

OPINION

Assessment as a barrier to inclusion

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Abstract

I argue that the methods used to assess mathematics in higher education too often prevent people from achieving their potential and have the (presumably unintended) consequence that the diversity of the mathematical community is reduced as a result.

Keywords: Assessment, inclusion, academic integrity

1. Introduction

This paper presents my personal views. It has been prompted by two relatively recent developments, which I feel should lead the higher education mathematics community to reconsider some of its assessment policies in order to provide more meaningful assessments and promote inclusion and diversity.

In the first part of the pandemic universities had to move teaching and assessment online, at short notice. This enforced innovation will have long-term consequences as we use the experience to improve the way we teach and the learning resources we provide. Initiatives such as TALMO (2020), conferences such as the 2021 CETL-MSOR conference (*sigma*, 2021) and journal special issues such as those of *MSOR Connections* (Hodds and Rowlett, 2022a and 2022b) helped disseminate the resulting good practice.

The switch to online examinations at the end of the 2019/20 academic year coincided with the biggest recorded drop in the white-Black, Asian and minority ethnic awarding gap (the difference in proportions of white and Black, Asian and minority ethnic students awarded a first/2:1 degree), between 2018/19 and 2019/20 (Codioli McMaster, 2021). Despite this apparent success (to which other factors may have contributed) and the concern over the awarding gap expressed both by regulators and by many HE institutions, to my disappointment many mathematics departments in HE seem keen to revert to traditional examinations for mathematics degrees.

The second development was the tragic case of Natasha Abrahart, a student at Bristol University who committed suicide in 2018 on the day when she was expected to participate in a presentation as part of her course (The County Court at Bristol, 2022). The court judgment shows how university assessments can, despite the best intentions of all those involved, cause considerable stress for some students: it is revealing to discover, from the judge's analysis, how higher education activities appear to someone outside the system.

2. Assessment in Mathematical Sciences

While other disciplines have broadened their assessment diets, Iannone and Simpson (2022) have shown that, for mathematics, universities in the UK continue to rely heavily on traditional closed-book examinations (the very slight decrease over the last decade being attributable to an increase in the use of modules with a less mathematical focus rather than a broadening of assessment in mathematics modules).

This contrasts with the working practices of today's mathematicians, at least in my experience. Whether in industry or academia: mathematicians do not work under exam conditions without access to digital and other resources, generally work collaboratively, and are rarely subject to the unrealistic time pressures imposed by traditional examinations. It is also arguable that the skills tested by these examinations are not very relevant to working mathematicians: for example the keynote talk at the 2021 CETL-MSOR conference by Neil Sheldon (a former Vice-President of the Royal Statistical Society (RSS)) discussed how exams in statistics tend to focus on mathematical calculations rather than statistical understanding, and a very distinguished applied mathematician told an Institute of Mathematics and its Applications (IMA) meeting in February 2022 how the assessment regime he experienced as an undergraduate failed to prepare him for research in mathematics (my undergraduate experience was similar).

Some university mathematicians argue that traditional examinations preserve “academic integrity”, suggesting that other forms of assessment are exploited by students who cheat. (I suspect that this view is based in part on an underestimate of the potential for cheating in examinations, especially as technology develops). I would have thought that “academic integrity” would be better served by assessment which meaningfully engages with the professional practice for which universities are preparing their students, rather than the very artificial examinations which, as I will suggest below, do not accurately measure the mathematical ability of many undergraduates.

The IMA, the London Mathematical Society and the RSS have issued a statement about assessment in mathematical sciences (IMA, 2022), which is endorsed by the Edinburgh Mathematical Society and the Heads of Departments of Mathematical Sciences (HoDoMS). This statement suggests that some mathematics departments are under pressure from their institutions to reduce their use of traditional invigilated closed-book examinations.

Assessment is also discussed in the Subject Benchmark Statement for Mathematics, Statistics and Operational Research published by the Quality Assurance Agency (QAA) (QAA, 2019): at the time of writing a revised subject benchmark statement is in preparation to be released in 2023. The 2019 subject benchmark statement indicates that a range of assessment methods is appropriate.

