How do we assess our students?
A survey of current assessment practices in UK universities

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Many articles, including in the MSOR Connections, address the way in which we assess UG mathematics students, what new assessment methods we use or which innovations in assessment we think are successful. But what are the most common assessment methods in UK mathematics departments? This article reports on the patterns of assessment in UK universities in a stratified sample of 11 mathematics departments to illustrate the current assessment diet in undergraduate mathematics.

Introduction

The way in which we assess our students at university has a big impact on their learning as well as on our teaching. It conveys to students strong signals about what we value in our subject both in terms of micro-skills (specific skills related to mathematical topics, such as the ability to carry out a particular calculation, implement a particular proof technique or apply a given result) and macro skills (generalisable or transferrable skills such as the ability to prove, work with abstract structures or present arguments clearly and concisely).

In this paper we report on a survey of assessment methods across universities in the UK aimed at determining exactly what assessment methods are most common, what alternatives there are to the most common methods and whether different areas of mathematics are assessed in different ways.

The general education literature on assessment in higher education has repeatedly stressed the importance of the introduction of innovative forms of assessment [1,2], either to assess the core skills of the subject studied (in our case mathematics) or other skills such as those deemed to enhance students’ employability. In the mathematics education literature there also have been calls to employ more innovative forms of assessment aimed at testing both micro and macro skills [3]. These include posters, projects, presentations and mathematical essay writing [4,5,6]. However, in order to understand the impact of calls to innovate, we need to understand existing forms and patterns of assessment. So we decided to investigate different types of assessment methods in use across a range of UK mathematics departments.

We are aware that all mathematics departments use some type of formative assessment to provide them and their students with feedback on developing understandings of the mathematical topics being studied, the research evidence suggests that the higher the stakes involved in assessment, the larger the impact on students’ approaches to learning [7,8]. Our own experience also suggests that even a relatively small number of marks assigned to a piece of work transform students’ engagement and effort. Thus, in exploring this issue, we focused on assessment which
directly impacts on the degree classification; that is, we restricted our view to summative assessment.

**Methods**

In order to create a picture of how we assess undergraduate mathematics students across the UK we tried to develop a relatively systematic survey representing a range of different universities. We constructed a sample of universities by beginning with a publicly available ‘league table’ of mathematics departments and then selecting one department from each group of six universities listed in order down the table (they are coded in league table order, alphabetically by pseudonym, in the discussion to follow). We collected data publicly available from the websites of these departments, focusing on the BSc Mathematics (determined by the UCAS code G100). We looked at how modules provided by the mathematics department are assessed, choosing not to examine modules taught by other departments or options which students could take outside mathematics.

For each institution, we recorded the proportion of the year-mark contributed by each module and the proportion that each year-mark contributes to the final degree mark. We also recorded whether the modules are compulsory or optional. As it became obvious that the overwhelming dominant form was the closed book examination, we also calculated an estimate of the proportion of the final degree mark from closed book examinations which would be obtained by a student taking as many other forms of assessment as possible. This gives a crude measure of the dominance of the examination in each institution.

**Analysis and Results**

Our initial findings are shown in Table 1. As noted, the closed book examination (CBE) constitutes the dominant mode of assessment across almost all of the universities.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Minimum Proportion of final award assessed by CBE</th>
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<tbody>
<tr>
<td>Acton</td>
<td>79.83%</td>
</tr>
<tr>
<td>Badwell</td>
<td>88.37%</td>
</tr>
<tr>
<td>Cavenham</td>
<td>86.5%</td>
</tr>
<tr>
<td>Denston</td>
<td>92.14%</td>
</tr>
<tr>
<td>Elmswell</td>
<td>67.83%</td>
</tr>
<tr>
<td>Fakenham</td>
<td>79.7%</td>
</tr>
<tr>
<td>Gedding</td>
<td>72.42%</td>
</tr>
<tr>
<td>Hawkston</td>
<td>75.2%</td>
</tr>
<tr>
<td>Ixworth</td>
<td>58.26%</td>
</tr>
<tr>
<td>Jarrold</td>
<td>27.41% (43.31% including class tests)</td>
</tr>
<tr>
<td>Kelsale</td>
<td>45.94%</td>
</tr>
</tbody>
</table>

Table 1 – Proportion of closed book exam in institutions

In some cases, deeper exploration showed that ‘coursework’ often took the form of a class test, held outside the usual examination period, but in examination conditions and indistinguishable in practice from a closed book examination. For example, Jarrold University uses these extensively in almost all modules and thus we have given two measures for the dominance of the closed book examination for that institution.

