the ministerial curricula and syllabi for elementary and middle schools as well as on the (experimental) curricula and syllabi for the upper secondary schools.

One of the main concerns is the role of calculators and computers within the traditional mathematics classes at all levels, from elementary school to university. Also the teaching of geometry at secondary level is under debate: the prevailing opinion is that, in spite of an introduction of coordinate and vector geometry, the synthetic point of view is still very important and should therefore maintain its traditional place in the new syllabi. The problem is when and how to start with an introduction of axiomatics.

A major difficulty in the Italian school system is the re-training of in-service teachers: most of them had no university preparation in computer science, nor in other non-traditional subjects only recently included in the new syllabi, such as probability theory or transformation geometry. In the past five years there was a national project for the re-training of upper secondary teachers in view of the introduction of computers (mainly in grades 9 and 10).

The project had some positive effect, since now most teachers are capable of using computers and writing at least simple programmes (mainly in Pascal). However, the project was limited to the more technical aspects of computer science. Hence, it did not contribute significantly to an improvement in the teaching style in the classroom, as would have been possible and desirable thanks to the new technology, nor did the project cover the other new topics mentioned above.

Mathematics and Education Policy in the United Kingdom

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As Howson points out in [5], p.216, "There is no single educational system for the U.K.; each of England, Northern Ireland, Scotland and Wales has its own education office (or ministry) and its own tradition." Although there is now a "national curriculum", this only applies to England and Wales and it only handles the 5–16 year age range. Even within England itself, different local areas may organise their school systems differently; thus although the majority of English counties have a co-educational comprehensive school system at secondary level, some have single sex, selective schools (usually called "grammar schools") existing in parallel with the comprehensive system. A further complication has been that
although most state-run schools are funded via local education authorities, recent
government reforms have introduced the possibility of a school “opting out” of
local education control and obtaining direct funding from central government.
The national curriculum applies to all state schools in England and Wales, but
“independent” schools (that is the private sector of education) do not have to
follow it, although as the national curriculum influences the content of the end of
school examinations, set by independent examination boards, the private schools
often do use the national curriculum as a basis for their syllabus structure. (For
details of the English national curriculum in mathematics, see [5], pp 216–235).

This heterogeneous structure in secondary education is also present at the level
of Higher Education Institutions (H.E.I.’s). The structure of higher education has
been changing rapidly for the last ten years. Until now, there has been a “binary”
system consisting of Universities and Polytechnics. The degrees in a university
are awarded directly by the institution, whilst those in Polytechnics, and other
non-university H.E.I.’s, have been validated by a central agency, the C.N.A.A.
(Council for National Academic Awards). At the time of writing (April, 1992) this
council is in its last year of existence, and the distinction between Polytechnics and
Universities will shortly disappear. Polytechnics have a tradition of handling more
vocationally inclined students, training them for work in industry and commerce.
The position of mathematics in this sector of the higher education system has
not always been well defined, nor has it been particularly strong politically. In
addition to these conventional H.E.I.’s, there is also the Open University, which
will be considered separately.

The curricular autonomy of universities has been almost complete. The de­
grees awarded are classified (First, Upper second, Lower second, Third and Pass
for Honours degrees, as well as Ordinary degrees). The decision on what grade
to award to a particular student is taken by an examining board, which includes
external examiners whose report is sent to the university authorities. This report
will include comments on the academic level of the courses, the organisation of the
examinations and so on as well as on the fair conduct of the examination. Apart
from this, there has been little or no external influence on what is taught, nor on
how it is taught. This level of academic autonomy is changing as more verification
of the quality of the teaching, examining and so on performed in the universities
is being required by central government.

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I. Mathematics Teaching in Secondary Schools and Higher Education

Overview

The education system in the United Kingdom is organised roughly as follows:

ENGLAND AND WALES: From 5 to 11, primary school; from 11 to 16, secondary school with the G.C.S.E. exam as the culmination of this period. From 16 to 18, either sixth form within a secondary school or a “sixth form college”. At the end of the sixth form, the typical qualification is up to three A level or an equivalent number of AS level exams. University education normally lasts from the age of 18 to that of 21, ending with the award of a B.A. or B.Sc.

NORTHERN IRELAND: This is approximately as above, but primary education starts at 4 and secondary schools are selective.

