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Teachers' and employers' views on the transition from GCSE Mathematics to A level Mathematics or employment

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Introduction

The General Certificate of Secondary Education (GCSE) is a British qualification taken by 16-year-olds at the end of compulsory formal schooling in England, Wales and Northern Ireland. Whilst students must continue with some form of education beyond this, it does not have to be full-time education, nor must it continue within a school or college. Therefore, the qualification marks a transition, and the results from it may be used as entry requirements for further study and employment.

Mathematics is one of the core GCSE subjects, and students are required to study the subject until the end of Key Stage 4 (KS4), when they are approximately aged 16. There is no requirement for students to take a qualification in Mathematics, but almost all students do. In 2011/12, 97.3 per cent of students at the end of KS4 took a qualification in Mathematics; 93.7 per cent of the KS4 students took a GCSE in the subject (Gill, 2013a).

GCSE Mathematics is important because it represents the end of students' compulsory Mathematics learning. Despite suggestions that all students should continue studying Mathematics beyond this point, it is currently only a requirement for those students who have not 'passed' GCSE Mathematics (i.e., those who have not gained a grade C or above) to continue studying to do so. Therefore, the qualification needs to accurately assess students' competence in Mathematics. It is also a requirement for continuing to study Mathematics at A level, so needs to reflect the skills that are necessary for starting that qualification. Finally, it may be necessary for studying Science subjects at A level; a good grade in GCSE Mathematics is often required if students wish to take A level Physics (Gill & Bell, 2013).

Despite being required for entry to further study and employment, there is a history of research that identifies problems in using GCSE Mathematics for both purposes. The transition to A level is seen to be problematic (Mendick, 2008; Hernandez-Martinez et al., 2011). Many students who start A level courses drop out during their first year or after their AS results (Mendick, 2008; Noyes & Sealey, 2012) and there is widely believed to be a gap between the Mathematics that is necessary to pass a GCSE and the Mathematics that students need to be able to do to start A level (Brown, Brown & Bibby, 2008; Noyes & Sealey, 2011). Schools have adopted two approaches in order to combat the gap and avoid high drop-out rates. Most schools require high grades for entry onto A level Mathematics courses. Students often have to have achieved a grade B at GCSE or even a grade A in order to be accepted for the course (Mendick, 2008; Noyes & Sealey, 2012; Hernandez-Martinez et al., 2011). The grades required for Mathematics may be higher than those used for other subjects (Mendick, 2008). Additionally, some schools run extra courses, or set work for students to complete between finishing GCSEs and starting A levels so that their Mathematics is of the standard that is needed for the A level course (Noyes & Sealey, 2011).

Whilst the notion of a gap between GCSE and A level Mathematics appears to be widely acknowledged, there is little research that has investigated what the nature of the gap is. Instead, most of the research

focuses on students' reasons for dropping out (e.g., Noyes & Sealey, 2012; Mendick, 2008). A few studies do mention problematic content areas. Algebra and algebraic manipulation skills are identified as being problematic for students at the start of A level (e.g., Wiliam, Brown, Kerslake, Martin & Neill, 1999; Noyes & Sealey, 2011; Hernandez-Martinez et al., 2011). The range of dates from studies that identify this issue suggests that this is not a new problem with GCSE Mathematics. Trigonometry was also identified as being problematic in one study (Wiliam et al., 1999), but as it was carried out on courses that date back almost 20 years, these findings may no longer be relevant.

GCSE Mathematics is also important for employment. The majority of students entering employment will not have studied Mathematics beyond GCSE. Many students do not take A levels – in 2013, approximately 60 per cent of students did not study for any A levels[1]. Even amongst those studying A levels, only 12.4 per cent took A level Mathematics in 2013 (Department for Education [DfE] & Truss, 2013). Employers are known to value mathematical skills even for non-numeric jobs (Confederation of British Industry [CBI], 2013; UK Commission for Employment and Skills [UKCES], 2012; Advisory Committee on Mathematics Education [ACME], 2011; CBI, 2010). Numeracy, which is defined by the CBI as "confidence with the handling of numbers, general mathematical awareness and its application in practical contexts" (CBI, 2010, p.2), is part of GCSE Mathematics. Employers are particularly interested in potential recruits' numeracy levels: 50 per cent of employers consider numeracy levels as part of the recruitment process when employing school and college leavers (CBI, 2013). Therefore, it is important that GCSE Mathematics prepares students adequately, particularly in areas of numeracy.

