'Hard to focus, difficult to learn': Covid19 impacts on teaching, learning and progression for A Levels in mathematics

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We explore year 13 (age 17-18) student accounts of how Covid19 has impacted their learning for pre-university mathematics qualifications in England. Findings derive from the final year of a four-year study (2017/18 to 2020/21) exploring enactment and impact of reformed mathematics 'A Levels', and efficacy of associated Pearson resources and assessments. Research tools were adapted to focus on impacts of Covid19. In this cohort's first year of A level (2019/20), teaching and learning was severely disrupted. Teachers anticipated significant, wide-ranging learning gaps as students progressed to year 13. Using data from Autumn 2020 and Spring 2021 we analyse student accounts of how continued disruptions to teaching and learning have impacted them. Variable access to teachers, barriers to collaborative work, and challenges of remote or reduced contact working have resulted in reduced depth and breadth of learning. Additionally, many students reported negative impacts on mathematical confidence and wider mental health.

Keywords: A levels; Covid19 impact; learner experiences

Introduction: the policy and pandemic contexts

Mathematics and Further Mathematics A levels, reformed for first teaching from September 2017, are the main mathematics pre-university qualifications in England. Compared with predecessor qualifications, they include enhanced content-related scope, and renewed focus on mathematical reasoning, problem solving and modelling. Students should, in particular, work with a large dataset. Both qualifications are available to year 12 and 13 students in schools and colleges ('centres'), and are assessed, usually by external examination, at the end of two years of study.

With the emergence of Covid19 in England, in March 2020, centres operated remotely for most students through March-July 2020 and again January-early March 2021, and summer 2020 and 2021 examinations were cancelled. Reopening, centres often offered a mix of in-centre and remote learning; the former was constrained by social distancing protocols and intermittent when teachers or students were required to isolate. Teacher-assessed grades based only on work covered, rather than full specifications, were announced in March 2021, replacing external examinations. Together, these events have had complex and rapidly evolving outcomes for the teaching of mathematics A levels, and for students' learning.

The reported work is part of a longitudinal (2017-2021) study, adapted to track the impact the pandemic has had on students taking mathematics A levels and their teachers, many of whom were often already feeling under pressure due to qualification reform. We focus on year 13 student accounts from Autumn 2020 and Spring 2021 terms, and track their evolving experiences with reference to findings from the same cohort in Summer 2020 (Redmond et al., 2020). The study is unique in

England in evidencing pre-university student perceptions of subject-specific impacts of pandemic-impacted learning, and contributes to an emerging global evidence base.

Research questions and theoretical frameworks

This paper draws on findings from the final year of the Pearson/UCL study. We set out to evidence the enactment and efficacy of Pearson's reformed Mathematics/Further Mathematics A Level qualifications and associated free/paid for resources. In an effort to understand the lived experiences of teachers and students, an institutional ethnographic approach (Smith, 2005) was adopted. In March 2020 through to July 2021 the study was adapted to capture also the impacts of the pandemic on participants, and particularly the subject-specific impacts. Although the samples are from Pearson-using centres, Pearson's majority market share in resources and assessments in England means the findings are highly likely to generalise more widely.

Research questions underpinning the study focus on enactment of the specification, teacher preparedness, student participation and progression, resources (free and paid for) used, impact of those on student learning, and summative assessment – and, more recently, the changes the pandemic made to any of these. Here, we focus specifically on questions related to the *impact on student learning* of Covid19, with reference to students of mathematics A Levels in year 13 in 2020-21:

- What do students anticipate the medium-term impact of their disrupted year 12/13 will be on their A Level knowledge, skills, processes and concepts?
- To what extent are learners having the opportunity to develop and demonstrate the A Level targeted mathematical skills and knowledge?
- To what extent are they being able to acquire the mathematical skills, knowledge and affect to progress to appropriate routes post-A Level?

Methodology

Table 1 presents data collection for the final year of this four-year study. Each annual cycle contained termly stages, allowing us to capture evolving student and teacher experience. In earlier cycles, the Spring phase included centre visits with semi-structured lesson observations and related teacher interviews and student focus groups. In 2020-21, pandemic-related constraints and ethical considerations limited data collection to surveys. We conjecture already-established working relationships with teachers and students supported the richness of survey responses emerging. This paper builds on previous findings to focus on Autumn 2020 and Spring 2021 data.

Table 1: Data collection in year 4 (2020-21)

Phase 1: Autumn 2020	198 year 12 student survey responses 179 year 13 student survey responses 34 teacher survey responses
Phase 2: Spring 2021	108 year 13 student survey responses 26 teacher survey responses
Phase 3: Summer 2021	Teacher surveys Year 12 student surveys Year 11 to A Level grades of all year 13 students.

