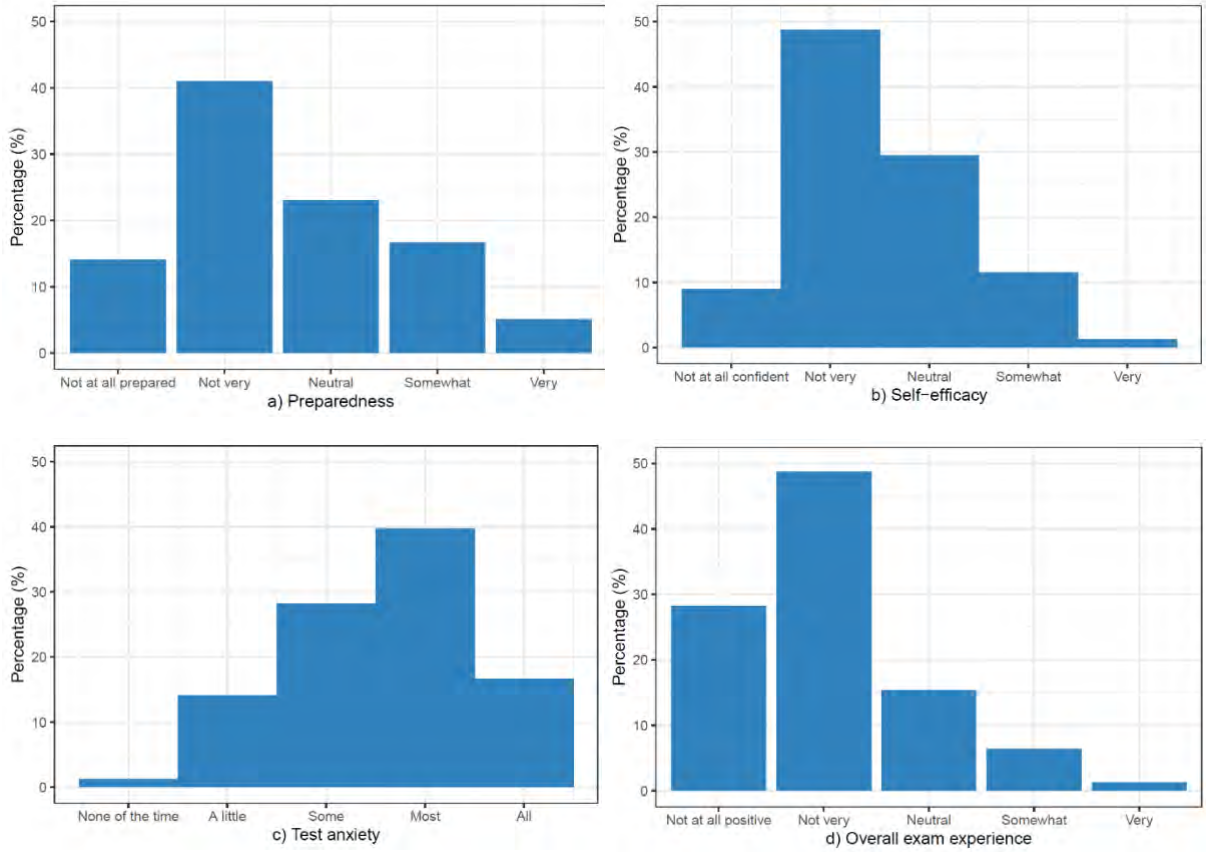
RESULTS

We present our findings in terms of the three research questions. Quantitative questionnaire responses were used to answer the first research question. The remaining two were both answered by our quantitative and qualitative findings. For these two questions, we present the quantitative results first, before contextualising and adding depth using our qualitative findings.

RQ1: What were students' experiences of university exams (in terms of their motivational beliefs)?

Students typically had a negative experience of university exams, with high test anxiety and low self-efficacy and preparedness. Figure 1 shows the distributions of students' responses for the four measures. The median preparedness rating was two, meaning that on average students felt "not very prepared" for their university exams. Fifty-five percent of students said they felt "not at all" or "not very prepared." The median self-efficacy rating was 2.5, meaning on average students felt low to neutral levels of confidence. Specifically for the third self-efficacy questionnaire item, 66.7% of students felt that they would do "not at all" or "not very well" in their university exams. No students said they felt they would do "very well," and very few said "somewhat well." The median test-anxiety rating was 3.6, meaning on average students felt test-anxious between "some" to "most of the time" during their exams, indicating moderate levels of test anxiety. Furthermore, 61.5% of students thought about failure "most" or "all of the time" during their exams, whilst 65.4% felt an uneasy feeling "most" or "all of the time." Finally, when asked about their overall exam experience, the median rating was also two, so on average students felt their overall exam experience was "not very positive." Seventy-seven percent of students said their exam experience was "not very positive" or "not at all positive."