SCOTLAND: Somewhat as above; 99% of local education authority schools are comprehensive with multi-ability intake and 90% of these have a six year course, so 12-18 is more usual as the age range in secondary school in Scotland than 11-18. The end of school qualifications are differently organised and have different names than in England and Wales.

I.1 Secondary education

In all areas schooling is compulsory until the age of 16, (but see Howson’s comment [5] p.7). The usual age at the end of secondary education is 18. At the age of 13, mathematics is a compulsory subject in school and a “typical” pupil (in England) would spend about 3.5 hours a week on it. At age 18, it is no longer compulsory, and at that age a pupil who is taking it, would be spending about 4.5 hours a week on mathematics. In Scotland, the comparable figures are a minimum of 3.5 hours in the third year of secondary education, whilst in their last year in secondary school, the course is designed to last 160 hours per year, which means about 4 hours a week on average. This, of course, depends on whether the pupil is following advanced or lower level mathematics courses at that stage.

The major qualifications taken at secondary school in England and Wales are the G.C.S.E. (General Certificate of Secondary Education), usually at the age of 16+, although some pupils take it at age 15 or less, and A (Advanced) or AS (Advanced Supplementary) level, taken at 17 or 18. The G.C.S.E. was introduced in 1988, but no review of A-levels occurred at the same time. Shortly after, AS-level was introduced. One of its aims has been to provide more options at a level below that of A-level, (it has approximately half the content of an A-level), in an attempt to encourage a broader academic profile for the end of school, its style though is still more compatible with the A-level than with the G.C.S.E.

Typically pupils take three A-levels or two A’s and two AS’s. There is worry about the falling numbers of candidates taking A-levels in mathematics, physics and chemistry. There is wide agreement that there is a crisis in as much as the
supply of mathematically qualified candidates for university courses in science, engineering, finance, etc. and eventually of “numerate” graduates to take jobs in industry and commerce, is insufficient. The existence of a crisis is agreed; what is not is a detailed analysis of the causes, and more importantly of the possible solutions, especially if the solution involves expenditure of large amounts of public money. The number of those taking A-level Mathematics is declining. In 1991, the 18 plus age-group was 79% of that of 1984, but the number of pupils taking A-level Mathematics was 70% of the corresponding figure for 1984. Attempts to explain the decrease in the entry for A-level Mathematics point to the recent reforms in the pre-16 syllabus. The G.C.S.E. introduced a different approach including open-ended coursework, projects and “investigations” as well as more traditional “dogmatic” teaching with each type having the corresponding type of assessment. No such reform was done of A-level, which retained its emphasis on formal algebraic manipulation, the beginnings of the differential and integral calculus and a start on mathematical rigour.

The Scottish system is different and unfortunately cannot be described in detail in the limited space available. A detailed discussion of the syllabus both in that part of secondary education (11-16) during which the national curriculum applies in England and Wales, and post-16, can be found in [5] pp. 216-235 and there is no room to repeat it in detail here.

### 1.2 Higher education

The structure of higher educational studies is typically:

- **First cycle**: a 3-year course leading to a Bachelor’s degree.
- **Second cycle**: a taught 1-year course possibly with a short dissertation, leading to a Master’s degree.
- **Third cycle**: research leading to a Doctorate, after at least 3 years. Students may have omitted the second cycle.

#### 1.2.1 First cycle

Entry to University or Polytechnic is selective on the basis of the A-level results and students do not tend to go to their local H.E.I. Students themselves select a limited number of degree courses for which they wish to be considered, (e.g. Southampton: Mathematics with Actuarial Studies; Bangor: Mathematics with Insurance, etc.) based on a course profile in the relevant University or Polytechnic prospectus. The requests for admission are sent to the H.E.I.s and typically certain students, whose school study-profile looks promising, will be asked for interview. An offer of a place may be given dependent on achieving given grades at A or AS-level. The student compares the offers received and short-lists two courses. When the examination results are available (in August), offers are confirmed for those who have obtained the needed grades, whilst those who have not, are handled through “clearing” and are helped to find a place that suits them.
A certain understanding of this quite complex selection system is needed to comprehend the problems of mathematical education in the initial years of a degree course in mathematics in the U.K. Not only may there be quite a large mix of A-level results—some selected early with good grades, some arriving through clearing, etc., but also there is the effect of the spread of geographical origins of the students already mentioned above. In the recent report "The Future for Honours Degree Courses in Mathematics and Statistics", ([8], p. 5), when discussing the present position one finds: "The background of students is very varied. Different schools may have taught the core syllabus in different styles and with differing levels of thoroughness, and students entering higher education with a qualification in mathematics may have studied different branches of the subject. They may, for example, have chosen to specialize in mechanics or in statistics. In these topics first-year higher education courses therefore need to cope with students having very different levels of knowledge." This poses problems, in particular, for first year teaching. At present the number of students taking degree level courses in mathematics and statistics is of the order of 3,000 in each year. Thus within a present age group at 18 years, of approximately 700,000, of which just under 20% enter higher education, there are about 3,000 students taking mathematics, possibly combined with another subject, that is about 0.5% of the age group and approximately 5% of those taking an A-level in mathematics. The low number is causing an increasing financial crisis for departments of mathematics in the U.K., exacerbated by the extremely low "guide price" paid by the government to H.E.I.'s per mathematics student. This "guide price" is considerably lower than all other sciences and is even lower than the average for all "humanities".

