A mathematics curriculum for the future: from the IMA – a contribution to QCA's futures debate:

Why study maths in the 21st Century?

Mathematics should be studied because of its utilitarian, cultural and aesthetic importance. The nature of the utility of mathematics has changed considerably in the past 20 years with the pervasive use of technology in the workplace: the curriculum now needs to change to meet employers' needs of school leavers. However, this makes an even more compelling case for the study of mathematical reasoning and logic. If techniques and applications are transient, as seems likely in today's fast changing technological society, then mathematics provides the framework of understanding to allow the techniques to be used appropriately and enable techniques and applications developed in the future to be assimilated more easily.

Something needs to be done to establish a closer equivalence between standards required in different subject areas. The development of a double award structure for mathematics promises an opportunity to address this issue. However, we feel it is important that all students study at least as much mathematics as they do at present, and also that all students, at all ability levels, have the opportunity to experience aspects of mathematics beyond the purely utilitarian.

In June 2002, a group from the Institute of Education produced the report *Mathematical Skills in the Workplace* which offered many insights into what mathematics is used routinely [see page 5]. Some of these would be recognisable components of the current curriculum but there are substantial areas which are not: 'traditional maths' is quite different . Mathematics has a poor 'image' with the majority of students: it is viewed as hard in many cases, but also as irrelevant and boring. We hope that the work being done on functional skills will make mathematics more obviously relevant to pupils and that many of the exciting new applications of traditional mathematics will replace some of the examples used in many texts.

Many tasks involving mathematics and technology are not thought of as mathematical by those undertaking them. A better understanding of the wide-ranging nature and pervasiveness of mathematics might help address some of the cultural issues where people view innumeracy very differently from illiteracy. Assessment systems where a 'good pass' can be achieved with less than 20% of the available marks do much damage and allow the culture of claiming innumeracy without embarrassment to flourish. There needs to be an assessment system in place that implies some level of competence and mastery of skills in the holding of a qualification.

Recently mathematics has concentrated too much on small scale activities: largely this has been driven by the structure of assessment, and the justification seems to be in terms of ensuring reliability. However, the effect of this is that the whole is less than the sum of the parts, and the validity of the assessment of *mathematics* is questionable: the abilities to solve problems, to apply simple techniques in new contexts, to combine reasoning and techniques from different areas of the curriculum, and to critically evaluate arguments and data presented in context are parts of mathematics which have been devalued. The nature and role of coursework needs to be carefully considered: investigative work in mathematics and applying the data

handling cycle in statistics can be hugely enriching experiences for children of all abilities. The curriculum of the future should strive for this to be the experience of all students.

Modelling, and fitting parameters in models, is conceptually accessible at school level, and can now be done reasonably [and in realistic contexts] using ICT. Contexts such as biomathematics, psychology, business studies, geography and citizenship offer a vast array of examples where mathematics plays an integral part which have been largely ignored by the subject itself. We also argue that we should consider the inclusion of areas which are made accessible now by the use of technology to handle the complex processing required, and which are of widespread use in technology today. These include: matrices, vectors, calculus and geometry in 3D, curve sketching, large samples in statistics and multivariate data. This would imply assessment including a component which requires specific computer software, and not just an 'on-line' version of a task which could be completed on paper.

Technology offers the opportunity to develop short digital video descriptions of applications of mathematics in such areas, which could be used by teachers to motivate the study of certain topics. For example, looking at the production of a video game could be used to motivate the study of algebra, geometry, vectors, matrices and even aspects of probability: the programmer has to replace the actual objects on screen, such as a game character, by *variables*, and recognise exactly how these variables [and one character will have many 'bits'] have to be manipulated in order to get a realistic image on screen. Students are well aware of the imperative for realism in movement; the level of complexity is apparent and so provides a motivation for manipulative skills, for the reductions in computation requirements that the use of matrices, functional transformations, vectors etc. might offer. The mathematics in medical imaging involves many similar opportunities and there is a wide range of other applications of mathematics that can ensure a reasonable gender balance. It must be emphasised that introducing modern contexts to motivate the learning of core algebraic and geometric skills should secure their central role in the mathematics curriculum: not reduce it.

However, it must be emphasised that problems in mathematics education cannot be solved by IT or curriculum changes. High quality teachers should be encouraged to remain in the profession by providing them with access to professional development and time to reflect on their practice to improve their competences and confidence. These components are essential for future curricula to be effective.

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