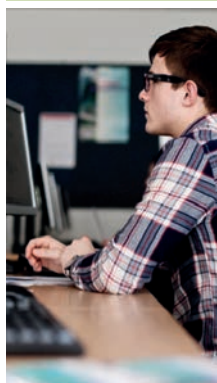
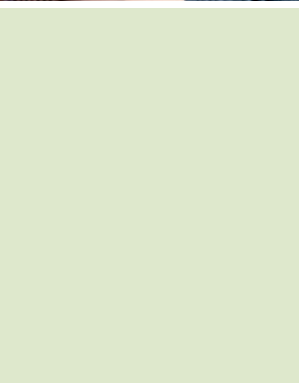
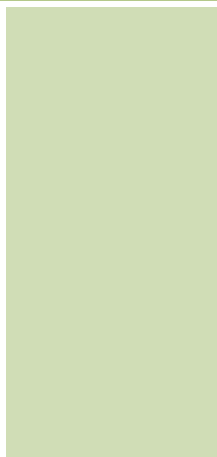


Post-16 Mathematics: Planning for success

ACME Post-16 Mathematics Project | acme-uk.org

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Key message for policymakers

In *Post-16 mathematics: A strategy for improving provision and participation*, ACME proposes four key strategies for dramatically increasing the number of young people studying mathematics up to the age of 18, including the introduction of a new post-16 mathematics qualification. This paper complements *Increasing participation* part by setting out the actions that will need to be undertaken to implement that strategy.

School, college and student behaviours are affected by a complex system of levers and drivers, and these factors need to be understood and responded to if schools and colleges are to offer appropriate courses and students are to choose to study them.

Creating a new mathematics qualification will not in itself achieve our goals of increasing post-16 mathematics provision and participation. This document and the actions described in it should be considered to be an essential part of choosing to implement the post-16 mathematics strategy; insufficient attention to the factors described here will mean that the aspirations of the strategy will not be met.

Summary of actions required for successful implementation

Coordination and consensus

1. **Coordinate implementation**, monitor progress with the strategy and intervene where necessary, allocating responsibility for the actions below as appropriate.
2. **Secure a politically stable consensus and realistic timetable** for development and implementation by establishing cross-party consensus on the broad aims of the new post-16 qualification.
3. **Ensure that all HE and employers understand and value qualifications** by coordinating the engagement between awarding organisations, Higher Education and employers during the development of the new post-16 mathematics qualification.

Continued Professional Development and teacher supply

4. **Support teachers in delivering new (and existing) post-16 courses** by creating a programme of funded, focused CPD, including for teachers who have little or no experience of teaching beyond GCSE mathematics.
5. **Determine the scale of teacher recruitment needed to facilitate the increase in post-16 mathematics participation** and build this into current teacher supply models. Consider whether a new post-16 course as proposed in the strategy could be taught by existing teachers of other subjects who already apply mathematics at a high level in their disciplinary areas.

Clear and comprehensive communication

6. **Communicate opportunities for post-16 mathematics clearly** by developing a sophisticated communication strategy that clearly presents a simple framework for post-16 mathematics qualifications to parents, students and teachers (including non-maths and senior staff).
7. **Support providers of Information, Advice and Guidance and Teacher Training** as well as existing school and college staff that work with Key Stage 4 students, by clearly communicating the framework in ways that are useful to them.