Our findings present a snapshot of experiences in a sample of 12 centres fairly representative in terms of governance, catchment area, socioeconomic intake,

inspection grade, and prior student attainment, though previously low-attaining centres were slightly under-represented. However, centre variables are so complex that findings are likely to be indicative of a range of experiences and impacts, rather than easily generalizable. They nevertheless offer valuable insights, particularly given the rapidly changing educational landscape over recent months. We collected data from 34 teachers and 22 classes (14 Mathematics A level and 8 Further Mathematics A level classes), though here we draw on student accounts only: our findings remain classroom close, drawing on rich data exploring their experiences.

All surveys were semi-structured, driven by research sub-questions, and analysis used a grounded approach (Charmaz, 2006) through open, axial and thematic coding within each sub-question. We took a proactive approach to addressing research integrity, including of potential conflict of interest with Pearson as both funder and focus provider (e.g. the UCL research lead and second author had sight of all data no later than any Pearson employee; cross-researcher validation of at least 10% of coding; occasional participant validation of interpretation where this was unclear (though not with student participants since those were anonymous for ethical reasons); cross-researcher triangulation of emergent themes and of writing).

Findings

In Summer 2020 data, we saw evidence of substantial disruption to teaching and learning, with teachers and students having to adapt rapidly to the constraints of Covid19. At this point, most teachers had attempted to maintain regular teaching of the year 12 cohort, though our data suggest that consistent, synchronous provision was unusual. Teachers had monitored submitted work in ways they felt had been effective, but student response had been variable – though most teachers expected to find a wide range of sometimes significant learning gaps as this cohort progressed to year 13, and were concerned about student's depth of learning:

> Students will head into year 13 with a much more varied range of knowledge (between engaged and non-engaged). They will have a more superficial understanding of topics and find it more challenging to build year 13 content onto their existing year 12 content. *Teacher 1, Centre 12, Summer survey 2020.*

Over 90% of students later reported that they had found it difficult to learn remotely in that first lockdown, with concentration, feelings of isolation, and conceptual grasp reported to be key issues. By March 2021, participant teachers and students reported varied approaches, with almost all teachers having become much more adept at structuring for remote teaching and learning; more synchronous lessons and more active and extended learning were usually expected. Academically selective centres had typically taught all content by the time students returned into classrooms in March, and then prepared for examinations, mirroring their routine in a 'normal' year. In centres where coverage to that point had been relatively superficial, efforts were often being made to deepen students' understanding. Half of centres switched to preparing for internal assessments once teacher-assessed grades based only on work covered were announced, in at least one case mandating that no new content then be taught.

In Autumn 2020 and Spring 2021 surveys, we saw evidence that at least 70% of students were struggling to overcome the cumulative and ongoing impacts of disruption to learning. Challenges experienced during periods of remote learning represented particularly strong themes in the data. At least half of those students

reported this was because remote pedagogy was a barrier to learning, particularly relating to the depth of engagement with mathematical concepts achieved:

> I personally feel more comfortable asking questions to teachers in person as they can explain it to me better and provide other alternative solving methods. (Student 13, Spring survey 2021)

Others cited technological challenges, with access to wifi being the most common issue referenced:

> My wifi is very poor so I would get kicked out of lessons often. (Student 02, Spring Survey 2021)

A minority of students were still unable to access suitable devices up to Autumn 2020, although by Spring 2021 this had largely been resolved:

> Lack of a laptop, and can't afford to buy one - this has made it difficult to join remote learning classes. (Student 147, Autumn Survey 2020)

> Didn't have a personal laptop that I could use to follow my lessons. However, I do have one now. (Student 77, Spring Survey 2021)

Key barriers to remote learning over this period and cited by students, were significantly reduced access to teachers (72%) and/or to peers (63%):

> Less in person interaction [with teachers] and opportunities to go through working out. (Student 33, Spring Survey 2021)

> As work was set over Teams, we weren't able to work collaboratively with my peers so we were able to challenge each other and improve together. (Student 20, Spring Survey 2021)

Constraints persisted even in-centre, though were mentioned less frequently by Spring 2021:

> 'We don't have any intervention/after school help because of covid so it makes it harder to get 1:1 help. (Student 167, Autumn Survey 2020)

> We can't have proper interactions with teachers because of social distancing. (Student 11, Spring Survey 2021)

The requirement through the pandemic for students to work more independently and organise and monitor their own work appeared to benefit a small minority of high-achieving, highly motivated students, but for many this was a significant challenge:

> Had to self-study large parts of the course from just the textbook, and with the level of interlinking in maths this is still causing some problems. Also self-studied the topics that were easier to self-study, so learnt things out of order, making learning Further Maths more difficult. (Student 123, Autumn Survey 2020)

Some areas were consistently identified by students as being more difficult to learn remotely, with statistics and mechanics, as well as calculus, being the most common:

> Mechanics is essentially practical, and there's a particular way of thinking about it that it's hard to 'catch' from a book. (Student 212, Autumn Survey 2020)