The majority of mathematics degree courses at the University or Polytechnic last three years. A few courses where the emphasis is more vocational, or more concentrated towards industrial applications of mathematics, have a period working in industry and a subsequent four year duration. Some courses recently introduced have a foreign language component and students spend their third year studying mathematics at another European university, after which there is then a fourth and final year back in the home university. (For the detailed structure of degrees in the ex-Polytechnics, see [3])

**Joint degrees and combined studies.** Students following courses that are described in this way, take their other subject for half of the time, and the subject matter within the mathematics part of their course will probably be restricted so as to provide a selection of those courses judged most suitable for the interaction with the second subject. For instance, students doing a joint degree in mathematics and economics might have to specialise in courses such as operational research, optimisation, statistics and probability, etc. in their third year.

**Course content.** The typical mathematics degree at a U.K. university has a wide mix of both pure and applied mathematics together with probability and statistics.
The applied mathematics is likely to include applied aspects of differential equations, examples of various modelling situations including mechanics, and perhaps biological modelling, fluid mechanics, and applications of stochastic processes, operational research methods, and numerical methods for solutions of problems, together with related aspects of computing. The pure mathematics, during the first two years at least, would typically be foundations of calculus and analysis, linear algebra, some discrete methods and some abstract algebra. Third year courses often provide students with a range of options. Computer algebra and graphical packages are increasingly being used. The statistics and probability content may vary considerably, but statistical data analysis, using statistical computing packages such as MINITAB, is quite common, leading on to the more theoretical areas later. Also students are increasingly being expected to be “computer literate”, being asked to use word processors, spreadsheets, statistical packages, graphical packages, etc. in the production of assessed material.

**Teaching methods.** The predominate teaching method has traditionally been the hour long lecture, usually augmented by problem classes and “tutorials”. The tutorial can take many different forms. At Oxford and Cambridge, in a tutorial there would normally be one tutor and two students. The hour-long session would consist of a discussion of recent material from lectures, based on completed assignments that the students should have handed to the tutor in advance. Other universities with fewer resources use tutorials more sparingly and tutorial groups are larger. “Class tutorials” or problem classes are also used. Ideas such as “student-centred learning”, “transferrable skills” and “self-paced learning” have increasingly been applied in an effort to handle the increasing number of students, the general weakening in their level of algebraic manipulatory ability and, on the positive side, to try to encourage and develop more independence and maturity in students.

**Assessment.** Higher education institutions tend to use “traditional” three hour written examinations on each course or group of courses, as the dominant method of determining whether or not a student should proceed from one year to the next. These examinations are usually taken at the end of the year. Increasingly, however, course work, continual assessment, project work and variants on the examination method, (open-book examinations, take-home papers, etc.) are being introduced.

**The Open University and mathematics.** Set up in 1969 with its first student intake in 1971, the O.U. has had a considerable influence on mathematics teaching in universities and polytechnics. The O.U. student is typically mature and in full time work. The teaching is done by course units and carefully chosen texts. Motivation, extra background, etc., is provided by radio and television programmes. These latter have given a very positive image of mathematics to the large number of people, not only students, that have watched them. There are also tutorial sessions organised in local centres and, on many courses, summer schools.
The O.U. degree is based on units and accumulated credits. A student can take a wide range of different units from different subject areas and so might perhaps combine mathematics, say, with technology, or humanities, in many different proportions. Because of this the figures of O.U. students taking mathematics have to be interpreted slightly differently from those of more conventional systems. At present there are about 17,000 students studying mathematics courses with the O.U. This figure does not represent the number who will get a degree in mathematics (as such a degree does not exist), but does indicate the considerable contribution to the mathematical training of adults made by the O.U.