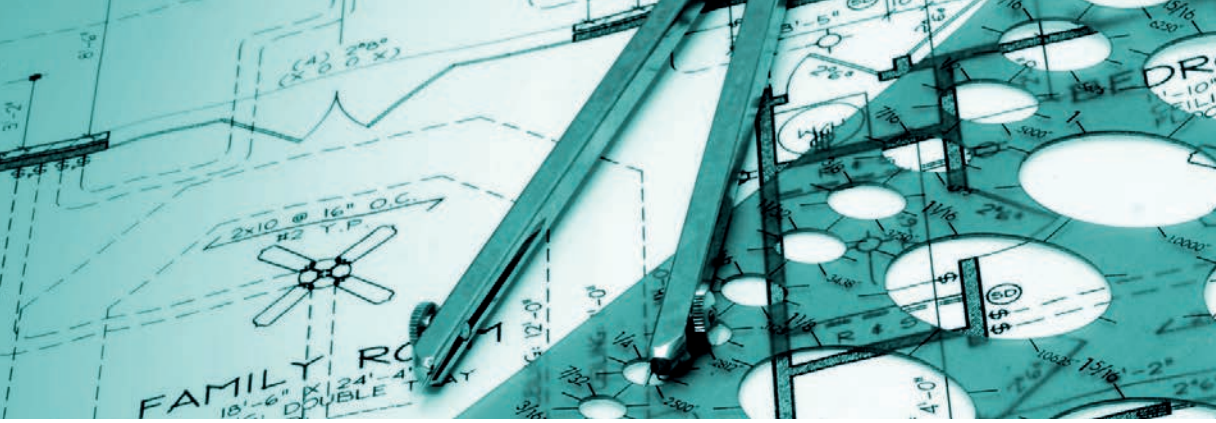
Curriculum and assessment

8. **Make post-16 mathematical study appealing and motivating** by ensuring that awarding bodies develop an approach and content for a new course in a way that is demonstrably engaging for students and their teachers.
9. **Champion the development of high quality support materials** including textbooks and online materials.

Creating incentives and recognition

10. **Develop recognition of post-16 mathematics pathways** by
 - a) introducing overarching qualification structures (e.g. ABacc)
 - b) engaging with university admissions tutors to encourage them to make the new post-16 mathematics qualification a requirement for a range of courses, and
 - c) by engaging with employers to secure recognition.
11. **Incentivise schools and colleges to provide the new mathematics course** by developing supportive **funding mechanisms** and **performance indicators** which privilege areas of national priority such as mathematics.

The Department for Education will need to use this document as guidance and develop detailed actions under each of the headings above. An indicative timetable for pursuing these actions is included in appendix A, to suggest which of these will need to be tackled first.



Planning for success

1. Coordinated implementation

Imperative: *The project of providing appropriate mathematics education for all students to 18 requires careful, coordinated planning and monitoring.*

Achieving significant rises in post-16 participation in mathematics is an ambitious goal. It is certainly a timely moment to consider making changes to post-16 mathematics provision. The education and qualification landscape in England is currently in a state of flux. Both GCSE and A-level qualifications are undergoing major reforms. Changes are being made to the way qualifications are developed and to the structure of qualifications, and these in turn are likely to result in changes being made to syllabus content and assessments. These reforms are likely to be introduced between 2014 and 2019.

The increasing post-16 mathematics participation envisaged will require coordination and steering over a period longer than the current political cycle. There is a clear need to monitor progress towards the targets set, and to ensure that all agencies are working in a similar direction. It is essential that responsibility is assigned for ensuring that the issues highlighted in this document are tackled, and that the recommendations in this paper are used as a checklist of things to prompt and coordinate.

Action 1:

ACME and DfE should jointly monitor progress with the strategy and intervene when necessary. HE, Learned Societies, employers and teachers should be engaged in this process.

2. Creating a politically stable context for change

Imperative: *There must be appropriate time for curriculum and assessment development and trialling, and the project must be able to survive a change in government.*

The lack of stability in qualifications is a significant barrier for any new qualification seeking to gain currency with employers and HE. Over the past few years, a number of qualifications have come and gone (e.g. Diplomas and Key Skills), and the introduction of a new qualification would be hampered by a lack of cross party consensus. All political parties have identified the need to address this issue, and we welcome this.

In particular, experience in 14-19 mathematics (e.g. Curriculum 2000 and subsequent curriculum changes, attempts to get two mathematics GCSEs, etc) suggests that it takes several years to establish qualifications that are fit for purpose. We understand the imperatives to increase participation rapidly but caution against the introduction of new programmes to very large cohorts without allowing for a period of iteration during their introduction. A phased approach is needed, with regular reviews of progress. In addition, teachers need to develop related pedagogies, and changing policies relating to supporting teacher development could hinder this.

Action 2:

The government and opposition should agree the broad aims of any new post-16 mathematics qualification framework and a realistic timetable for implementation.



3. Ensuring that HE and employers value qualifications

Imperative: Any new qualifications need to be overtly and clearly advocated and valued by universities and employers.

The name, or brand, of any qualification is crucial. Higher education institutions (HEIs) and employers are wary of new qualifications. Brands known to HEIs and employers are limited; GCSE, BTECs, AS and A level are the only widely recognised qualifications.