Students also highlighted problem solving skills and proof as key processes which had suffered:

> There were less opportunities to develop problem solving skills as we focussed on finishing content first. (Student 20, Spring Survey 2021)

Collectively, the barriers explored above led to over 75% of students reporting considerable impacts on their learning, as well as on their motivation to learn:

> It's a lot harder to learn maths online compared to in schools because you don't have that contact and if something is difficult to understand, it's amplified by the distance and less interactive. (Student 131, Autumn Survey 2020)

> It was hard to stay focused and motivated, and harder topics were difficult to self-teach. (Student 120, Autumn Survey 2020)

Such challenges led to at least half of students reporting reduced content coverage and/or relatively superficial mathematical learning:

> Feel like I will be more memorising processes for exams only to forget them whereas would probably have a deeper understanding from consistent consolidation without disruption, and therefore maintain my maths skills longer term. (Student 50, Spring Survey 2021)

> I will not understand it as much as I could have done if I had been taught the whole course. (Student 47, Spring Survey 2021)

More than half of students also reported that their mathematical confidence, or similar attribute, had decreased:

> My confidence is significantly lower considering the lockdown as I feel my learning was disrupted and I was less able to consolidate my learning especially as Teams calls focused more on finishing content rather than understanding. (Student 20, Spring Survey 2021)

> Confidence took a hit due to uncertainty and lack of real challenge. (Student 48, Spring Survey 2021)

Although the research tools did not target these explicitly, frequent references to constraints of students' home life and personal circumstances highlighted the very individual ways in which disruptions to teaching, as well as the wider impacts of Covid 19, shaped their experiences and outcomes. Issues sometimes seemed to be exacerbated by economic or social disadvantage, but were apparent across student backgrounds. A key theme emerging throughout Autumn and Spring data was the impact on students' mental health, with feelings of isolation common:

> Little to basically non-existent contact with peers and it's affecting my mental health. (Student 82, Autumn Survey 2020)

> I had a lot of difficulties with my mental health which I struggled with a lot during lockdown. However I don't feel comfortable sharing that with anyone, hence I feel that it has put me back. (Student 60, Spring Survey 2021)

In particular, some students highlighted that such challenges were impacting their levels of concentration and motivation:

> Many students have not had the support circles they would usually has and at different levels this has individually affected students' grades and willingness to learn. (Student 44, Spring Survey, 2021)

Comments on pandemic impact on progression beyond A level had been impacted by the pandemic were mixed. Most felt that their progression to university would be negatively impacted, sometimes due to the projected failure to achieve predicted grades. Many students were concerned about content coverage and depth of understanding that they would be taking with them to university:

> My knowledge will be of less detail: although I may have the fundamentals I won't have the proofs or extensions which are vital for university. (Student 48, Spring Survey 2021)

> I am planning on studying economics at university. I think this will be affected by the pandemic as a lot of economics requires an understanding of maths, which I may not fully have. (Student 35, Spring Survey 2021)

Such concerns highlight medium to long-term impacts that are likely to shape the experiences and opportunities of this cohort of students for some time to come. Although beyond the scope of this study, this will be an important area of future research as students move through their further studies and into employment.

Discussion

Our findings, covering the period up to April 2021, showed most year 13 students of mathematics A Levels still working to overcome the challenges of the previous year while responding to continued uncertainty as they move forward. We saw everyday disruption reducing as teachers and students adapted and pandemic-related restrictions recede. However, students' accounts also indicated persistent impact on learning due to in-class social distancing and the repeated need for teacher and/or students to isolate. Students also emphasised persistent and sometimes significant learning gaps, in terms of content coverage and depth of mathematical engagement, related to earlier disruption, and which students were still struggling to resolve. Students commonly reported that the combined effects of the pandemic on their academic and personal lives had led to reductions in their mathematical confidence and often, negative impacts on their mental health. The depth and breadth of mathematical learning that students will take with them to university was also a prominent concern.

Continued timely support for these students is needed, particularly in addressing learning gaps, consolidation of learning, mathematical confidence, and mental health. Many will also need transitional support as they progress to university. Although we saw clear trends emerging, impacts varied according with individual students' circumstances as well as the diversity of centres' approaches to teaching, meaning that support provided needs to be individually responsive. Impacts are also likely to have been mediated by social and economic disparities, and such wider structural elements also need to be considered when designing support.

Our research offers a unique lens on pre-university students' mathematics-specific experiences of the pandemic in England. It contributes to Pearson's further development of A level mathematics qualifications, their assessment and surrounding support material. Findings are also being shared with policy bodies such as Ofqual, DfE, and with HEIs, and recently formed a key part of an extensive efficacy report mapping the journey of these reformed qualifications (Mason et al., 2021). These approaches will continue through the final stage of the research in Summer 2021.

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