

Comparing Standards

Academic and Vocational, 16-19 year olds

The Report of the Politeia Education Commission

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Chapters 2 and 8 are based on work done by the Politeia research team, led by John Wrathmell and Sharon Wroebel, revised in consultation with our subject experts.

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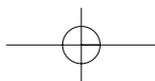
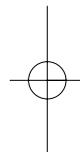
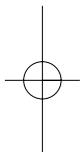
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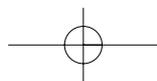
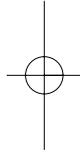
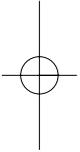
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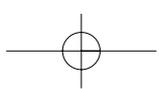
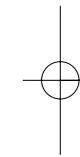
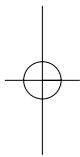
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Part I - Vocational and Academic Provision for 16-19 years olds





1

Introduction

Sheila Lawlor

Raising educational standards has become a goal of politicians, left, right and centre. Although the politics of standards are a relatively recent phenomenon, those of education have long been central, certainly since the 1870s. The controversy then set the tone of the great debates in the 20th century over who would control and own the system. Subsequent differences - about the religious or secular character of schools, the purpose of education, the length of compulsory school age, the nature of the system and its reconstruction, the respective roles of state and parent - had their origins in that older English debate. Where should the balance of power and responsibility for the education system lie, between the state and its bureaucracies and between those who owned or ran the schools, taught in them or the parents and children who used them?

By the 1980s these issues were fought on a new battleground, that of standards. Higher standards were to be achieved both by freeing up the system (re-inventing voluntary schooling and parental choice) and by exercising greater state control (over the curriculum and examination system). Throughout the 1990s and the early 2000s, state control and *dirigisme* were increasingly favoured as the way to 'raise standards': some of the important fundamental content would be restored to the curriculum, having been mislaid during the progressive educational periods of the 1960s and 1970s. Yet, at the same time, the systematic changes continued to what was to be learned and how it was examined, in line with the more extreme experimental ideas which had found some official favour here. Such changes were justified as being designed to help the lower attainers and the socially disadvantaged.

As a result, reintroduction of basic teaching in the national curriculum of the 1980s and 1990s was accompanied by a modish emphasis on skills and competencies. The change in the examination system at 16+ in the 1980s from O-levels (for **c. 25 per cent of the age range**) and later CSEs (for c.25 per cent) to GCSEs (using c. 90 per cent of the age range) involved a change of emphasis in the curricula and testing modes. It also depressed the standards at which pupils started, and completed, A-level courses. Other

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influences have been at work: the changes to the A-level syllabus and examination system and the attempt to accommodate higher participation rates for 16-19 year olds in a single system with the same examination at 18+. At the same time the perennial and justifiable concerns about the disastrous state of vocational education and training have led to further attempts to make the system as a whole more 'inclusive' of vocational education and eliminate the differences (whether institutionally or in the qualifications) between vocational and academic schooling. The upshot has been a number of changes to the curriculum, courses, examinations and qualifications over the past two decades, with more planned. (The most recent plans are set out in the government's Green Paper, *14-19: extending opportunities raising standards*.)

Politeia's *Comparing Standards* Series focuses on how standards in this country compare with those in a number of similar European or Anglophone countries. How do the principles on which they are based, the structures, the content and examination systems compare? The aim, in looking beyond the shores of this island to other systems, is to contemplate in a wider perspective some of the important principles on which the systems of advanced industrial democracies like our own are based, and the way in which the different education systems are organised.

The initial study considered how British pupils fared in language, mathematics and science at ages 9 and 13, by comparison with pupils in a number of continental and Anglophone countries, against an analysis of the different educational systems. The second examined pre-school standards. In this, the third study in the series, *Comparing Standards Academic and Vocational, 16-19 year olds* a number of academic specialists consider the courses and qualifications which pupils take between 16-19 in a range of academic and vocational subjects in a number of comparator countries and the UK. For each subject and country, the content and framework of courses and the examination system is analysed. The focus is on how the courses and qualifications here compare, in terms of content and standards, with those in France, Germany, the Netherlands, Switzerland, New Zealand, the United States? Have the A-levels remained a 'gold standard' and do they hold their own with courses offered for the same level elsewhere? In terms of vocational education, have the serial reorganisations brought them into line with the much lauded continental systems? And what of the qualifications? Do the examinations here – the vocational or academic A-levels measure standards as well, as rigorously, or as fairly as examinations for this level in comparator countries? Do the examinations serve the same purpose here as abroad?

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Part I of the study presents the findings for the different academic and vocational subjects and qualifications. Chapter 2 explores the different systems and the structures for vocational and academic education and training in each of the countries studied. This is a summary of the detailed survey released with this study.¹ The next chapters (3-5) analyse the academic courses and examinations for maths, language and history and these are followed in chapters 6-8 of an examination of the vocational courses and qualifications for electronics, chefs' training and nursery nurses. Part II contains the reports of the Politeia Education Commissioners, bringing the reader through the results of the individual surveys (chapters 9-11) and the study ends with an overall conclusion and a series of recommendations for policy makers in this country.

1 The analysis of individual courses and exams in this study is supported by a detailed comparison of the countries, their systems, percentages of pupils taking the courses as a percentage of the age range, the numbers and percentages taking different courses, the levels or degree of specialisation and time spent on teaching or courses, and the nature of the exam in terms of the levels at which taken and the number of subjects taken. All of these – and other factors – which have a bearing on standards are discussed in the separate account (released simultaneously).