A large scale survey showed that 56 per cent of employers think that five A* to C GCSE passes, including English and Mathematics, are the best indication of numeracy skills needed in the workplace (CBI, 2012). However, there is a perceived issue with the level of numeracy required by school-leavers for employment (CBI, 2013). Employers are dissatisfied with numeracy skills and some have to provide further training in this area (CBI, 2010; CBI, 2012). This may be caused by a difference between the Mathematics that is taught in schools and the numeracy skills that are required by employers; there is concern that employees are not good at applying the Mathematics skills that they learnt at school (ACME, 2011). However, some employers believe that the gap between completing GCSE Mathematics and entering employment also contributes to poor numeracy skills (ACME, 2011; CBI, 2010). This problem may be compounded by early GCSE entries, as the time between studying Mathematics and entering employment would be larger. Gill (2014a) found that almost 38 per cent of students entered at least one GCSE early (in Year 10). Whilst it was not found to affect students' chances of obtaining a grade C, it may have affected their ability to perform to their potential (Gill, 2013b).

The CBI carried out a survey in 2010 that focused upon employers' views on numeracy levels, and identified that employers had concerns about employees' numeracy skills. They identified the following areas as necessary for the workplace (CBI, 2010):

- Carrying out mental arithmetic (without using a calculator)
- Interpreting and responding to quantitative data
- Calculating percentages and interpreting their significance
- Working comfortably with fractions, decimals and ratios (the ability to use a formula is also 'highly desirable')
- Awareness of different measures and converting between them
- Checking potentially rogue results and calculation errors
- Having a basic understanding of odds and probabilities.

The current study aimed to build on the work that had been carried out previously, and to identify the areas of Mathematics that were problematic for students who had just completed GCSE Mathematics. It also aimed to discover whether there was any overlap in the skills that were considered to be problematic as preparation for A level and those considered to be problematic as preparation for employment. It uses responses from a larger survey of teachers and employers to consider three research questions:

1. What areas of Mathematics are GCSE students well/poorly prepared in?
2. What teaching is needed to bring students up to the standard for starting A level Mathematics?
3. What Mathematics training do employers run for school leavers?

Method

As part of the Oxford, Cambridge and RSA (OCR) Examinations Mathematics GCSE redevelopment work, stakeholders including schools/colleges and employers, were consulted about various issues affecting GCSE Mathematics. Researchers within the Research Division at Cambridge Assessment developed two questionnaires for this consultation work: one for schools/colleges, the other for employers. The researchers worked with the OCR Mathematics Redevelopment Team to identify and prioritise the issues and research questions that were considered useful for redeveloping the qualification. Questions were then drafted and reviewed by the researchers. The completed questionnaires were piloted by ten Mathematics teachers and five employers. A final draft of each questionnaire was then put into a web-based format for online completion. The teachers' questionnaire was sent to 2,085 schools and colleges offering OCR A level Mathematics qualifications. Participants in the employers' questionnaire were recruited by personal and institutional links, targeting of key professional roles, and snowball sampling (asking participants to pass the questionnaire onto colleagues in other organisations.) A total of 143 questionnaires were distributed to employers, of which 35 were returned.

Four questions from the teachers' questionnaire were considered to be useful for this study:

1. How well does GCSE/Cambridge International General Certificate of Secondary Education (IGCSE®) Mathematics prepare your students for A level/Advanced Subsidiary (AS) level Mathematics in terms of the following [16 areas of Mathematics were listed]
2. Which of the above areas (or other areas) would benefit from greater emphasis or greater depth at Key Stage 4 to aid progression to A/AS level Mathematics?
3. Are extra/recap lessons needed at the start of A level to bring students up to the level required?
4. If so, what content do they cover?