Introducing a new qualification without direct engagement with HEIs and employers in its development would risk its being devalued when compared with AS Mathematics or GCSE Mathematics. Such engagement and widespread understanding of new qualifications is notoriously difficult to achieve. Many mathematics qualifications have struggled to gain this recognition, even with extensive input from higher education. The way higher education institutions engage with qualification development is currently under review, but it is clear that they will need to be involved in the development of a new post-16 mathematics course if it is to meet the needs of their students, and if it is to gain currency as a desirable or required qualification.

Similarly, employers and sector representatives must be engaged in the development if it is to fit well alongside vocational qualifications.

Action 3:

ACME should host discussions with UCAS, groups of universities, and with a wide range of Subject Associations and Learned Societies, to discuss the practical ways in which Admissions tutors can be encouraged to familiarise themselves with the new qualifications and make them at least a recommendation and preferably, a requirement.

Action 4:

The awarding organisations' engagement with Higher Education and employers should be coordinated during the development of the new qualification, including gaining agreement for national standards for the new qualification, in a similar manner to the development of new A levels.

4. Continued Professional Development

Imperative: Teachers will need to be supported in learning how to deliver a post-16 course with a focus on problem solving.

Any major education reform should be supported by a programme of CPD which improves teacher subject knowledge, and this is no exception; indeed it is particularly relevant here because of the need for innovative pedagogy to deliver a post-16 course focused on problem solving. The National Centre for Excellence in Teaching Mathematics (NCETM) was established to coordinate the provision of mathematics CPD and has an important role to play here.

The need applies to existing teachers of mathematics as well as teachers of other subjects who may be needed to apply their knowledge to support delivery (see below).

Action 5:

A programme of funded, focused CPD should be provided to support good implementation of the new qualification at scale, and should be coordinated by the NCETM. Where necessary, this should be enhanced for teachers who have little or no experience of teaching beyond GCSE mathematics. The Further Mathematics Support Programme highlights what can be achieved.



5. Teacher supply

Imperative: *The lack of suitably qualified and experienced teachers needs addressing.*

Even with excellent qualifications, adequate resourcing, suitable incentives and improved value and recognition of post-GCSE mathematics courses, it will not be possible to increase the number of students taking a higher level qualification without addressing the shortfall in available mathematics teachers.

At present, data on the number of suitably qualified staff in schools and colleges is largely unavailable. However, we do know that schools and colleges are already struggling to recruit teachers at Key Stage 4 and below. It is hard to imagine that they would find it easier to recruit teachers with confidence to teach the new post-16 course. The strategy also indicates that there should be a drive to improve uptake of AS Mathematics as well, and this too will require more teachers.

Moreover, if the new qualification has a more problem-solving approach, it will need teachers who can deploy different pedagogies, addressing hitherto unexplored content at this level.

To make provision for the more than 200,000 students who currently achieve a grade C or above in GCSE Mathematics to continue with their studies to 18 is clearly ambitious. In order to get a sense of the scale required, consider 200,000 students being taught in classes of 20. The proposed course could be 2 hours contact time per week for two years. That means we would be seeking 40,000 hours of extra teaching time a week for this cohort alone, which would equate to roughly 2,600 new teachers required¹.

There is a limited number of ways of increasing the teaching capacity, and it is likely that all of them will need to contribute in some way to increasing provision:

- Targeting the recruitment of new teachers, either from university or career changers
- Enticing returners to rejoin the profession
- Improving retention of teachers
- A broader range of staff could contribute to the delivery of the new course, possibly via team teaching with mathematics specialists, supported through knowledge enhancement courses

The Department for Education has undertaken some workforce analysis, and we look forward to receiving its findings.

Action 6:

The DfE should plan for a significant increase in post-16 mathematics participation and consider whether the new mathematics course might be taught by existing staff who already apply mathematics at a high level in their disciplinary areas.

6. A clearly communicated framework for post-16 mathematics

Imperative: *The qualifications structure needs to be clear and easily understood by students, parents, teachers, careers advisors, employers, school and college managers, and end users including HE admissions tutors.*

In the current education system, awarding organisations are not obliged to provide any new qualifications, or stop providing existing qualifications. Moreover, schools and colleges are free to choose which courses they offer. Without some rationalisation of existing provision, and the introduction of new provision, the parsimony advantage will be lost – but the only mechanism for rationalisation is through positive signposting of preferred qualifications and allowing market forces to take effect.

To achieve this, ACME recommends that a clear framework for post-16 mathematics should be established, ensuring that over time there is not a proliferation of competing qualifications. The framework should enable all students to access to mathematics courses appropriate to their needs, ability and interests.