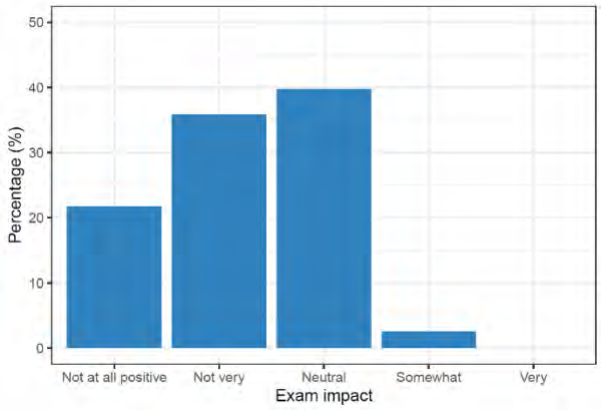
Figure 1. Bar charts and histograms showing the percentage of students for each rating for a) preparedness, b) self-efficacy, c) test anxiety, and d) overall exam experience



RQ2: What factors (including the cancellation of school exams) affected their university exam experiences?

Qualitative and quantitative results revealed associations between the exam experiences from RQ1 and cancelled exams alongside other factors. Figure 2 shows the distribution of students' responses for the exam impact. The median rating was two, meaning that on average, students felt the impact of the cancellation of school exams on their ability to sit first year exams was "not very positive." There were 57.7% of students who rated exam impact as "not at all positive" or "not very positive," whilst only two students felt this exam impact was "somewhat positive."

Figure 2. Bar chart showing the percentage of students for each rating for the exam impact



We then explored whether this exam impact was related to the motivational beliefs from RQ1 (see Table 2). We found statistically significant but weak correlations between the exam impact and self-efficacy, test anxiety, and preparedness. Students who felt more negatively impacted by the exam cancellations on their ability to sit exams were more likely to feel anxious during their university exams, felt less prepared and confident, and reported a more negative overall university exam experience.

Table 2. Spearman's rho correlation coefficients for self-efficacy, test anxiety, preparedness, and overall exam experience, with the exam impact of cancelled school exams

	Exam impact
Self-efficacy	0.282*
Test anxiety	–0.279*
Preparedness	0.279*
Overall exam experience	0.278*

*p<.05

In the questionnaire, students were also asked if there were any other factors affecting their university exams. Together with the focus groups, the constructed themes included: a lack of practice sitting exams and under-preparedness for open-book exams.

Lack of practice sitting exams

Most students mentioned long-term implications for their ability to sit future exams. The cancellation removed opportunities to sit high-stakes exams, and students felt out of practice ("Been so long since I've sat an exam so out of practice," as one student wrote). Specifically, students felt that

their work ethic, stress management, and exam technique and time management had been affected. This led to feeling under-prepared and increased levels of test anxiety as stated by one student:

> I had forgotten how to do exams and was very anxious throughout the exam. Up until I sat the exam, I thought it would be ok as I had always been good at exams but I neglected to think about the fact I hadn't sat externally moderated exams for 2.5 years.

Students also felt the cancellation of exams negatively impacted their confidence with the content, mainly due to never consolidating their learning at A-level:

> If I did have my A-levels, I think maybe I would have more confidence in the exams, because I would have had, you know, a qualification for something that I did, and not just from the past three years ago or two years ago. And I think it also would help me my motivation, and maybe have prepared me in terms of how to prepare for an exam, even though A-level exams and uni [sic] exams are very, very different.

Overall, students felt that several aspects both before and during exams were impacted by a lack of practice with high-stakes exams.