1. No published statistic is available on this. In mid-2013, the Office for National Statistics (ONS) (2015) estimated there to be 650,210 18-year-olds. Gill (2014b) reports that 260, 087 Year 13 students (i.e., students aged 18) took at least one A level in 2013. Using these two figures shows that approximately 60% of 18 year olds did not take any A levels in 2013.

Four questions from the employers' questionnaire were considered to be useful for this study:

1. What GCSE grade do you think provides good evidence that new employees have sufficient levels of Mathematics skills to work confidently, effectively and independently?
2. How useful would you consider the following mathematical skills and content to be for new employees? [12 areas of Mathematics were listed[2]]
3. Are there any specific skills that you think new employees lack when they have completed a GCSE Mathematics course and which are key to their successful transition from education to employment?
4. What is the purpose of any training that you currently provide for new employees who have already completed a GCSE Mathematics course?

Findings

The teachers' questionnaire was emailed to 2,085 schools and colleges offering OCR A level Mathematics qualifications. One hundred and seventy-nine schools responded; a response rate of 8.6 per cent. Responses were received from a range of different school types (see Table 1), although they were not representative of the proportions of each school type found nationally.

Table 1: Institution types within the questionnaire sample

Institution type	*Count*	*Percentage of responses*
Comprehensive	79	44.4
FE Institution	19	10.7
Independent	34	19.1
Secondary Selective	16	9.0
Sixth Form College	16	9.0
Other (please specify)	14	7.9

The employer questionnaire was sent out to 143 employers. Thirty-five employers responded; a response rate of 24.5 per cent. The majority (54 per cent) came from businesses that employed more than 250 employees, and they represented a wide range of employment sectors.

Teachers' questionnaire

Teachers considered that students were prepared adequately for AS/A level courses in most areas of Mathematics. However, several areas were identified where GCSEs were considered not to prepare students well. These were:

- Proof (68%)
- Unstructured problem solving (54%)
- Familiarity with other technology (47%)
- Algebraic fluency (44%).

2. These areas of Mathematics were different to the ones listed in the teachers' questionnaire for aiding progression to KS4.

In contrast, few teachers thought that students were unprepared in five areas:

- Sequences and patterns (12.4%)
- Appropriate uses of calculator (9.6%)
- Geometry (9.6%)
- Data handling (8.5%)
- Measures (5.1%).

When asked which areas would benefit from being taught in greater depth in KS4, a large number of responses were provided. The most frequent comments related to algebra or algebraic fluency (61%). For example:

> *Algebraic understanding. The GCSE exam requires very little understanding to gain the top grades and thus the issue at A level.*
>
> *I suggest all of them but in particular algebra and multistep problem solving. You can now get a B with very little algebra this is unacceptable…*
>
> *Greater fluency in algebra from grades C upwards (as this is our minimum entry requirement for AS level) – current boundaries allow students to gain C or B grades without actually having solid skills in algebra, which is insufficient for AS transition.*

However, two respondents were concerned about the effect that the increased emphasis on algebra would have on those students who were less strong or not intending to continue to study Mathematics. For example:

> *More emphasis on algebra would aid progression, but hinder those not wishing to proceed to A/AS.*
>
> *Algebraic manipulation – but then this would disadvantage those students who are not ace mathematicians.*

Other areas which were identified by ten or more respondents included: problem solving (18%); proof (18%); functions and graphs (18%); coordinate geometry (12%); and surds (7%).

> *…There also needs to be more emphasis on core skills such as surds and indices.*
>
> *Whilst I realise that Mathematics is a developing subject, an inclusion of a greater level of formal geometry would certainly help. It gives the students a better understanding of the concept of proof.*

The majority of respondents (86%) offered extra lessons for some or all of their students at the start of A levels (see Figure 1).