2 Systems

The United Kingdom is disunited so far as its education system is concerned. England and Wales share the same structures of schooling and examinations; Scotland and (not examined here) Northern Ireland each have different ones. In England and Wales, compulsory schooling ends at 16. By 1998, roughly three quarters (74.4 per cent) of 16-18 year olds were in education and training, and over a half (55.1 per cent) in full-time education. Only ten years before, the proportions were considerably lower – barely more than a third in full-time education, barely more than half in education and training altogether. A couple of generations ago, post-compulsory education was even less common, although in some trades apprenticeships were common. This rapid rise in what is called ‘participation’ (paralleled at university level) has usually been welcomed by politicians, but it has raised concerns about whether the content of courses has been diluted and standards lowered.

Until recently, academic assessment at 18+ was by means of the Advanced Level General Certificate of Education (A-levels). Schoolchildren desiring entry to university would take three or four A-levels; the two best universities, Oxford and Cambridge, used to have their own entrance and scholarship examinations, but abandoned them. The system was then complicated, in order to broaden the course for 16-18 year olds, by the introduction of AS-levels, examinations supposedly at the same level as A-levels but with half the content of the A-level. Last year the A-level system underwent fresh upheaval. Now the final A-level qualification consists of an AS-examination (which can also form an independent qualification) and an A2 examination: a normal pattern might be to complete the AS-level by the end of the first year in the sixth form, and the A2 by the end of the second year, but other arrangements are possible. The first AS levels were taken in 2001 and the first A2 levels in 2002.

AS and A-levels are set by several different examination boards, which are now constrained by fairly rigid criteria, agreed between them and a government-appointed curriculum authority, as to the content, form and level of the papers. The subjects covered range from the traditional ones, such as mathematics, history, physics and Latin, to the modish (such as media studies and drama studies). Candidates may choose their

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combinations of AS and A-levels. Universities usually require candidates to have taken at least 3 A-levels. The examinations have, for some time, been graded from A – E and the government intends to retain existing A – E grades set at their present levels. Different universities set different levels for applicants.

In addition the AEA – an additional extension exam for A-levels, aimed at stretching the most able students – will be taken in 2002 for the first time as an exam designed ‘to differentiate between able students who can achieve an A grade at A-level’. Although taken separately to the main A-level papers it is ‘based on the same body of knowledge’ with two grades, merit and distinction.

The system of vocational qualifications introduced from 1986 onwards has failed to achieve the clear shape that was intended. General National Vocational Qualifications (GNVQs) are supposed to be the equivalents, at Foundation and Intermediate Levels, of GCSEs, and at Advanced Level of A-levels. Unlike the academic courses, they are modular in structure and assessed mainly by coursework. National Vocational Qualifications (NVQs), which are based on ‘National Occupational Standards’ (NOSs) of knowledge, skill and understanding in particular areas of work. Vocational education and training has also been subject to successive changes and repackaging and re-branding and further changes are now planned for the 16+ system of training. The intention is for schools to provide different combinations and mixtures of general and vocational courses. There is to be an end to the distinct labels which distinguish the vocational, and other (‘general’) GCSEs and A-levels.

Schools, the government insists, will have to change to accommodate the new system and offer a wider range of courses, including vocational courses, collaborate with other institutions, develop new ‘partnerships’ – including partnerships with employers to support work-related learning. Teachers will be obliged to teach subjects to a wider age range, across a greater range of qualifications and with a wider range of teaching styles.

16-18 year olds study or are trained in various different types of institution. The great majority of these institutions are funded by taxpayers and free to those who use them. Entry to A-level courses may require certain basic attainments in the GCSEs taken at the end of compulsory schooling. Some schools, however – including what are generally recognized as the most outstanding academically – are private institutions, and parents are required to pay the full cost of the education provided for

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their children there (although some children receive scholarships). Entry to these schools (at 11 or 13 or 16) is often highly competitive. Many 16-18 year olds, especially of those taking the academic courses, remain in the schools – comprehensive (11-18), selective (grammar) (11-18) or independent (11/13 – 18) – they entered earlier; some move on to sixth-form colleges. Some, especially those taking vocational courses, attend further education colleges. Vocational training is all based on tuition at school or college, not at the workplace.

In Scotland the school-leaving age is 16, as it is in England and Wales. Scotland resembles its southern neighbours, too, in the increase in the proportion of 16-18 year olds remaining in education or taking vocational training. In 1986/87, roughly a quarter of the age group remained at school, and another fifth took some form of full or part-time vocational training. By 1996-7, nearly two fifths (37.7 per cent) were still at school, and over 70 per cent were involved in some form of education or training.

The small proportion of 16-18 year olds (less than 10 per cent) who attend independent schools in Scotland usually follow the English and Welsh system of academic examinations. For the great majority, who are educated at the expense of the taxpayer, the system of examination and schooling is different. There are two academic examinations: Scottish Certificate of Education, Higher Grade (known as 'Highers'), and the Certificate of Sixth Year Studies (CSYS). Generally, the courses for these examinations are open to those who wish to take them, although schools may advise prospective candidates about their suitability. It is usual to attempt Highers in 4 to 5 subjects, and for the brighter schoolchildren to take them at the end of their first year of post-compulsory schooling. Brighter children can then either take further subjects at Highers at the end of the second year, or do more specialized work in some subjects required for the CSYS. As with A-levels, the choice and combination of subjects is left to the candidates and their schools. Highers are, altogether, a broader examination, at a lower level, than A-levels in England and Wales. The work required for the CSYS is nearer to that needed for A-level. (In England and Wales, the government has recently made pupils take AS-levels one year after GCSEs, and then go on to take A-levels a year later: this experiment brings the English system close to the Scottish one.)