Unprepared for the open-book format

The new, open-book format of their university exams also caused feelings of unpreparedness. There was uncertainty around the new question style, which decreased their self-efficacy. This was due to a lack of practice questions (One student suggested, "would have been good to have at least one mock question that was designed for open book exams, to give us a better idea of the types of questions we might have to answer"). This lack left students feeling the exam was more difficult than expected, as one student said:

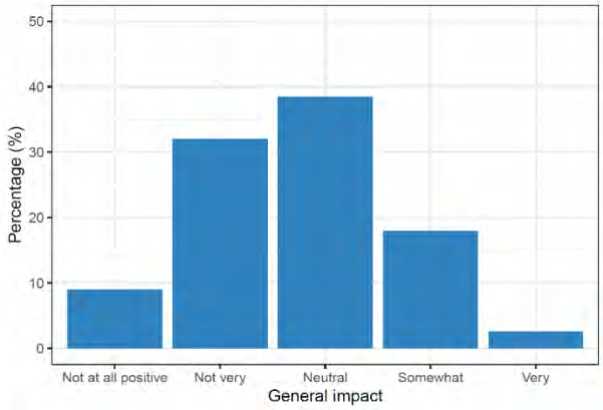
> I didn't really know what to expect really because they said that they're going to change the format of [the exam]. So the past papers weren't that helpful and most of them didn't have solutions anyways . . . I didn't know what sort of questions they were going to ask since it was open book . . . But I thought, okay, it's gonna [sic] be hard, but it should be manageable. But I was wrong, of course, it really wasn't [manageable].

One student even remarked that they were "lulled into a false sense of security" by being provided with past papers that were not applicable to the open-book exam format. However, students did feel that the first exam in January provided the practice needed in open-book-style exams for a better summer exam experience. One student reflected, "in January, I was uncertain, I was a lot more nervous. My summer exams . . . I felt a bit more comfortable with the examination style, I'd had a taste of it." This thereby increased their self-efficacy and preparedness and reduced test anxiety.

RQ3: In what other ways did the cancellation affect them?

The students were also asked whether the cancellation of school exams affected them in other ways. Figure 3 shows the distribution of students' responses for the general impact. The median rating was three, meaning that on average, students felt "neutrally" impacted by the cancellation of school exams more generally.

Figure 3. Bar chart showing the percentage of students for each rating for the general impact.



The students were also asked how they felt when they discovered exams would be cancelled. Together with the focus groups, the constructed themes included: short-term relief from exam stress and sense of belonging.

Short-term relief

The short-term response was generally positive. Students appreciated the reduced stress from not having to sit school exams ("Less stress since I no longer had to worry about performing well in the exams," as one student said), and the time gained ("Lots of free time to focus on other hobbies and pick up new skills/interests," wrote another student). Some students used the increased time to relax, and others used it to study physics without having to worry about revising for other exams.

Sense of belonging

Students felt that the cancellation meant they were not able to prove themselves or what they were capable of (". . .somewhat upset as I no longer had a chance to prove myself and how hard I had worked for the last 1.5 years"), leading to a sense of loss. Some students questioned whether they would have achieved their predicted grades had exams not been cancelled. One student expressed:

> And I was very happy, even though it did feel sort of like I didn't, did I really achieve these grades? You know, if I did the exam, would I get that? Like, I would aim for that, and I would try my hardest but also, would I [inaudible]? I can't complain, really. But yeah, it was a bit of a mix of emotions.

Some students doubted whether they really earned their place due to predicted grades, leading to feelings of imposter syndrome. While most students felt the exams negatively impacted their self-efficacy and sense of belonging, this was not the case for all students. A few students described how the cancellation initially increased their confidence, but then reduced it during university exams, as one student expressed:

> It probably provided a bit of overconfidence? It was like, I guess in the back of my mind, I'd just passed a set of exams without actually having to sit a set of exams . . . and I just thought to myself, it's the first year, it can't be that bad. So, I guess it's a bit of a wakeup call.

This mixture of positive and negative qualitative findings from the general impact of exam cancellations supports the quantitative results, where the average "general impact" was neutral.

Overall, the students' experience of first-year exams was negative. The main factors were a lack of practice sitting for high-stakes exams and a lack of preparation for the exam format. Together this made students feel more test anxious and decreased self-efficacy regarding exams. The students highly valued the exam in January as an opportunity to practise both sitting exams and the format. More broadly, the cancellation of school exams left some students feeling as though they had not been able to prove their ability, contributing to doubts about self-efficacy, feelings of imposter phenomenon, and belongingness uncertainty.