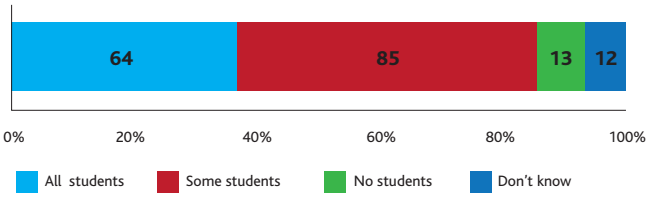

Figure 1: Extra lessons required at the start of A level Mathematics

Many of the respondents (130) provided detail of the content of these lessons, indicating that a variety of topics were covered. Most of these respondents focussed the sessions on particular knowledge and skills,

although a few (2%) tailored help for individual students. In general, the most common areas addressed in these sessions were:

- Algebra (80%)
- Surds (26%)
- Quadratics (17%)
- Graphs and functions (15%)
- Indices (14%)
- Solving equations (12%[3]).

Most of the respondents indicated that they taught generic algebra skills, but some of them focused on particular areas of algebra that students found difficult. For example:

> *General algebraic manipulation and the solving of linear, quadratic and simultaneous equations.*
>
> *Factorising. Expanding brackets. Simultaneous equations.*
>
> *Algebra, algebra and algebra, and the basic concepts that are connected to sim[ultaneous] equations, factorising, dealing with brackets either way – geometry a bit too.*

Other respondents mentioned areas of Mathematics that were needed for B grade GCSE students who were studying AS/A level Mathematics. For example:

> *Algebra is needed for the lower ability students who take on A level with a grade B at GCSE.*
>
> *Fractions, indices, surds, quadratics, simultaneous equations. It's not that this isn't covered in Core 1, but that the grade B students don't pick it up quickly enough to apply skills to work on coordinate geometry and calculus.*
>
> *The B grade students are encouraged to attend some extra classes after the exams. The "old money" intermediate students. We mainly cover the algebra topics such as quadratics, sketching graphs, we cover some trig and indices and surds.*

However, even the top grade GCSE students at some schools were given extra help. For example:

> *We re-do all the algebraic work and the surd work. We have found the A* target students are typically at an E grade of understanding if we do not do this.*
>
> *Some need it because they can achieve an A at GCSE with 65 per cent and little algebraic ability. They think they are good at Maths but not surprisingly bomb at A level because it is so algebraic.*

One respondent suggested that it was the gap between GCSE and AS that caused the problem, rather than the content of the GCSE course or the students' GCSE grades.

> *This is more because of the long time gap between them finishing lessons in Year 11 (before study leave and exams) and then coming back in 6th form. We cover basics of algebra, algebraic fractions, solving equations etc., surds, coordinate geometry.*

3. Whilst quadratics and solving equations are part of algebra, they were coded separately as many respondents listed them as separate topics.

Another suggested that it was due to a lack of top level material on the GCSE exam papers.

> *We prepare our students very well for the GCSE exam, however there is not enough of the A/A* material on the exam. Our students get very good results and as a consequence think they are better at Maths than they actually are. A few students then decide to take A-Level Maths and are not really up to it!*

Employers' questionnaire

The majority of the employers who responded to the survey felt that a grade B in GCSE Mathematics provided good evidence that new employees could work confidently, effectively and independently (see Table 2). Very few required a higher grade at GCSE, but some indicated that a C would be adequate. Whilst there was an opportunity to choose grades below C, none of the employers chose these grades.

Table 2: GCSE grade providing good evidence of Mathematics skills to work confidently, effectively and independently

*A**	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*Don't know*	*None of the above*
8.6%	8.6%	42.9%	22.9%	0%	0%	0%	0%	2.9%	14.3%
3	3	15	8	0	0	0	0	1	5

The employers felt that almost all of the mathematical skills they were asked about were useful for new employees to have. The most useful skills were:

- Effective and appropriate use of ICT packages (spreadsheets, charts) (97%)
- Proficiency with quantity and number (97%)
- Ability to understand the principles behind calculations (94%)
- Ability to make meaningful estimates (94%)
- Using diagrams, charts and tables (91%).

Employers responded that the least useful of all the skills listed was use of symbolic notation, but even that skill was regarded as useful or very useful by 51 per cent of employers.

