



Professor Alison Wolf
Wolf Review of 14-19 Vocational Education
Sanctuary Buildings
Great Smith Street
London
SW1P 3BT

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Dear Professor Wolf,

Wolf Review of 14-19 Vocational Education

We welcome the opportunity to contribute to your review of 14-19 vocational education. We will restrict ourselves to comment on matters relating only to mathematics, given our remit.

We believe you are already aware of the work of the Advisory Committee on Mathematics Education (ACME). We are an independent committee based at the Royal Society and operating under its auspices, with a remit of 5-19 mathematics education in England. We were created in 2002 by the Royal Society and the Joint Mathematical Council, with the explicit backing of all major mathematics organisations. Our responsibilities incorporate both responding to government requests, inquiries and issues and also proactive projects in areas which the committee believes are of major importance. This results in the committee's activities covering teaching, assessment, curriculum and qualification issues across the whole 5-19 age range.

Firstly, we would like to stress how important we believe mathematics is in all aspects of education. Mathematics is central in a number of ways – it is the foundation of many other subjects, it provides the tools of analysis used in many areas, and competence in it is a skill sought after by many employers. However, when it comes to vocational qualifications, many students simply find the mathematics too challenging.

Underpinning this, there are three particular issues that arise with mathematics in vocational education, all of which are interrelated. The first is the question of who delivers the mathematics. The second is whether the mathematics is embedded in the vocational area or taught more generically as a separate subject. The third is the importance of keeping doors open, so that those who take a vocational pathway at an early age are able to study mathematics at a higher level and in a more academic way if they later come to realise that they need or want to.

Mathematical content in many vocational routes was traditionally delivered through the Key Skills agenda, of which there have been a number of criticisms over the years. ACME believes that there was some substance to these criticisms, as the Key Skills agenda provided only a modest amount of mathematical content, often packaged as 'numeracy'. In addition, it failed to require sufficient quality mathematical teaching and learning *in context*. We believe that this was not enough to support an adequate mathematical understanding, and thus potentially undermined routes into further study and employment.

Recent developments have seen the introduction of the functional skills qualifications in mathematics. These require deeper mathematical understanding than in Key Skills, for example, in order that sensible selections can be made in the relevancy of data selected and

the choice of the mathematics used. In functional skills mathematics is intended to be seen both within familiar and unfamiliar contexts in order to support transferability of mathematical skills (this is something which did not happen in the Key Skills agenda).

However, the knowledge and experience needed to teach this effectively can make large demands on teaching staff, especially when these courses are delivered by non-mathematics specialists and vocational staff. Our concerns have been echoed in the recent Ofsted report¹ on diplomas, which has highlighted difficulties with the functional skills element of the courses. In particular, the report raised concerns that the functional skills have been taught in isolation from the rest of the diploma course, with some students failing to realise that this element constituted an important part of the diploma.

ACME has previously raised concerns about how the functional mathematics agenda (covering Level 1 and 2) interfaces with the Key Skills agenda (Application of Number for Level 3 upwards). Students following a course with a more mathematical content within the vocational area (e.g. engineering) do not currently value functional mathematics at only Level 2. Therefore, we favour provision (courses and assessment) that will allow students to become more functional in mathematics at Level 3 to accompany vocational routes.

We also refer your inquiry back to two pieces of work which address many of the issues that concern your inquiry. One of these is the Nuffield Foundation work *Education for All – the future of education and training for 14-19 year olds*². The second is Professor Adrian Smith's 2004 report on post-14 mathematical pathways³. It is our view that in the six years since its publication, the section dealing with vocational education issues continues to be highly relevant and ought to form the basis of your thinking in this area. Adrian's key finding – which will resonate with your thinking – is that it is vital that there are clearer routes for mathematics through the education system.

Another long-standing challenge in mathematics vocational education is the question of where the subject is studied, and who teaches it. A number of scenarios are possible – the mathematics teaching maybe classroom based, or workplace based. It might be embedded fully in the wider vocational course or it may be taught separately as a standalone unit or module.

On this issue, the committee is in agreement with Adrian Smith's report in that ideally the mathematics will be taught in an integrated manner. But we fully recognise the limitations of this approach and that the difficulties faced by non-mathematics specialist teachers in delivering the mathematics are the most significant. There is clearly need for much professional development to further an integrated approach. In addition, we do believe that, however the mathematics is taught – be it in context, or not – the mathematics (and its application) should be assessed separately. This will ensure that it is treated seriously when considering whether a student is well enough qualified for further courses, and by employers.