**1.2.2 Second cycle.** The next level of degree is the M.Sc. (or M.A.), that is, the Master of Science (or Arts) degree. Little public funding is available for students to follow such courses and fees are too high for many students to finance taking such a course themselves.

The number of students awarded an M.Sc. (or Post.Grad.Diploma.) is approximately 300 a year, including overseas postgraduates. The numbers of funded places to study pure mathematics and traditional areas of applied mathematics at M.Sc. level is small, but they are also widely sought after by postgraduates from other countries as the first step towards a doctorate. In addition the Open University has some taught M.Sc courses. The number of students registered for these courses have been in the order 200 for each of the last 3 years (1989–1991).

**1.2.3 Third cycle.** The doctorate (Ph.D. or D.Phil.) nominally takes 3 years. In mathematics, a limited number (about 160 each year) of postgraduate studentships are available from the Science and Engineering Research Council (S.E.R.C.). These provide funds for 3 years. The S.E.R.C., in an attempt to ensure good supervisory practice, is applying pressure on institutions at which students are taking more than 4 years to complete their research programme. Such pressure is, of course, handed on to the student! The number of students involved in Ph.D. programmes is of the order of 350 to 400 in any one year. Of course these include a high percentage of students with non-U.K. backgrounds, who will return to their home countries upon completion of their studies.

### II. Mathematics and Engineers

There are no specialist engineering schools in the U.K., all engineering schools being a part of a university or polytechnic. The prestige of the engineering profession in the U.K. is not that great at the moment. Manufacturing industry would seem to be less well considered by the general public than are the financial sector and service industries, and in the last ten years many of the best mathematically qualified of the 18+ age group have opted for degree courses in accountancy, business studies, etc., rather than engineering or computer science. Once in an engineering course at a University or Polytechnic, the mathematical demands placed
on the student vary greatly from course to course. The professional engineering bodies have been putting pressure on departments of engineering to ensure that students spend as much time as possible on engineering rather than on mathematics, physics, etc., and this together with the decrease in the mathematical and physical backgrounds of incoming students has led to complex problems. Including both an increased amount of engineering and the necessary areas of mathematics and physics, is increasing the risk of student “overload” in first degree courses in engineering. The report [4] (quoted in [8]), for example, includes a suggestion to “Teach only the mathematics... applicable to their chosen kind of engineering degree” and a proposal to “Reduce “analytical theory ”. Such developments are a cause of worry for many mathematics departments, as too much integration of the mathematics content in engineering degrees, into purely engineering courses means that (i) the importance of mathematics as an independent discipline in the global view of the governing authorities of the H.E.I.’s is decreased, (ii) there is a risk that too narrow a mathematical education may lead the engineer to apply inappropriate mathematics to practical problems. Another more positive view is emerging in some quarters. “Where mathematics is not covered in engineering degrees, it will need to be supplied by mathematicians, but by mathematicians who know how to communicate with technologists. In fact, there is already a need in industry for well-trained mathematicians with a sufficiently deep and wide range of knowledge to enable them to develop the applications of mathematics to major technical problems.” ([8], p.8)

Thus the position of mathematics in engineering courses is very variable. Where mathematics is taught as such and by mathematicians, the level of mathematical knowledge of the students is even more varied than in the specialist mathematics degree courses. The numbers involved are often large and given the attitude of the engineering profession, there are big problems of motivation and consequently often poor attendance rates at lectures. Some experiments with using “student paced learning”, Computer Aided Learning, and variants of these have been tried with varying success. This is an area in which more research into the learning of service subjects is urgently needed if the mathematical knowledge of engineering students is going to be adequate and appropriate to their needs.