Very few employers responded to the question about skills that new employees lacked, so it was not possible to draw firm conclusions about the skills that were lacking but considered important for employment. Three areas were included by more than one respondent: mental arithmetic and basic skills; understanding the magnitude of numbers; and using Mathematics in context:

> *Basic Maths skills – times tables especially.* (Real Estate Activities sector employer).
>
> *Non-technical staff I would expect a basic level of arithmetic.* (Professional, Scientific and Technical Activities sector employer).
>
> *Having a feel for numbers and understanding what the calculations mean.* (Aerospace, Manufacture and Design sector employer).

Despite the low number of respondents identifying problematic skills, approximately half of the respondents said that they provided some form of Mathematics training for new employees. This was slightly less likely to be remedial training than job specific training, or training which built on existing knowledge (see Figure 2).

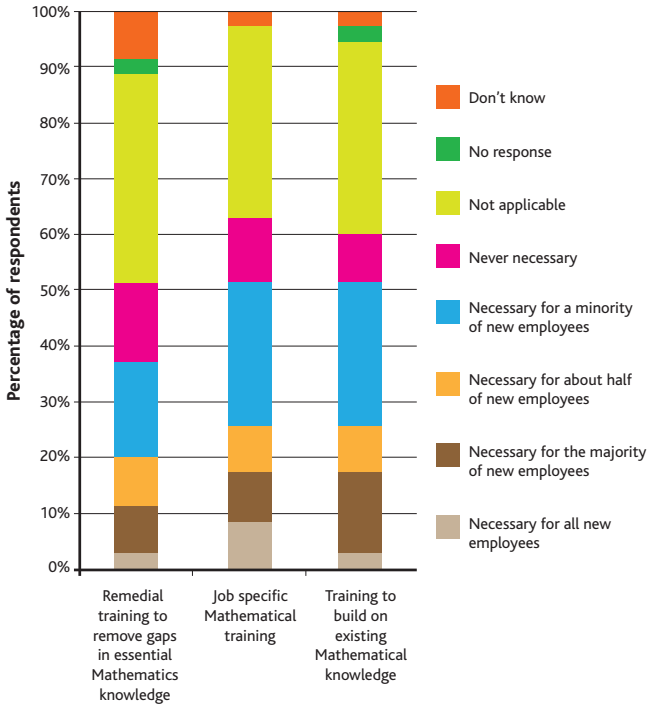

Figure 2: Purpose of extra Mathematics training provided to new employees with GCSE Mathematics qualification

Discussion

The clearest finding from the teachers' survey was that students' algebraic skills were considered weak by the majority of teachers, and students were considered to be underprepared in this area. These results confirm the findings from earlier research, which identified algebra skills as problematic for students beginning A/AS level Mathematics courses (e.g. Wiliam et al., 1999; Noyes & Sealey, 2011), and suggests that it is an on-going problem. Teachers were not asked why this area was problematic, but a few teachers made suggestions when answering other questions. One said that it might be the length of time between finishing GCSE examinations and starting A/AS level courses that caused the problem. Other respondents suggested that it might be because there was relatively little content related to this on the examination papers and that this meant that students were able to get the grades necessary to start A level study without understanding the more advanced GCSE algebra content.

Currently, many of the respondents compensate for the weakness in algebra skills by including them in extra lessons or work that is given to students before the start of their A level courses. However, a large number of them thought that algebraic skills would benefit from being taught in greater depth at KS4. Including more of this content may cause a problem, as the GCSE course also has to be suitable for learners aiming for lower grades, or those students not planning on continuing to study Mathematics post-16. Several of the teachers were concerned about the effects on these learners if specifications (and examination papers) contained a greater emphasis on algebra.

The tension between amending specifications to provide better preparation for A level and ensuring that they were appropriate for students with lower grades who were not intending to continue can also be seen in other problematic areas of content. Many teachers included work on surds and indices in their extra lessons, and they also suggested that students were poorly prepared in proofs. All these skills are important for A level, but they are less relevant for other students. Increasing the emphasis on these areas may mean that other topics that are important for employment are not given the emphasis that they require.