The Scottish system of vocational qualifications is even more chaotic than that in England and Wales. English and Welsh NVQs are paralleled by Scottish SVQs, but there are various other courses and certificates. Since

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1999 a reform of the examination system has been underway, to achieve the fashionable end of combining vocational and academic education within a single system.

Most 16-18 year olds who follow an academic education do so in the comprehensive school they had entered four year earlier. Colleges of further education are devoted to vocational education, whilst some 11.4 per cent of the age group receive vocational training outside schools and colleges by taking the 'Skillseekers' scheme.

In France, where 16 is the age limit for compulsory schooling, education and training for 16-18 year olds is organized around the *baccalauréat*, taken after two years of post-compulsory schooling. The *baccalauréat* is descended from the examination which was taken after the first 4 years of the arts course at medieval universities. Students would go to university at about 14, and so the *baccalauréat* was taken, as now, at roughly 18. More recently, the *baccalauréat* became an examination taken at the end of schooling; a pass – achieved by roughly four fifths of candidates – entitles students to a place at the university of their choice (in contrast with the English system, where universities interview and make offers based on attaining certain grades at A/AS-level). More recently still, the *baccalauréat* system has been expanded to embrace vocational qualifications.

There are three types of *baccalauréat*. The general *baccalauréat* is the academic examination, and it is taken by over half (52 per cent) of *baccalauréat* candidates. Schoolchildren must choose between three main groups of subjects: one based around literature and languages, one based around economics and social sciences, and one based around mathematics and the natural sciences (the most popular, taken by roughly half the candidates). The technological *baccalauréat*, taken by 30 per cent of candidates, concentrates on technology and its scientific bases and is divided into four types. Whereas those who gain the general *baccalauréat* can go on to a full-length university course, those who take the technological *baccalauréat* usually go on to a shorter university course. An alternative to the technological *baccalauréat* is the *brevet de technicien* (a qualification as a specialist technician in some area, usually leading directly to employment) or the *certificat de fin d'études secondaires*. In 1985, a third sort of *baccalauréat* was introduced, the *baccalauréat professionnel*. Like the technological *baccalauréat*, the vocational *baccalauréat* (taken by 18 per cent of candidates) can lead to higher education (a short higher technology course). But these *baccalauréats* were developed in close collaboration with

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employers and are aimed to teach pupils particular occupations. They include a considerable element (16-20 weeks over the two years) of on-the-job training.

Most French schoolchildren begin secondary schooling (age 11) in a *collège* and will have moved from a *collège* to a *lycée* by 15, i.e. the year before compulsory schooling ends. Lycées are selective, usually on the basis of the marks given to pupils at their *collèges*. Teaching for both the general and the technological *baccalauréats* takes place in 'general and technological' *lycées*, whereas the *baccalauréat professionnel* is usually taken at special vocational *lycées*. *Lycées* of all types are funded by the taxpayer and charge no fees. But nearly a fifth of French schoolchildren attend private schools (usually Catholic schools), which are heavily subsidised from public funds.

One feature of French education, which affects only a small percentage of children but has a large bearing on the intellectual and administrative life of the country, is the system of *Grandes Écoles* and *classes préparatoires*. Whereas entry to university is open to anyone who has passed the *baccalauréat*, there is a group of élite higher educational establishments called the *Grandes Écoles*, many concentrating on training in science and technology at a very high level (for example, the *École Polytechnique*) or on administration (the *École Nationale d'Administration*) or on academic education (the *École Normale Supérieure*). Entry to these institutions is by competitive examination, taken two years after the *baccalauréat*. The best *lycées* run 2-year *classes préparatoires* for these examinations, and those who fail to gain entry to a *Grande École* can begin their university courses at third-year level.

As in Britain and France, compulsory schooling ends in New Zealand at 16. In 1997, nearly two thirds (63 per cent) of pupils gained some sort of academic qualification from their post-compulsory schooling, although 38 per cent of this group have merely attained the certificate for one year of post-compulsory studies. The framework for qualifications for 16-18 year olds, as it has been until now, involves three different academic examinations. There is the Sixth form certificate, taken at roughly 17, after one year of post-compulsory school. Usually 5 – 7 subjects are taken, and the performance is graded from 1 – 9. The next year, pupils take the Higher School Certificate, involving at least 3 subjects. This examination is not graded. At the same stage, pupils may take the University Entrance, Bursaries and Scholarships Examination.

Post-16 academic education is provided in the main 13 – 18

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(occasionally 11 – 18 or even 5 or 6 – 18) schools. By contrast, vocational 16-18 education is provided by polytechnics, which have strong links with business and industry as well as the universities and local government. Vocational pupils take the New Zealand Certificate and the New Zealand Diploma (which involves work experience).