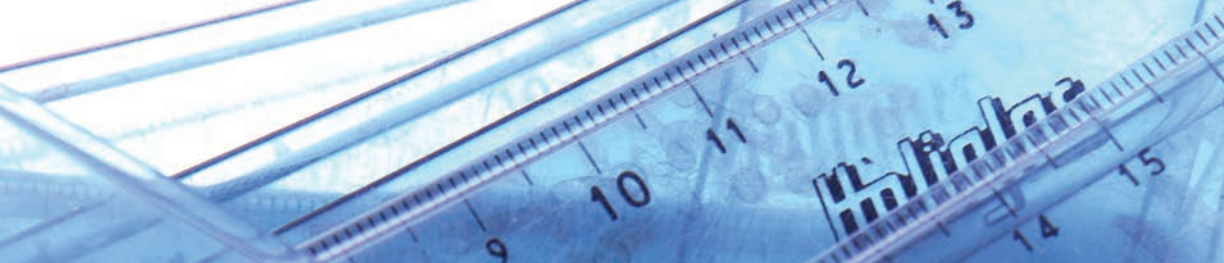
Even with a clear framework in place, a significant culture shift is needed if the Government's participation goals are to be realised through student choice alone. Parents, peers and siblings are key influencers of young people's choices in terms of education. There is a considerable job to be done in communicating any new proposals to schools, college, students and parents. This needs not only to include practical details of courses available but must also seek to win the hearts and minds of those people who would not normally have considered mathematical study beyond 16

Action 7:

The Government should develop a sophisticated communications strategy for parents and students, drawing on and working with relevant organisations and media partners.

Action 8:

The DfE should endorse and promote a clear framework for post-16 mathematics qualifications, so that all students can benefit from information about, and access to, a common set of mathematics learning opportunities.



7. Information, advice and guidance

Imperative: Advice and guidance for students will need to articulate clearly the benefits of new and existing courses. School and college prospectus will need to include appropriate information and advice to aid decision-making.

The quality and accuracy of support and guidance available to young people, including at the critical age of 16, is variable. Research also highlights how the values of key staff can result in students getting quite different advice about qualifications². When a clear and commonly understood framework of qualifications emerges, it will be much easier to develop strong advice and guidance for teachers, parents and students. While the NCETM might take a role in supporting this aspect of mathematics teacher CPD, many other teachers will require access to such advice and training.

Action 9:

Providers of information, advice and guidance, and training for teachers, advisors and students should include comparable information about post-16 mathematics qualifications, based on the framework.

8. Making post-16 mathematical study appealing

Imperative: The post-16 mathematical provision will need to be attractive, engaging, motivating and rewarding for the full range of students.

Uptake of a qualification is ultimately based on student choice. Studies suggest³ that AS/2 mathematics is often chosen for its extrinsic value, particularly in relation to students' intended higher education destinations. A new suite of post-16 mathematics options, particularly a new *mathematical problem solving* course, needs to appeal to the majority of students, for whom mathematics might not have been a positive experience. This is by far the most difficult challenge in the list. Many young people have not had a positive experience of mathematics up to the age of 16⁴ so there is considerable work to be done (including, of course, tackling the origins of this problem in pre-16 education).

Making post-16 mathematics appealing is not an easy task and research suggests⁵ that this requires a long-term programme to raise the mathematical aspirations and self-efficacy of learners in the later years of secondary schooling.

Action 11:

Awarding bodies must present the difference in approach and content for the proposed new course clearly and in such a way that it is demonstrably engaging for students and their teachers.

9. Developing high quality support material

Imperative: The introduction of a new post-16 qualification must be accompanied by high-quality support material which reflects the aims of the course.

The quality of support materials such as textbooks and online resources is a relevant factor in the choices schools and colleges make over which courses to offer. It is also very important that the pedagogical approach implied by the nature of a new post-16 mathematics provision is suitably reflected in the materials available to support teaching and learning.

Like all good materials, these should not be focused solely on preparation for assessment, but should be prepared with a clear understanding of the purpose of the course and the ways in which it will need to be taught. This recommendation relates closely to the need to make post-16 provision appealing to students.

Action 10:

Resources should be developed to support the pedagogy associated with a course focused on problem solving.