Responses to the employers' survey suggested that an emphasis on a very different set of skills is needed if GCSEs are to prepare students better for the workplace. Employers valued proficiency with number, understanding the principles behind calculations and making meaningful estimates. All these skills are much more closely aligned with the numeracy skills that previous research (e.g. CBI, 2010) has shown that employers value.

The only areas that both teachers and employers identified as weak were students' skills using ICT/Other Technology, and their ability to interpret graphs, functions, charts and tables. The differences between employers' and teachers' views may have arisen because different areas of Mathematics are necessary for progression to further study and employment. Many jobs require numeracy, indeed the CBI (2010) reports that employers want all of their employees to be numerate. However, algebra skills are less commonly required in workplaces, particularly in roles which do not require qualifications in Mathematics beyond GCSE level. In contrast, A/AS level Mathematics courses rely on good algebra skills more than they do upon good numeracy skills.

Approximately half of the employers responding to the questionnaire provided some form of Mathematics training for new employees. This is higher than the 18 per cent reported in the CBI (2010) numeracy survey, but this could be due to the low number and less representative nature of the employers responding to the questionnaire.

Limitations

The response rate for the teachers' questionnaire was low, although it was comparable to similar questionnaires which were sent out to English and Science teachers. This means that the responses cannot be generalised to a broader teaching population. However, given the limited literature that is available in this area, it provides a starting point for researchers, qualifications developers and the teaching community to understand areas of GCSE Mathematics that may be problematic for students.

Whilst the response rates for employers were higher, they still only represent a very small proportion of the employers within England and therefore it is also necessary to be cautious about making inferences from a limited sample. However, the results do add to the findings from the large scale surveys that have been carried out and enable researchers and qualifications developers to see whether the findings from the older studies are still relevant.

Conclusion

This study has shown that there are areas of Mathematics in which the transition from GCSE to A level Mathematics is problematic. These areas generally correspond to the ones that have been identified within previous studies. It has also found that employers also think that some areas of Mathematics are not being covered thoroughly enough at GCSE. Generally, the areas that employers are concerned about are different to those that are considered to be problematic for the transition to A level. Any additional content which would enable GCSEs to prepare students

better for A levels is likely to mean less emphasis on an area that employers consider to be important and vice versa. Therefore, whilst this study has shown that there is support for amending the GCSE content, and has identified the content areas that should be considered, it is not possible to ascertain which of these areas should be covered in greater detail.

Postscript

Since this work was carried out, the updated subject content and assessment objectives for GCSE Mathematics have been published (see DfE, 2013). This document contains the detail that all awarding bodies need to include in their specifications for the reformed GCSEs, although additional content can be added by awarding bodies to increase the breadth and depth of their qualifications.

Several areas of subject content have been added to the specification, including extra algebra at both the Higher and Foundation tier, additional work on graphs, and extra number skills which should increase students' proficiency when working with quantities. However, the new content does not necessarily cover the entirety of the areas that had been identified as problematic. There may be other areas of these topics which teachers and employers would have liked to be included, but which were not. Furthermore, the inclusion of topics does not ensure that all students are taught these topics, since some are only included for the Higher tier. Students who are not likely to enter the Higher tier are unlikely to study this content.

There are also several areas identified in the study, such as tables and ICT skills, which appear not to have received any extra content. Awarding bodies may include these areas in the extra breadth and/or depth that they are allowed to add within their specifications, but this will not necessarily happen. It is likely that students will continue to be underprepared in these areas when the new GCSE specifications are taught.

In January 2014 a new "Core Mathematics" qualification was announced. This qualification is a Level 3 qualification, and is targeted at students who have achieved a grade C in GCSE Mathematics. It aims to "provide a sound basis for the mathematical demands that students will face at university and within employment across a broad range of academic, professional and technical fields" (DfE, 2014a, p8), by assessing students' skills in applying GCSE Higher tier Mathematics content to authentic situations, and developing further mathematical skills and knowledge.