III. Recruitment and Training of Mathematics Teachers

The majority of the teacher training in the U.K. is at present through courses leading to a Postgraduate Certificate in Education (P.G.C.E.). A student taking a P.G.C.E. course in mathematics need not have a degree in mathematics. For instance in 1982, Woodrow, [12], found that recruitment to university P.G.C.E. courses contained about 60% mathematics graduates. More recently Straker, [11] found that at the University of Newcastle, the percentages of 1st degree mathematicians in the P.G.C.E. class decreased from a peak of 86% in 1983 to 50% in 1987.
The Cockcroft report, [2] gave national figures of 61% in 1978, 63% in 1979 and 58% in 1980. Thus the problem is not new. To have the nation’s children trained in mathematics by teachers who do not have a degree in mathematics seems a bit like getting dentists to act as heart surgeons! This suggests there is a “hidden” shortage of qualified mathematicians in British schools. “The proportion of mathematics graduated opting for a career in teaching has been in decline for the past 40 years and even in recent times, the proportion has declined from 17% in 1974 to 8% in 1984” [11]. The average percentage for 1989 and 1990 is 5.6%. [8].

There is no direct link between the number of mathematics posts in secondary schools and the number of places for students on P.G.C.E. courses. It is therefore also difficult to estimate the extent to which there is a shortage of supply of teachers of mathematics.

In an attempt to curb this decline, in January 1986, the D.E.S. announced that it was introducing a tax-free bursary for intending teachers of shortage subjects such as mathematics and physics. This was an effective overall grant increase of about 60%. In 1986, the figures for P.G.C.E. were an intake of 703, by 1988 they were up to 867, but by 1990 some of the effect seems to have worn off (779). As these years correspond to a down-turn in the job market, it is not certain that this increase in entry was due to the bursary or to the general economic climate. How many of these students mean to try teaching as a career is difficult to tell. Some may be intending the P.G.C.E. to be an additional qualification which will stand them in good stead for future job hunting inside or outside education. A recent survey [13] for the Joint Mathematical Council (conducted by Derek Woodrow of Manchester Polytechnic) indicated that only about 70% of P.G.C.E. students in 1991 were known to have taken up teaching posts.

There are thus several problems: (i) a low percentage of mathematics graduates amongst the Mathematics teachers; (ii) a shortfall in recruitment to training courses (except for this year); and (iii) the low percentage of qualified teachers entering the teaching profession, which combine to give a very worrying profile of the future of mathematics teaching in the U.K. In addition to these, one has two factors not specific to mathematics. The first is the large number of skilled teachers (and mathematics and physics teachers in particular) who have left the profession in the last 15 years. The other factor is that experienced, mature teachers have been more likely to leave the profession than young relatively inexperienced ones. Their posts are either not being filled at all or are being taken by much younger (and hence cheaper) teachers. Given the falling percentage of mathematically qualified teachers, etc., this effective removal of experienced mature colleagues to whom the younger teacher might turn for advice and guidance, is causing a lot of worry. The shortage of highly qualified mathematics teachers in the U.K. is not new. It was already apparent in the early 1960’s. Officially there is no crisis as a crisis might imply that someone was to blame, but officials have admitted to there being
a problem—but have not come up with any solution as yet. The problems hinted at earlier of the jump in difficulty from G.C.S.E. to A-level Mathematics may further cut the number of students taking A-level Mathematics and hence even if total student numbers increase in higher education as planned by the present government, it looks unlikely that there will be a corresponding increase in the number of mathematics graduates. If that is what happens, it is difficult to see how sufficient mathematics graduates can be attracted into teaching to fill the admitted shortfall, let alone the hidden one that is not admitted to exist.

**Content of a P.G.C.E. course in mathematics.** As mentioned at the beginning, Universities are autonomous and so they can design their own P.G.C.E. courses within some general guidelines from the D.E.S. All such courses seem to be different, so here we will only look at the main features of the courses on which I have details (see [1], [6], [7]).

In the last twenty years, there has been a swing away from formal courses on, say, the philosophy and history of education and more assessment is based on coursework and practical teaching experience, rather than on examinations. There is also a tendency to make the P.G.C.E. more school based. At present the government requires that at least 12 weeks are spent on teaching practice, usually some in primary schools and the rest in secondary. This is likely to increase with government pressure for more school based or in the extreme case, wholly school based training. The Open University is preparing a radical training package, starting in 1994, and using a mix of tutoring, distance learning and radio/television, that may provide a way in which this may be done with reasonable effectiveness.