At a time when, for many reasons, assessment methods in mathematics are under discussion, their impact on inclusion should be one of the factors considered.

3. Issues with assessment types

An inclusive community welcomes people from all backgrounds. Bradshaw and Mann (2021) identify obstacles which might affect students' sense of “belonging” as mathematicians. The assessment students' face during mathematics degrees is potentially a barrier.

Each form of assessment in mathematical sciences has strengths and weaknesses. The following discussion can only indicate some of the issues which affect the inclusive nature of our subject. My own experience, as a privileged straight white cis male from an academic family, provides the context for my discussion, which draws heavily on my more than 30 years' experience of teaching mathematics in higher education.

As a student I was very good at traditional examinations – my school had prepared me very well in exam technique – and I enjoyed and looked forward to my university exams. (In fact, I was so good at school exams that I got the highest mark in my year for French, despite not being able to make myself understood in the language or to understand spoken French, which says something about the value of exam marks as an indication of ability!) Nevertheless, at university I lost over a stone in weight every year in the run-up to the examination period, and during my final exams my doctor put

me on Valium because I was experiencing chest pains due to nerves. (It didn't occur to me at the time that this might not be good for me!) Students who suffer from mental health difficulties, or physical illness or disability, may struggle in exams in ways for which arbitrary allowances of extra time may not fully compensate. Time of day, time of the month (for half the population), and time of year (for example for those suffering from hay fever or taking medication for it) may affect exam performance.

Of course, from a student's perspective, which topics in an exam come up is a matter of chance. (In my father's university scholarship exam, the unseen translation question happened to be the passage he had tried as a practice the day before.) But this luck doesn't affect everyone equally – some students are more adept than others at question-spotting or picking up hints dropped by their tutors, and students' background is a big factor in that skill.

I did well at exams because I was well prepared in examination technique from an early age, by family and teachers, and was trained from my youth to revise and focus on exams. Not all students have my privileged background, and during my teaching career I have seen many able students whose exam performance did not reflect their mathematical competence. When Nobel laureate Sir Roger Penrose has talked about his slowness in doing mathematics exams (Fry and Penrose, 2018), it seems to me hard to argue that time-constrained exams are a good way to assess mathematical ability.

Some students suffer from exam nerves, and some may be unable to focus on exam preparation because of family or caring commitments. A single parent who has to take children to school on the way to the exam, or who has to worry about leaving the exam room promptly to collect their children, will not be able to focus on the exam as I could. A student caring for an elderly dependent won't be able to revise as single-mindedly as I used to. Students who rely on part-time work to support their studies may not be able to spend the time preparing for their exams as their more privileged peers do.

So, in a number of ways traditional examinations may disadvantage some students, particularly those from less privileged backgrounds.

Of course, other forms of assessment can also present barriers to inclusion. For example:

- Presentations may be terrifying for some students and will potentially be more difficult for students for whom the language of presentation is not their first language. They can be difficult for some students for reasons relating to neurodiversity or mental health.
- Writing reports can feel intimidating for students not confident in their language skills.
- Group assignments might be problematic for students whose work, caring commitments or health makes it difficult to attend meetings with other group members. Working with others may be intrinsically difficult again, because of neurodiversity or mental health factors.
- Coursework deadlines create stress and are difficult to manage for many students.

The fact that such assessments are valued by employers and develop skills that will benefit students in their careers, while a strong reason for including such elements as part of the assessment diet, should not cause us to overlook the barrier they may pose for some of our students, not affecting everyone equally, and thus reducing the potential diversity of the future mathematics community.

4. Mitigations

So, how can we design our mathematics assessments to encourage inclusion in our courses? I don't claim to have any answers but I tentatively offer the following suggestions.

- In designing assessment strategies the impact on inclusion should be considered.
- A variety of different assessment methods will to some extent mitigate the drawbacks of each assessment type.
- Explaining the rationale for each chosen form of assessment to students might be beneficial. For example, helping students understand the relevance of presentations or groupwork for their future careers might motivate an anxious student to address their fears.
- Providing purely formative or low-stakes opportunities to practice each assessment style would help develop the desired skills and allow students to build their confidence. (In this context it is perhaps unfortunate that institutional assessment policies designed to reduce the assessment burden on students sometimes have the effect of reducing opportunities for low-stakes assignments.)