A level Mathematics is also being redeveloped for first teaching in September 2016. The new subject content and assessment objectives for A level Mathematics (DfE, 2014b) were published in December 2014, after this analysis had been carried out. Several new areas of content have been added. The algebra content has been expanded, and some areas that were originally only included at Foundation level are now included at Higher level as well. There is also a more content for graphs, functions and charts, some of which overlaps with algebra. Within the areas that employers identified, there are more numeric proficiency skills. Making meaningful estimates is also covered in greater depth. However, the new content does not necessarily cover the entirety of the areas that had been identified as problematic. There may be other areas of these topics that teachers/employers wanted included and have not been added. Nor does it ensure that students are taught these areas. There are also several areas which appear to have no additional content. Awarding bodies may include these areas in the extra breadth and/or depth that they are allowed to add within their specifications, but this will not necessarily happen.

It is possible that changes to the core Mathematics content at A level (which relies on most of the areas that teachers suggested were inadequately prepared) may mean that the transition from GCSE to A level Mathematics is less problematic. Additionally, the redevelopment of both GCSEs and A levels at a similar time means that awarding bodies should be able to ensure a smoother transition between the two qualifications.

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Statistics and Mechanics: Comparing the Applied Mathematics of international Mathematics qualifications

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Introduction

In this article, we report on data collated as part of a large-scale study investigating how A level Mathematics and Further Mathematics prepare students for the mathematical demands of university study in a range of subjects. We investigate and compare the applied mathematical content (Mechanics and Statistics) in a range of international Mathematics qualifications and conclude that the A level has notable differences to similar qualifications in other jurisdictions. In particular, the existing modular structure at A level introduces significant variability into the mathematical backgrounds of students studying what is theoretically the same qualification. Although this problem will be rectified by the introduction of prescribed content from 2016, two other differences emerged during this investigation. First, whilst Mechanics content at A level is primarily studied in Mathematics and/or Further Mathematics, in nearly every other jurisdiction this content is studied within the Physics course. Secondly, there appears to be no international consensus about what statistical content is taught at this level. These findings may have implications for ongoing reform at A level, particularly with respect to the applied content in Further Mathematics, and may also prove interesting for employers and universities with a global reach who currently use Mathematics qualifications for admissions or recruitment purposes.

Background

As part of ongoing qualification reform in England and Wales, A level Mathematics and Further Mathematics are being reformed for first teaching in 2016. The reforms have significant implications for the structure and content of post-compulsory Mathematics in the UK. All A levels are moving from a modular to a linear system, meaning that students will be required to take all of their examinations at the end of the two-year course, rather than throughout as is currently the case. Additionally, the AS level and the A level are being 'decoupled'. The A level is currently a two-year course; students sit examinations during the first year which contribute to their final A level grades which also counts as a qualification in its own right (the Advanced Subsidiary or 'AS' level). However, in the reformed A levels, the AS level will become a stand-alone qualification and will no longer count towards a student's overall A level grade.

Students are able to study two Mathematics A levels: Mathematics and Further Mathematics[1]. The four main awarding bodies (AQA, Oxford, Cambridge and RSA (OCR) Examinations, Pearson Edexcel, and WJEC) all offer their own versions of both A levels, and students and schools are able to select which awarding body's specification they would like to study. Currently, there is a great deal of flexibility in the structure of both subjects, particularly in relation to the applied content. Further Mathematics must be studied alongside or after A level Mathematics, and its content builds on material covered in Mathematics.

In A level Mathematics, students sit four 'Core' Pure Mathematics modules, and two 'Applied' modules. The Applied modules can be chosen from Mechanics, Statistics and Decision Mathematics, and students can either take one module from two different strands, or multiple modules from the same area (e.g., Mechanics 1 and Statistics 1, or Mechanics 1 and 2). For example, a student interested in studying Engineering or Physics at university may be encouraged to specialise in Mechanics, whilst a prospective Biologist or Social Scientist may choose only Statistics modules (Lee, Harrison, & Robinson, 2007; A Level Content Advisory Board, [ALCAB] 2014). However, students are rarely able to choose their own modules as these decisions are predominantly made by the school/college. Schools/colleges often lack the resources to offer different modules for individual students and instead tailor their module

1. Two awarding bodies also offer an AS/A level in Statistics, but these are taken by very few students.