DISCUSSION

We investigated first-year physics students' motivational beliefs for university exams, factors that affected their university exams, and how the absence of school exams affected them. Many students who took the questionnaire or participated in focus groups had a negative experience of higher education exams, with low levels of self-efficacy and preparedness, moderate levels of test anxiety, and a low overall exam experience. Students felt the absence of school exams had a negative impact on their ability to sit university exams; students who felt more negatively impacted were more likely to feel less prepared and self-efficacious and had higher test anxiety compared with students who felt less negatively impacted. Specifically, cancelled exams removed practice in sitting for exams.

However, a non-cancelled-exam-related factor was a lack of practice with the open-book format, which was a key contributor to reduced self-efficacy and preparedness, agreeing with recent findings (Arora, Chaudhary, and Singh 2021; Marzoli et al. 2021). This highlights the importance of assessment methods that are familiar to students and that reduce stress and anxiety (van de Watering et al. 2008). For example, students were unfamiliar with open-book exams and the high-stakes exam routine, after several years without them, and experienced stress and anxiety from being "out of practice." Indeed, students identified how they were more nervous for their exam in January compared with their summer exams.

We then explored other effects of cancelled school exams and found a mixed response, ranging from initial, short-term relief to doubts about their sense of belonging. This mixed response echoes Mccarthy (2022) and Bhopal and Myers (2023) who found that some students felt advantaged by the cancellation, as they could still achieve high grades without actually doing exams. Other students were also demotivated by the cancellation, suggesting exams instil motivation and have high importance. Students in Mccarthy (2022) displayed an exam-oriented habitus and were "disillusioned" by the cancelled exams. The negative effect on motivation was further due to the increased time spent "not doing physics" between secondary school and higher education.

A lack of sitting exams and achieving subsequent grades caused belongingness uncertainty because students felt unsure that they deserved their place. Wenham and Lee (2022) found similar feelings among secondary school students in England. Performance in external exams is a predictor of success in higher education maths and science (Johnston et al. 2022), suggesting physics students place a lot of importance on doing well on exams (Bøe 2023). Good grades may be a source of recognition for them as physicists, particularly for our setting which requires high grades for admission.

Informing our practice

The two student partners created a bespoke welcome booklet[1] based on our findings for each new student to support their university transition. Willcoxson, Cotter, and Joy (2011) specifically

recommend providing transition resources to first-year students that include good quality course advice, and a staff awareness of transition issues in order to foster feelings of belonging. Consequently, the booklet contains module information, support signposting, hand-drawn pictures of all first-year staff (with quotes and jokes provided by staff members), and more general pages on building motivation and confidence (e.g., "You belong here – you are not an impostor, you deserve to be here."). These "positive affirmations" can boost a sense of belonging, particularly among underrepresented students (Cook et al. 2012). In addition, accessing the right information, having the right skills, and receiving the right support are three aspects of preparedness that can assist students' adjustment to higher education (Money, Nixon, and Graham 2020). Our booklet aims to provide students with the right information and support.

Following positive feedback, the booklet has been updated and distributed to each new cohort of students along with a Microsoft Forms questionnaire to obtain feedback. So far, students have found it helpful and useful, with an average 4.39/5 rating. When asked, "What did you like most about the booklet?," one student said "how welcoming and helpful the staff comments were," whilst another felt the booklet "answered a lot of initial questions/uncertainties at the start of term." For some students, the resource alleviated their uncertainties. Although originally created with students who had cancelled exams in mind, the messages are relevant for future cohorts as well. Staff in the department are now familiar with updating their welcome messages for the booklet, showing a growing awareness of the university transition. Regarding implications for practice, we recommend working with students to design transition resources, as they have the most up-to-date knowledge of this process and best understand how to support their peers.

Implications for wider practice

Alongside provided transition resources, our wider implications focus on assessment and exam preparation. We first recommend setting realistic expectations of university assessment through an initial induction on what students can expect. Although our study focused on physics students, these recommendations could apply to a variety of disciplines. As supported by our findings, students often lack confidence when it comes to higher education assessment, often due to unrealistic or mismatched expectations (Murtagh 2012). Students benefit from learning about upcoming assessment formats and prefer staff to clarify expectations (Murtagh 2010). Taylor (2008) recommends a three-phase model of first-year university assessment during the first semester, involving assessment for transition (setting assessment goals and expectations, such as an individual study plan), assessment for development (mid-semester detailed feedback on learning, e.g., a draft lab report), and assessment for achievement (traditional assessment methods).