This framework is at present undergoing considerable change. A 'National Qualifications Framework' is being developed for secondary education in general and, in keeping with international fashion, it will aim to embrace both academic and vocational courses. The whole curriculum is broken into over 6000 separate units – an aspect of a subject a student can supposedly show that he has mastered. (English readers will notice that these new plans read as though they are based on a *reductio ad absurdum* of the methodology on which our own National Curriculum – for 5 – 16 year olds – is based.) From this year, the National Certificate of Educational Attainment, obtained through the new framework, will be the main qualification at secondary schools.

Germany has no single system of education, because education is the responsibility of each of the Federal Republic's 16 States (*Länder*). None the less, there are many similarities, and the central government has encouraged integration over the last decade. Compulsory schooling ends at 15 or 16. Only a small minority of 16 – 18 year olds who remain in education or training (about one fifth) follow academic courses; four fifths take vocational courses. There is a sharp distinction between the academic and vocational paths and the institutions in which each are pursued. Indeed, the direction of a pupil's education – whether it will run, through a *Gymnasium*, the *Abitur* and university, or will be more vocationally-oriented and lead to a trade – is decided, though not irrevocably, at about the age of 10. At this age, depending on examination grades or recommendations, they enter either a *Gymnasium*, an academic school, a *Realschule*, where a general education with a number of vocational courses is offered, or a *Hauptschule*, where the emphasis is on preparation for the world of work.

Children at a *Gymnasium* remain there, if they wish to follow academic post-compulsory education. The academic examination taken, usually at 18 or 19, at the end of the two years of post-compulsory schooling is called the *Abitur*. Although some specialization is allowed, candidates have to take a balanced course, which includes languages, humanities, mathematics and science. The *Abitur* (and completion of the years of schooling which will have been needed) gains pupils the right to attend any university and most

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courses. Some popular courses, however, require a specified grade in the *Abitur*.

A few children from other sorts of school, who have performed sufficiently well and who wish to follow an academic course, transfer at 15 or 16 to a *Gymnasium*. Most, who choose to follow a vocational course, go to one or another type of vocational school.

The most popular sort of vocational education, followed by about four fifths of those in vocational 16 – 18 training, is that provided in *Berufsschulen*, where a three year course leads to the *Berufschulabschluss*, an examination set by the representatives of the profession for which the training is being given. The pupils spend the greater part of their time – three or four days a week – at the workplace, and receive, more theoretical and background teaching at the *Berufsschule*. Some children, however, choose to follow a vocational course without training on the job. They go to a *Berufsfachschule*, where the course lasts for between one and three years. There are also other vocational routes, including a vocational *Abitur*, which allows successful candidates to enter university.

The 26 Cantons of Switzerland each have the responsibility for organizing education in their own area, and so there is even less of a unified system here than in Germany, especially since, as well as the differences between local administrations, there is the broader division of the country into French-speaking, German-speaking and Italian-speaking regions. None the less, there are some features that are broadly true of Swiss schooling as a whole. A very high proportion (88.5 per cent) of pupils remain at school after the end of the compulsory period, at 15 or 16 - a big increase from the already high percentage (77.4 per cent) in 1978. Of those who remain, roughly two thirds go into vocational education, and most of the rest into academic education which prepares for university.

The school-leaving academic examination, taken at 18 or 19, is called the *Matura*, and it is normally a requirement for university entrance. Candidates must take 7 basic subjects and two optional ones, and produce a project, alone or as part of a team. Just 17 per cent of the age group receives a *Matura* certificate. As in Germany, admission to the academic stream depends on having been admitted, earlier on, to a selective academic school – a *Gymnasium* (or *Matutitätsschule*).

Recently, a middle way between academic and vocational education has been introduced, for those who, at 18 or 19, will go on to vocational training in a non-university tertiary college. A mixture of general and technical

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subjects is taken, and the diploma (*Diplommittelschule*) is based partly on a final examination and partly on continuous assessment. There is also a French version of this new way, involving a vocational baccalaureate (*maturité professionnelle*). These new approaches, however, are followed only by a small percentage of pupils. Over 70 per cent of all pupils at the end of compulsory education go into an apprenticeship, lasting for 2 or, more usually, 3 or 4 years. Usually, they spend a day and a half each week at a vocational school – in the German manner – in order to study the more theoretical aspects of their chosen work. At the end of the apprenticeship, there is an examination for the Federal Diploma (CFC), with practical and theoretical elements.

The United States, like Germany and Switzerland, is a federation of states, each of which has responsibility for education in its area. None the less, education for 16-19 year-olds in any of the states differs radically from that provided in the European and Anglophone countries surveyed in the preceding paragraphs. In general, there is far less differentiation between courses and between types of schools; education from 16-19 continues more directly from education over the preceding 10 years or so than elsewhere (and, indeed, although in 30 states the school-leaving age is 16 – as in many countries – in 9 it is 17, and in 12 children may not leave school until 18). Most children in the USA, then, who stay on beyond the minimum school-leaving age, continue in what is called a 'High School', which they will have entered sometime between the ages of 12 and 14. The schools cater for children of all abilities, and usually they will be streamed into one of three main 'tracks': academic (preparation for higher education) = A; vocational only = V; general = G. The proportion of those in the V and G tracks has fallen from 33 per cent and 58 per cent respectively in 1982 to 21 per cent and 42 per cent in 1994, whilst that of those in the A track has risen from 8 per cent to 32 per cent over the same period. Despite these changes, many of the entrants to higher education come from the G track. (Higher education in the USA is widespread; about two-thirds of high school graduates enter it.)