Mathematics teachers also find it difficult to complement the courses or indeed use their context as a springboard for learning if a substantial element of the course is taught outside of the classroom. We would therefore strongly urge you to look at the *coherence* of the vocational and academic within the mathematics qualifications. There are precedents in this area: because of your involvement in the work to create freestanding mathematics

¹ *Diplomas – the Second Year* (October 2010) Ofsted <http://www.ofsted.gov.uk/Ofsted-home/Publications-and-research/Browse-all-by/Documents-by-type/Thematic-reports/Diplomas-the-second-year>

² *Education for All – The Future of Education and Training for 14-19 Year Olds* (2009) Richard Pring, Geoff Hayward, Ann Hodgson, Jill Johnson, Ewart Keep, Alis Oancea, Gareth Rees, Ken Spours and Stephanie Wild (Nuffield Foundation)

³ *Making Mathematics Count – The Report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education* (Feb 2004) <http://www.mathsinquiry.org.uk/report/MathsInquiryFinalReport.pdf>

qualifications (FSMQs), you will appreciate that the stimulus was for a need to marry teaching and learning materials that are academic in context and vocational in the way they are taught. FSMQs – and the overarching Use of Mathematics qualifications at GCSE, AS and A-Level – have a key role to play in the future and we would urge you to look closely at what efforts can be made to promote these qualifications to a wider audience, and to revisit the funding mechanisms for FSMQs in order to provide a level playing field with other qualifications.

Further systematic development of materials which help the teacher relate the mathematics in specific contexts to a generic set of mathematics items would be valuable, so that there is a better possibility of both teacher and student recognising that a piece of mathematics learned in one context might be used in another, and also to give each student as full an opportunity as possible of making further progress in mathematics itself. Efforts in the past in this area have not been hugely successful and it will require sufficient resources to ensure that the same mistakes are not repeated. In particular, resources to support teaching mathematics with a more practical emphasis should be seen as intrinsic to the qualifications, and not simply as an 'add on'. Nor can this be left solely to commercial publishers who will see little return on any investment because of the large number of qualifications with relatively little uptake. The responsibility instead lies with government, charitable foundations or the private sector to fill the gap, as has happened with funding for materials to support the engineering diploma.

We believe that the current level to which mathematics is taught should also be looked at in detail. Currently, many vocational mathematics courses have a mathematics component at Level 2 (or below), which ACME believes should be higher for those able to cope with a more complex and challenging curriculum. We recognise that this is full of challenges, but it ought to provide a more supportive education to those seeking progression into HE and employment.

Between the ages of 14 and 16, there is currently a legal entitlement for all students to be taught the programme of study for GCSE Mathematics. Therefore, mathematics is in a slightly different situation to most other subjects in that it must be taught to students in this age range whatever pathway or other options are chosen. Moreover, the new programme of study at Key Stage 4 has a greater emphasis on applications and processes which should prepare students better for vocational course. ACME also believes that the new linked pair of GCSEs in mathematics which is currently being piloted will improve further this preparation for vocational courses with their focus on using and applying mathematics.

Beyond 16, there clearly is an issue, with England having a smaller proportion of pupils continuing with some form of mathematical study in vocational and educational routes compared to most other similarly developed nations. Adrian Smith recommended a suite of appropriate pathways for post- 16 year olds continuing in education and/or training. Each of these pathways would have some appropriate mathematical content. The pathways agenda is still unresolved, but it remains a burning issue (see our later comments on post 16-mathematics).

One other issue which is worthy of consideration concerns the timing of the choice of vocational/academic decisions. At 14 students may never have been taught mathematics by a subject specialist, and so do not have a complete set of experiences on which to base a decision. Moreover, we would recommend you look in more detail at the evidence from those places where attempts have been made to introduce vocational pathways from 14. We believe this has been tried in both Alberta and some Australian states but has encountered some difficulties.


We would like to draw your attention to two areas of ACME work that will be of interest to your inquiry. Firstly, there is our recent work on Post 16 Mathematics⁴. In this, the committee has produced an overarching framework for post-16 study in which mathematics would form a component of the study and training of all those between 16 and 19. In essence, there are four 'pathways' within this model. Mathematics is an element of each pathway, studied to an appropriate level of sophistication and volume. While our work has not yet been fully developed, it is our view that pathways A and B are particularly relevant to those who take a vocational route.

Secondly, we have an ongoing project looking at Mathematical Needs. This is subdivided into two themes – one of which is looking at the mathematical needs of learners progressing to HE, employment (or neither). The second theme is about learners' needs throughout their education, in order to achieve those final outcomes as identified in the other theme. Our aim is to provide an evidence base which can inform and influence the curriculum in a way which we believe has not happened for some years. Our report is due to be published in early 2011, but given the timings of your inquiry, we might be able to share with you at an earlier opportunity some of our emerging recommendations.

During the period in which you will consider the responses you have received, ACME would be very keen to facilitate a discussion with key expertise from the mathematics community. This might take the form, for example, of a round table event with a selected group of people who have a particular knowledge in the vocational education field. We hope that you would find this suggestion welcome and, if so, do contact Martin Smith in the ACME Secretariat on martin.smith@royalsociety.org who will be only too happy to organise this.

We look forward to hearing more from your project in the coming months.

Yours sincerely,



Professor Dame Julia Higgins FRS FREng
Chair, Advisory Committee on Mathematics Education (ACME)

⁴ *Post 16 in 2016: Proposals for 16-19 Mathematics in anticipation of the review of qualifications scheduled for 2013 with resulting changes to be implemented from 2016* (August 2010) <http://www.acme-uk.org/downloaddoc.asp?id=228>