While the standard examination is the norm almost everywhere, we also found that there is a significant correlation between league table ranking and the dominance of closed book examination (Fig 1).

This broad picture of the assessment diet in undergraduate mathematics gives a general sense of the most common features. However, we decided to investigate whether there are specific areas where assessment is not dominated by closed book exams, by seeing if there were common modules across our sample with different patterns of assessment.

We found that the assessment of statistics, history of mathematics, mathematical education and projects follow different patterns. We also found information on particular idiosyncrasies in individual departments.

**The assessment of statistics**

Every mathematics department we surveyed offered some statistics and/or probability modules across the three years. In general there was more variety in the assessment of statistics than in pure and applied mathematics modules. Many departments assessed statistics using open book exams (where the material available to students varies from formula sheets to pre-released set of data) and projects.

We also found that statistics and probability modules were more likely than pure and applied mathematics modules to be assessed by a combination of methods (across the three years) rather than by 100% closed book (or open book) exam.

**The assessment of history of mathematics and mathematics education**

Three out of the eleven departments we surveyed offered a history of mathematics module and five offered one or more modules in mathematics education taught within the mathematics department. In these institutions the
modules were offered as options and assessment tended to be through essays, projects and presentations, with far less reliance on closed book examinations.

Projects

All departments we surveyed (except Kelsale University) had at least one project module. Assessment of this sometimes consisted entirely of a written submission but occasionally included a presentation of the project.

Idiosyncrasies

When we looked into the assessment diet of each of the 11 mathematics departments we surveyed more closely, we found that some departments had modules not entirely assessed by closed book exam but did not fall in the categories outlined above. The results are summarised in Table 2.

From Table 2 we can see that some mathematics departments (noticeably Acton and Jarrold) had a relatively wide range of modules not assessed by closed book exam, including those with quite traditional mathematical content. Other departments had smaller numbers of modules which were less reliant on the traditional examination, though these were often aimed directly at improving students’ employability skills.

Concluding remarks

Despite decades of scholarly literature and pedagogical writings on alternative forms of assessment, the picture emerging from our survey is of a subject dominated by the closed book exam. Apart from those few exceptions including projects, history of mathematics and mathematics education, the final degree mark a student obtains will be based overwhelmingly on closed book examinations.

The apparent link between the dominance of closed book examinations and league tables is, perhaps, unsurprising. The more research focussed the university (particularly with students more obviously successful in the closed book examinations which form the majority of the entrance requirements) the more that closed book examinations dominate; while universities who see their missions as developing the employability skills of students who have perhaps underperformed in previous examinations tend to use more varied methods. But even here, the closed book examination still tends to account for the significant majority of the final degree mark.

We should be clear that our aim is not to criticise the current situation or to advocate change for change’s sake. We simply give an indication of the position that the field is in. As a discipline, we may have very good reason to believe that closed book examinations meet our needs well and that the skills that distinguish a good mathematician from a poor mathematician are better assessed using this method than most others available to us. As the London Mathematical

*Note: The names of the modules in this table have been changed to preserve anonymity of the institutions but reflect the module content

Table 2 – Other modules not assessed by CBE in the sample

Society suggests, mathematics may be a quite different discipline as far as assessment is concerned [9]:

“...the competence-based assessment of a fine, modular subdivision of the programme material, while appropriate for a vocational course, is not appropriate for a difficult academic discipline. A mathematics student has to engage bravely with substantial, interconnected, daunting constructions.”

That said, there is evidence in our survey that some mathematicians do feel that they can assess students’ understanding of those “substantial, interconnected, daunting constructions” in other ways. Both Acton and Jarrold Universities assessed what appear to be standard mathematics modules in non-standard ways and most universities provided a level of synoptic assessment through the use of a final year project.
Over 40 years ago, Keith Hirst and Norman Biggs, commenting on their then innovative introduction of final year projects [10], noted:

“… most undergraduate mathematicians know only the placid stream of text-book mathematics, and remain quite unaware of the muddy swamp of half-formed ideas which is at its source. For these undergraduates, mathematical problems are exclusively of the type encountered in examinations - and must be solved in a short time using one standard result and a little ingenuity; thus a problem is merely an illustration of the use of a theorem.”

As a result of this they advocated alternatives to the closed book examination in order to “broaden the student’s view of the subject, and to enable [them] to recognise and gain confidence in different forms of mathematical activity.” Perhaps four decades on, the assessment diet and its influence on students views of the subject still needs some exploration.

References