By contrast with the position in all the other countries examined here, there is no official system of school-leaving or university entrance examinations in the USA. Universities usually choose candidates on the basis of their school record and their performance in privately administered and set SATs (scholastic aptitude tests). Although the SATs by the College

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Board, a non profit-making company, are used by over 300 universities, including most of the best known, they are unlike a national examination in the sense that they do not aim to set a syllabus for candidates to have followed, but rather to test ability in particular academic areas. Some US schoolchildren do, however, take the International Baccalaureat, which does resemble a European school-leaving examination.

Vocational education is followed by a smaller proportion of 16-19 year-olds than elsewhere. It can be pursued as one of the 'tracks' in general High Schools (see above), or, more rarely, in area vocational schools or in Vocational or Technical High Schools (these sorts of High School account for fewer than 2 per cent of the total number of High Schools). Fewer children than in the past have been choosing vocational education, and those who do tend to have low academic achievements and a low social background. US laws severely restrict the amount of work that those under 18 are allowed to do, and so there is little practice in actual trades for those who take vocational courses.

3

Mathematics

David Burghes

Introduction

The remit for this study was the provision and standard of mathematics in post 16, but pre-university, education which in most countries is the 16–19 age group.

Various documents relating to:

- a) syllabus and qualifications
- b) sample or past examination paper(s)

were provided for the following countries:

- England and Wales
- Scotland
- France
- New Zealand
- USA
- Germany
- Switzerland.

In the following sections, each country's provision will be summarised, highlighting both the similarities and the key differences when compared to that for England and Wales. The standard of the questions on the papers will be compared, but note the qualifying comments below. The final section will attempt to bring the conclusions together and, in particular, to make suggestions for the long term development of mathematics provision for 16–19 year olds in the UK.

There are a number of important caveats.

- 1) The documents and exam papers being analysed relate to mainstream provision for mathematics 16–19 but in countries such as the UK this is

Comparing Standards

essentially the 'academic' course which is taken only by a relatively small percentage of the age cohort. Other countries have a broader sixth form, with a much greater percentage of the age cohort taking mathematics. Also, provision in many countries gives a range of options, some of which are taken only by a small proportion of students.

2) Although it is clear who the exam papers are for, and in some cases marking schemes are also provided, it is not clear what the 'pass' mark is. This could be quite crucial, because a paper which seems to have challenging questions might have a very low pass mark (in the UK recent pass marks on small modules have been in the region of 20–30 per cent). Alternatively, a seemingly easy paper might have a very high pass mark, as it is expected that students should be able to show competence across all questions.

3) Many countries are in a state of change, sometimes more than just cosmetic; for example, in the UK revised AS/A-level qualifications are now just starting, as well as initiatives to encourage students to take mathematics, or return to mathematics, in the form of free-standing modular courses which will build to an AS-level qualification.

Therefore conclusions on trends drawn in this study must be treated with caution and the caveats borne in mind when making comparisons. This does not devalue the study but great care must be taken in making and using the conclusions.

Country Provision

Each country is dealt with in turn and its section is subdivided into:

- a) curriculum framework and syllabus content,
- b) examination framework and test paper(s),
- c) general comments.

England and Wales

Curriculum Framework and Syllabus Content

AS and A-level provision is promoted by the following national exam boards:

- Edexcel

Academic and Vocational, 16-19 year olds

- AQA
- OCR

In the past these boards have offered a number of contrasting frameworks for the syllabus and its assessment with, for example, a linear course in which all the assessment is at the end of the two years of study or a modular course, consisting of 4 or 6 modules, available at least twice during the year.

All the boards offer a core of Pure Mathematics (to be called a Mathematics A-level, the common core specification must be met) together with options in

- Further Pure Mathematics
- Statistics
- Mechanics

and some boards also provide modular options in

- Discrete Mathematics.

In short, there is a high degree of diversity here, although not all options are necessarily allowed as suitable combinations for the award of an AS or A-level.

Edexcel, in its current modular provision has, for example, 6 Pure Mathematics modules: P1, P2, . . . , P6 , and if all 6 modules are taken an extensive range of topics will be covered. It is very unlikely though that students will take this combination.

So, for example, the topics:

First and Second Order Differential Equations (P4)

Polar Coordinates (P4)

Complex Numbers (P3 and P6)

Hyperbolic Functions (P5)

Matrix Algebra (P6)

Vectors (P6)

Maclauren Series (P6)

Proof by Induction (P6)

Comparing Standards

will not be taken by most Mathematics A-level students. On the other hand, most A-level Mathematics students will take a combination of Pure Mathematics with Mechanics or Statistics or Applied topics. In this way, students will be exposed to (and examined on) the concept of mathematical modelling and will be expected to use and analyse the concept critically.

Examination Framework and Exam Papers

This to a certain extent depends on the exam board taken and the syllabus followed. Two examples are considered here; one from the previous linear examination scheme and one from the current modular scheme.

i) 'Old' AEB - Although this could be taken as a modular course, this was designed more for linear candidates (taking all examinations at the end of the 2-year course). It has 7 basic exam papers, each 2 1/2 hours long and candidates have no choice of questions. The 7 papers are:

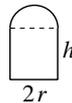
Pure Maths 1
 Pure Maths 2
 Mechanics 1
 Mechanics 2
 Statistics 1
 Statistics 2
 Decision Maths

Each paper consists of between 8 and 13 questions, starting with short, relatively straightforward questions but gradually increasing in length and complexity. Here are two examples taken from Pure Maths 1.