10. Recognition for Post-16 Mathematics

Imperative: *Unless post-16 qualifications have exchange value they are unlikely to flourish, so the influential support of qualifications structures (e.g. ABacc), HE admissions tutors and employers is critical.*

One method of encouraging uptake of mathematics post-16 is through additional awards for students with a given range of qualifications (sometimes called baccalaureates). Some schools and colleges already offer awards for students within this kind of baccalaureate framework, and others could be encouraged to do so. This school and college-led approach has the advantage of being able to address local needs. That said, there are risks associated with leaving such arrangements to local initiative, such as students having quite different opportunities for post-16 mathematical study, depending upon where they live. It would be similarly undesirable if different universities, groups of universities, or employers produced their own recommendations for the structuring of 16-18 programmes of study.

A better way forward would be to consider developing an overarching National Level 3 Award that could consist of (i) three A levels or similar sized vocational qualifications, (ii) the proposed new post-16 mathematics course and (iii) a similar course with a focus on essay-based argument. Such an approach would reflect common practice in high-engaging jurisdictions around the world⁶. However, developing such an Award is relatively complex, and although there are short term attractions of these 'baccalaureate' awards in terms of providing soft compulsion or encouragement for post-16 mathematical study, there is a danger that a quick fix could do more harm than good if appropriately relevant courses were not sufficiently well developed to meet the needs of this large group of new students. We therefore suggest the development of high-quality appropriate qualifications, and their establishment in schools and colleges, prior to the introduction of a new overarching National Level 3 Award.

Similarly, including post-16 mathematics qualifications (or a form of overarching National Level 3 Award) into accountability measures could prove to be effective in terms of expanding participation in the short term, although any negative impact on the experience of students and teachers would need to be avoided.

Action 12:

The DfE should give serious consideration to introducing a new overarching National Level 3 Award which would include the new post-16 mathematics qualification as an option.

11. Incentivising schools and colleges – funding and performance measures

Imperative: *The way in which schools and colleges are funded should actively support widening and increasing participation in Post-16 mathematics rather than hinder it.*

Funding structures and performance measures such as league tables play a significant role in determining which courses schools and colleges provide.

There is a risk that uptake will not increase if post-16 funding arrangements restrict schools and colleges in such a way that they are unable to provide the new course alongside A level Mathematics and appropriate qualifications at level 2 and below.

Performance Indicators in post-16 education must not discourage AS Mathematics and AS Further Mathematics being taken over two years, and should actively support the introduction of a new post-16 mathematics course.

Action 13:

Supportive funding mechanisms and Performance Indicators should be developed, if necessary privileging courses (including non-standard size or shape courses) in areas of national priority such as mathematics.

¹ Assuming 15 contact hours/week.

² See discussion of Mathematics versus Use of Mathematics in the Evaluating Mathematics Pathways report, available from <https://www.education.gov.uk/publications/standard/publicationDetail/Page1/DFE-RR143>

³ This was explored as part of the TransMaths project <http://www.transmaths.org/tp-exchangevalue.htm>

⁴ Ofsted, 2012: *Making Mathematics Count*

⁵ Brown, M., Brown, P., & Bibby, T. (2008). "I would rather die": reasons given by 16-year-olds for not continuing their study of mathematics. *Research in Mathematics Education*, 10(1), 3-18.

⁶ <http://www.nuffieldfoundation.org/uk-outlier-upper-secondary-maths-education>

Appendix A: Indicative timetable for implementation

	LATE 2012	EARLY 2013	LATE 2013	EARLY 2014	LATE 2014	EARLY 2015	LATE 2015	2016	2017	2018	2019	2020	2021
Milestones / ecosystem developments	Cross-party consensus on long term strategy					Funding levers	Overarching L3 qual. as accountability measure				ITT bursaries only for those with new course or AS maths	Primary teachers require to have studied new course or AS maths	
Qualification development		Development of new course starts – AO commitment to develop	Work on embedding in other qualifications Research	Ofqual signs off qualification	Qualification available in schools		First teaching of post-16 mathematics course	Second version of post-16 mathematics course					
HEI engagement		HEI input to development starts						Meetings with Admissions tutors					
Teachers	Consideration of recruitment strategy		Recruitment drive starts										
Communications				Framework published (ICQ?)	Schools and colleges encouraged to offer new course	IAG for students & parents							
Resources					Resources developed		Resources available						
CPD			CPD providers develop courses		Funded CPD available								
# students taking new course	0	0	0	0	0	0	Twice as many as UoM?			100k?			250k?
# teachers who can teach new course							Twice as many as for UoM?			1.5k?			2.5k?