As an example of what P.G.C.E. training entails, we will look at the course at Bangor. The School of Education at Bangor runs a small P.G.C.E. course in mathematics. (Most of what follows is adapted from the Course Handbook, as supplied to me by Paul Coackley.) The course is largely seminar/workshop based. As well as the periods of teaching practice, regular visits are made to schools at other times. These visits sometimes have a specific focus or may merely be opportunities to gain experience of as many different schools as possible. The content of the workshops/seminars (see below) is derived from the topics the student will be asked to teach or from parts of the National Curriculum, G.C.S.E. or A-level. The students might, for instance, be required to consider the resources necessary, previous knowledge, or methods of assessment suitable, for a given subject area or to look at relevant documentation on assessment methods.

The content of the course can perhaps best be gained from the workshop topics listed below: (the list is not complete).

- The Nature of Mathematics
- Problem Solving and Investigational Work in School Mathematics
- Watching yourself teach!
- Generic Software—Logo and its possibilities
- Open and Closed Activities
- Key Documents in Mathematics Education
- The National Curriculum—its structure and terminology
- Lesson planning—
nature and purpose; Setting, marking and recording work; Some teaching ap­
proaches to Mathematics topics—area, volume and fractions; Mathematics and
language—an introduction to cross-curricular themes; An introduction to Theories
of Learning; Teaching practice review—lessons and targets; Generic Software—
Spreadsheets; GCSE Mathematics—structure, variety and assessment; GCSE
coursework—what is it and how do you mark it? The use of calculators in the
classroom —good practice or bad?

Unlike in many other countries, teachers in the U.K. are not civil-servants.
They are recruited by the school. This is usually done by placing an advertisement
in the national press. This explains the lack of data available on the number of
teaching posts in mathematics that are filled by non-mathematics specialists. The
selection committee in a school may have very little competence in mathematics,
but may call in local mathematics advisors, inspectors, etc., if it is felt to be
necessary. With increasing independence of schools and the lessening of the
resources of the local education authorities, it is not clear if there soon will be
enough specialists to assess the candidates’ mathematical ability. Certain aspects
of this increased independence are therefore quite worrying, especially in shortage
subjects such as mathematics.

**Higher education teachers.** Jobs in Universities and Polytechnics are also ad­
vertised in the national press. A selection committee is appointed to examine the
candidates’ applications. This is done totally internally to the institution with no
recourse to any body outside. The selection process will often involve a presenta­
tion of the applicant’s research in a short seminar, however no other indication of
teaching ability is usually possible. As the monetary resources of a department de­
pend in part on its research profile, the decisions as to whom to appoint are usually
based on research potential and the compatibility of the candidates research area
with those already in place in the department, although with the appointment to
more senior posts some considerations of an educational nature may be involved.

There is no requirement that a beginning teacher in higher education have
any training in teaching methods, or even any knowledge of relevant educational
issues. In any case it is difficult to see how an institution based scheme can
provide subject specific training given the small number of people involved and
their disparate needs.

IV. Some Aspects of Research into Mathematics Teaching

Research into mathematical education takes place in most of the institutions in­
volved in the training of mathematics teachers. Some of these have centres for
science and/or mathematics education within a school or department of Education,
in others the “mathematical educators” are attached to a School of Mathematics.
Some of the centres are relatively well funded with money from industry augment­
ing the governmental funding (e.g. the Shell Centre for Mathematics Education at
the University of Nottingham), but this is the exception rather than the rule.

Research into, and development of, new teaching material has recently received a lot of impetus and importance, given the recent changes in the structure of teaching in secondary schools. Some centres such as the Nuffield Advanced Level Project at the University of London, are designing new syllabi for schools, others such as a small group within the School of Mathematics and of Education at Bangor, have been designing and experimenting with new material for structured investigations at G.C.S.E. level (13 to 16 age group), whilst the Centre for Mathematical Education at the Open University has been developing resource packs for professional development throughout the age range (cf. [9]).

The Mathematical Association and the Association of Teachers of Mathematics are two organisations which provide a useful service to teachers, encouraging the sharing of research findings at a practical level through their journals. (For instance Mathematical Association publishes reports including that by [5] and summaries of research findings.)

Finally it is worth mentioning the amount of innovation in the teaching of mathematics at degree level. This innovation brought about by the changing academic profile of the incoming students has occurred at a time when ideas relating to “quality control”, “enterprise”, and “public accountability” are entering into the language that is being employed in higher education institutions and are forcing a re-evaluation of the traditional aims and objectives of a degree in mathematics.

Note: a longer version of this report with more detailed figures is available from the author.

References