Q.1 The first term of an arithmetic series is 3. The seventh term is twice the third term.

(a) Find the common difference. (2 marks)

(b) Calculate the sum of the first 20 terms of the series. (2 marks)



Q.11 A glass window consists of a rectangle with sides of length $2r$ cm and h cm and a semicircle of radius r cm. The total area of one surface of the glass is 500 cm^2 .

Academic and Vocational, 16-19 year olds

- (a) (i) Write down a formula connecting h and r . (1 mark)
(ii) The perimeter of the window is p cm. By eliminating h , show that (2 marks)

$$p = \left(2 + \frac{\pi}{2}\right)r + \frac{500}{r}.$$

- (b) (i) Determine the positive value of r for which p has a stationary value, giving your answer correct to three significant figures. (3 marks)

- (i) Calculate $\frac{d^2p}{dr^2}$ and hence determine whether this stationary value is a maximum or minimum value. (2 marks)

'New' Edexcel

Under this new system, AS-levels are not merely examinations that are taken to broaden a candidate's studies but rather, each A level is made up of three AS modules (50 per cent of the assessment) and three A2 modules (also 50 per cent of the assessment). Candidates can take the AS modules at the end of the first year in the sixth form, and A2 modules at the end of the second year, although candidates can still take all modules at the end of their two years of study or indeed any other combination. The exam papers are now 1_ hours in length but as before there is no choice of questions. There is also one additional constraint on two of the compulsory AS modules – only scientific calculators are allowed (so, for example, neither graphics calculators nor computer algebra calculators would be permitted). There has also been a revamp of the formulae book which all exam boards allow candidates to use and it is no longer permitted to quote some of the rather basic formulae such as

$$\sin^2 \theta + \cos^2 \theta = 1 \quad \text{and} \quad \frac{d}{dx}(x^n) = nx^{n-1},$$

with the aim of ensuring that all candidates have instant recall of these facts, rather than having to find them in the formulae book.

Comparing Standards

General Comments

There is choice in the provision at A-level, both among and within exam boards. Although the new arrangements mean that the differences between boards are now mostly cosmetic, there still remains much choice within each board's provision. Assuming a pattern of entry similar to the current one, you would expect most candidates to do three (core) Pure Maths modules combined with the appropriate number of Applied modules.

This combination undoubtedly gives candidates a broad, balanced mathematical foundation including the underlying ideas of mathematical modelling but it also means that many key mathematical topics will be missed by the majority of candidates.

It should also be noted that a new advanced extension paper is being planned for those candidates capable of an A grade in the normal A-level examinations. It is aimed at stretching the most able students, and although taken separately, it is based on the same content as the A-level syllabus. There will be just two passing grades, namely 'merit' and 'distinction'.

Scotland

Curriculum Framework and Syllabus Content

The key difference here is that the Scottish education system permits entry to university one year after 16+ exams (Scottish Certificate of Education at Standard Grade, which is equivalent to the English GCSE). Hence, this is a one-year course and assessment is based on extending the SCE Standard Grade to SCE Higher Grade. The following year there is a one-year Certificate of Sixth Year Studies² with exams and assessment in:

- Mathematics (General)
- Pure Mathematics
- Statistics
- Numerical Analysis
- Mechanics.

So to make any comparison with the English and Welsh system (E and W) you need to look at the combination of the two courses. Interestingly, there

² Called sixth year. In Scotland pupils have 7 years in Primary School (P1 to P7) followed by 4 years in secondary school (known as S1 to S4) up to Standard Grade, a further year (S5) for Higher Grade and then one more year for Sixth Year Studies (S6).

Academic and Vocational, 16-19 year olds

is no choice in the Higher Grade in terms of the syllabus, which is mainly pure mathematics and broadly comparable to the content of modules P1-3 in E and W. It does, though, contain in its assessment an investigational coursework, based on the same content.

The content of the Sixth Year Studies modules are again broadly comparable with the E and W modules; although there are fewer choices, the modules themselves are more substantial. For example, candidates can take Pure Maths and Statistics, or Pure Maths and Mechanics but cannot take modules in Pure Maths with elements of Mechanics and Statistics.

Examination Framework and Exam Papers

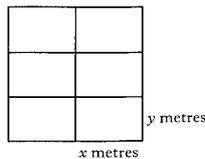
The one key difference here is that at Higher Grade 10 per cent of the assessment is devoted to investigational/ problem solving/ application types of project (the board provides suggestions for these but centres can supply their own if first approved by the board). A possible example is given in Appendix 1.

The two exam papers for the Higher Grade consist of short, compulsory questions on Paper 1, for example

- (a) Show that $x = 2$ is a root of the equation $2x^3 + x^2 - 13x + 6 = 0$
- (b) Hence find the other roots

but substantial questions on Paper 2, although there are clear signposts throughout the paper to aid progress. Here is an example:

A zookeeper wants to fence off six individual animal pens.