Secondly, educators should deliver more frequent, low-stakes practice exams to boost preparedness, particularly for subjects where written exams dominate assessment. Summative, high-stake assessments can be detrimental for learning when not counterbalanced with frequent formative assessment (Harlen et al. 2002), both in terms of learning gains but also in students' motivation (Amrein and Berliner 2003). Formative assessment is also seen by students as more purposeful and worthwhile than summative assessment (Pereira, Cadime, and Flores 2022; Skinner 2014). Frequent testing is a powerful learning strategy that benefits retention, exam performance, and metacognitive awareness (Rowland 2014; Naujoks, Harder, and Handel 2022). Low-stakes exams are also particularly beneficial for underrepresented students (Malespina and Singh 2022). Naujoks, Harder, and Händel (2022) emphasise implementing regular practice exams throughout the course, ideally with feedback to promote engagement and build confidence (Taylor 2008). We therefore recommend early and frequent opportunities to experience exam success through practice exams, which will increase self-

efficacy and preparedness and reduce test anxiety. Indeed, our findings showed how highly the students valued the exam in January, which although high stakes, allowed the students to feel familiar with sitting for exams again ahead of their summer exams.

Limitations

There are several limitations to our study. Firstly, students opted to take part, which introduces a non-response bias; we do not know how these students' experiences relate to their motivational beliefs and belonging, and non-participating students may have felt unaffected by the cancellations.

We also did not exclude overseas students from our analysis. These students may not have experienced the same exam cancellations, due to different education systems. However, as most of our students had completed A-levels, this means the small number of overseas students included were either educated in England or completed A-levels abroad. We expect the latter to be small enough to not change our overall results, but necessary to maintain an appropriate sample size.

Our questionnaire was also anonymous, meaning we are unable to draw conclusions about students' performance, engagement, or participation for those who felt negatively or positively impacted by cancelled exams. Finally, our questionnaire utilised self-reported measures using a Likert scale, meaning there is variability between students' interpretations of the rankings.

CONCLUSION

Written examinations (either in person or remote) dominate physics assessments in both secondary school and higher education. A lack of sitting exams (which build mastery experiences) can impact a student's sense of belonging, both as a physicist and student. Through this mixed-methods study, we found that physics students who felt more negatively impacted by the cancellation of upper-secondary-school exams felt more test anxious, less self-efficacious, and less prepared for their first-year university exams. Overall, they had a more negative exam experience, compared with students who felt more positively impacted. Qualitative findings found that students felt underprepared from a lack of both sitting school exams and a new exam format. Furthermore, we found that exam experiences can be central to a student's sense of belonging, allowing them to prove themselves and earn their place.

Learning, teaching, and assessment have returned to normal since the COVID-19 pandemic. However, future cohorts will have experienced remote learning or cancelled school exams. The format of university examinations could also be modified again, potentially resulting in new forms of assessment that students do not have prior experience with.

Our study shone a light on the under-researched assessment transition from secondary school to higher education. The COVID-19 pandemic provided a unique opportunity to investigate how exam experiences transfer from secondary school to higher education, and what we can learn when this transition is disrupted. When exams were cancelled, students felt like they could no longer prove themselves or earn their place. This suggests that positive exam experiences are important for students' sense of belonging or motivational beliefs, such as building self-efficacy. For some, doing well in exams helps them feel recognized as a physicist and feel as if they belonged, meaning confidence in exam performance is crucial.

Supporting students in their transition and their first-year exams by providing opportunities for mastery experiences are therefore vital to ensure students feel confident and have low levels of test anxiety. Within a standard undergraduate physics course, there are many opportunities for students to be formatively assessed and gain mastery experiences, through problem sheets, tutorials,

and seminars. This will impact their exam experience, their mastery experiences, and for some students, their sense of belonging.

NOTES

1. A shortened, 8-page version of the 40-page welcome booklet can be accessed at: https://jessiedurk.github.io/Imperial_Welcome_Booklet/Welcome_Booklet_Physics_Undergraduates_Shortened.pdf.

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ETHICS

Research was approved through the Imperial College London Education Ethics Review Process.

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