In my opinion the excessive focus which degree courses put on assessment has the unfortunate consequences of causing great stress to students and disadvantaging those who do not perform well in the forms of assessment they face. While students as well as tutors assign great importance to assessment, that can sometimes obscure that the primary objective of degree study is learning. It is particularly unfortunate therefore that assessment may not correlate with students' attainment, causes stress and may affect mental health, and may disadvantage those whose backgrounds or circumstances do not suit the way in which they are assessed.

5. Conclusion

We aspire for inclusion in our mathematics degrees but assessment issues can discourage and/or disadvantage some students, especially those from non-traditional academic backgrounds. To mitigate this, consideration should be given to this aspect of assessment. As Iannone and Simpson (2021) report, higher education institutions in the UK rely heavily on traditional forms of assessment such as time-constrained examinations. The community should consider whether changes in our assessment strategies might make our subject more inclusive.

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7. References

Bradshaw, N. and Mann, T., 2021. Welcoming students to the mathematics community: obstacles to "belonging". *MSOR Connections*, 19(3), pp. 75-86. Available at <https://journals.gre.ac.uk/index.php/msor/article/view/1268> [Accessed 29 November 2022]

Codioli McMaster, N., 2021. Ethnicity awarding gaps in UK higher education in 2019/20. York, AdvanceHE. Available at <https://www.advance-he.ac.uk/knowledge-hub/ethnicity-awarding-gaps-uk-higher-education-201920> [Accessed 29 November 2022]

The County Court at Bristol, 2022. Judgment between Dr. Robert Abrahart and the University of Bristol. Available at <https://www.judiciary.uk/wp-content/uploads/2022/05/Abrahart-v-Uni-Bristol-judgment-200522.pdf> [Accessed 29 November 2022]

Fry, H., and Penrose, R., 2018. Interview. Available at <https://www.youtube.com/watch?v=iZ8GaK2YzWo> [Accessed 29 November 2022]

Hodds, M. and Rowlett, P. (editors), 2022a. CETL-MSOR Conference Special Issue 1: Responding to the COVID-19 pandemic. *MSOR Connection*, 20(1). Available at <https://journals.gre.ac.uk/index.php/msor/issue/view/93> [Accessed 29 November 2022]

Hodds, M. and Rowlett, P. (editors), 2022b, CETL-MSOR Conference Special Issue 2: Innovations in teaching, learning, assessment and support. *MSOR Connections*, 20(2). Available at <https://journals.gre.ac.uk/index.php/msor/issue/view/94> [Accessed 29 November 2022]

Iannone, P. and Simpson, A., 2021, 'How we assess mathematics degrees: the summative assessment diet a decade on'. *Teaching Mathematics and its Applications: An International Journal of the IMA* , 41, pp. 22-31. Available at <https://academic.oup.com/teamat/article/41/1/22/6271028> [Accessed 29 November 2022]

Institute of Mathematics and its Applications, London Mathematical Society, and Royal Statistical Society, 2022. Statement on Methods of Assessment in the Mathematical Sciences. Available at <https://ima.org.uk/20287/statement-on-methods-of-assessment-in-the-mathematical-sciences-2/> [Accessed 29 November 2022]

Quality Assurance Agency, 2019. Subject Benchmark Statement Mathematics, Statistics and Operational Research. Available at <https://www.qaa.ac.uk/docs/qaa/subject-benchmark-statements/subject-benchmark-statement-mathematics-statistics-and-operational-research.pdf> [Accessed 29 November 2022]

sigma, 2021. The CETL-MSOR Conference 2021 Homepage. <http://sigma.coventry.ac.uk/cetlmsor2021> [Accessed 29 November 2022]

TALMO, 2020. Teaching and Learning Mathematics Online. <http://talmo.uk/> [Accessed 29 November 2022]