Each Pen is a rectangle measuring x metres by y metres, as shown in the diagram

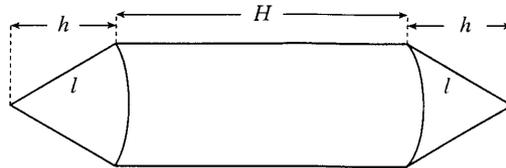


- (a) (i) Express the total length of fencing in terms of x and y
- (ii) Given that the total length of the fencing is 360m, show that the total area, $A\text{m}^2$, of the six pens is given by $A(x) = 240x - \frac{16}{3}x^2$
- (b) Find the values of x and y which give the maximum area and write down this maximum area.

Comparing Standards

For the Sixth Year Studies assessment, there is one exam paper per topic, with all but Mathematics (General) offering a choice. The Mathematics (General) is taken by all candidates, has many questions in context and is mathematically demanding. For example

A plastic container for holding pens is made from a cylinder with conical ends as shown in the diagram. The cylinder has radius 3cm and length H cm. Each cone has perpendicular height h cm and slant height l cm. The total volume of the container is 900cm^3 .



- (a) Find an expression for H in terms of h .
- (b) Show that the surface area, $S\text{cm}^2$, of the container is given by

$$S = 600 - 4\pi h + 6\pi\sqrt{9 + h^2}$$

- (c) Find the value of h for which the total surface area of the container is a minimum. Justify your answer.

General Comments

The exam papers offered seem broadly compatible with E and W, although there is some evidence of the use of more challenging questions. The main point that emerges is the simplified nature of the provision, with no choices to be made in the equivalent of the first year of the sixth form but substantial (though limited in number) options available in the second year

France

Curriculum Framework and Syllabus Content

France has a radically different framework for post 16 education with streaming into two types of course:

Academic and Vocational, 16-19 year olds

- academic in a *lycée générale*
- technical vocational in a *lycée technologique*

or leading, after 2 years, to the *General Baccalaureate* (academic) or *Technical Baccalaureate* and, within each of these schools, students can choose to follow one of three specialisations:

1. Socio-Economic Science
2. Literature
3. Scientific Studies

There is some degree of agreement in the topics across the three specialisations, but as you might expect, more probability in 1 but more calculus in 3. The content is of the level expected at sixth form (although it should be noted that mathematics of some sort will be taken by all students at this stage, which is considerably more than the 10 per cent of the age cohort in the UK taking AS/A-level examinations).

Examination Framework and Exam Papers

Unfortunately, the details of the assessment framework were missing from the documents provided. There was, though, one exam paper to illustrate their style of question setting, based on specialisation 1. Here are a couple of sample questions, which give a good flavour of the paper.

Q.1 The number of customers at a petrol filling station, X , follows the distribution given below.

$$p_i = P(X = i) \quad \begin{array}{c|ccc} x_i & 0 & 1 & 2 \\ \hline p_i & 0.1 & 0.5 & 0.4 \end{array}$$

- a) Give a graphical representation of X .
- b) Calculate the mathematical expectation of X . In this petrol station, the probability that a customer buys petrol is 0.7, the probability that he buys diesel is 0.3.

Comparing Standards

- c) Define C_1 : in five minutes, only one customer comes to the station
 C_2 : in five minutes, two customers come to the station
 E : in five minutes, only one customer buys some petrol.
- d) Calculate $P(C_1 \cap E)$
- e) Demonstrate that $P(E|C_2) = 0.42$ and calculate $P(C_2 \cap E)$.
- f) Conclude the probability that only one customer buys petrol within 5 minutes.

Q.2 a) Show, using a geometrical interpretation, that every solution in \mathcal{C} of the equation

$$\left(\frac{z-2}{z-1} \right)^n = i$$

when n is a non-zero natural whole number, has real part $3/2$.

Find, in algebraic form, the solution of the equation above.

General Comments

Again, the comparisons are difficult to make, not only because of the problems of cohort size taking mathematics in France but also because of the different content and style of questions. Both have a very academic feel but may not be quite as demanding as they look on first sight. This is partly due to a limited syllabus, with less breadth but perhaps more depth in the topics it specialises in.

Topics not covered include most statistical theory and mechanics and there seems to be less calculus overall, although techniques such as integration by parts are emphasised.

New Zealand**Curriculum Framework and Syllabus Content**

Here is yet another different system but with some interesting features. The first is the separation of the curriculum and its assessment. There is a Y1–13 progression which covers five mathematical strands:

Academic and Vocational, 16-19 year olds

Number: Levels 1–6
 Measurement: Levels 1–8 (with Calculus on levels 7 and 8)
 Geometry: Levels 1–8
 Algebra: Levels 1–8
 Statistics: Levels 1–8

with progression across the years from primary school to university entrance. (This is shown in Appendix 2.) The continuity across the complete school age range is an interesting concept.

Examination Framework and Exam Papers

This is a separate entity and would appear to have two options at the end of Y12, although it is not clear what percentage of the age cohort enter these options. The options are:

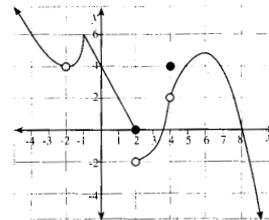
- Mathematics with Calculus
- Mathematics with Statistics.

Both are examined by 3 hour examination papers, with a set of compulsory (and reasonably short) questions and a section of much longer questions (in context and with progression) where there is some choice.

Both sets of questions show interesting facets. The short questions often examine understanding rather than skills, which is unusual. This is in part due to the very extensive formulae sheets provided, so that the usually short skills questions become redundant. For example, on the Calculus option, there is the following question which is about understanding the concepts of limits, continuity and differentiation.

(a) Use the figure above to find the following. (If an appropriate value does not exist then write “does not exist”.)

1. $f(4)$
2. $\lim_{x \rightarrow 4} f(x)$
3. The value(s) of x for which $f(x)$ does not have a limit
4. The value(s) of x for which $f'(x) = 0$



Comparing Standards

- 5. The value(s) of x for which $f'(x)$ does not exist and $f(x)$ is continuous
- 6. The values of x for which $f''(x) < 0$.

(b) Sketch the graph of a function $y = f(x)$ which has the following properties:

$$\begin{array}{lll} f'(x) > 0 & \text{for} & 0 < x < 2 \\ f(0) = 1 & \text{and} & f(2) = 3 \\ f''(x) > 0 & \text{for} & 0 < x < 2 \end{array}$$

The longer questions also make interesting (and rather daunting) reading. Each of the questions has a build-up to the more advanced work but a contextual theme runs throughout.

a) Table 1 shows the number of road accident deaths for some countries in 1994.

Country	Deaths	Deaths per 100 000 population
Canada	3260	11.1
France	9019	15.6
New Zealand	580	16.2
United Kingdom	3807	6.5
Australia	1937	10.9
USA	40676	15.6
Japan	12768	10.2

Table 1: International Road Accident Deaths

- 1. Explain how you would reorder the countries using the data from Table 1 so that it is easier to make sensible international comparisons about road deaths. (1 mark)
- 2. What type of plot or graph should you use with the data in Table 1 to effectively communicate these international comparisons?

(b) Table 2 shows the number of New Zealand road accident casualties for the 15-19 year old age group for each year from 1990 to 1997.

Academic and Vocational, 16-19 year olds

Year	Deaths	Injured	Total
1990	135	3855	3990
1991	101	3420	3521
1992	105	3087	3192
1993	97	2851	3948
1994	64	3215	3279
1995	83	3169	3252
1996	94	2690	2784
1997	75	2524	2599

Table 2: Road Accident Casualties: 15-19 years of age

1. Describe a trend for the number of road accident deaths for this 15-19 year old age group from 1990 to 1997. (1 mark)
 2. Using the data in Table 2, give an **estimate** of the percentage of the total road accident casualties which result in death for this age group. (1 mark)
 3. In 1997 the road accident death rate in New Zealand for the entire New Zealand population was 14.1 deaths per 100 000 people in the population. In 1997 there were approximately 265 000 people in the 15-19 year old age group. How does the road accident death rate for the 15-19 year old age group for 1997 compare with that of the entire population for 1997? Justify your answer. (2 marks)
- (c) Over the past 6 years, one of the worst accident black spots in Auckland has been a roundabout in the suburb of Panmure. There have been 153 crashes at this spot between 1 January 1992 and 31 December 1997. Let the random variable X be the number of crashes at this roundabout per month.
1. Calculate, correct to 2 decimal places, the mean number of crashes per month over this 72 month period. (1 mark)
 2. The Poisson distribution with $\lambda = 2.1$ is used to model the distribution of the random variable X . The Poisson model makes several assumptions about the occurrences of crashes at this roundabout. State clearly any **one** of these assumptions. (1 mark)

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3. Under this Poisson distribution ($\lambda = 2.1$) model, the number of crashes per month is very likely to lie within two standard deviations of the mean of this distribution. That is, for any given month, the number of crashes is very likely to be between a and b . Find the values of a and b . (2 marks)
4. Find the probability that for any given 2-month period there are exactly 4 crashes in total at this roundabout. (2 marks)
5. (i) Using the formula for evaluating Poisson distribution probabilities, find the probability that in any given month there are no crashes at this roundabout. (1 mark)
(ii) Find the probability that for any given 12 months, there are exactly 6 of these months in which there are no crashes at this roundabout. (3 marks)

General Comments

To English eyes, the New Zealand curriculum and assessment breaks new ground in a number of ways. Firstly, it is a consistent curriculum, with progression across all school years; secondly, the form of assessment, namely one exam paper out of two, gives little choice but its simplicity is captivating compared with the new modular E and W system.

It also breaks new ground in that many of the shorter questions really do test understanding while the longer questions have built-in progression based on a theme or context. They put mathematics in an interesting light.

USA

Curriculum Framework and Syllabus Content

This is incredibly difficult to assess as the stated syllabus for the SATs³ 2 is extremely brief. The SATs are designed for colleges and universities to use as entrance examinations, although colleges can use their own levels of achievement if required. The SATs are available for

- English
- History and Social Sciences

3 Standardised Assessment Tests.

Academic and Vocational, 16-19 year olds

- Mathematics
- Science
- Languages

They are offered six times a year and can be taken at local testing centres. In mathematics there are two levels available, Level IC and Level IIC and the syllabus content of each is given below.

Level IC

- Algebra
- Geometry (plane Euclidean, coordinate, 3-dimensional)
- Basic trigonometry
- Algebraic functions
- Elementary statistics, including probability, counting problems, data interpretation, mean, median and mode.
- Miscellaneous topics, including logic, elementary number theory, arithmetic and geometric sequences.

Level IIC

- Algebra
- Geometry (coordinate and 3-dimensional)
- Trigonometry
- Functions
- Statistics, including probability, permutations and combinations
- Miscellaneous topics, including logic and proof, elementary number theory, sequences and limits.

This does give some information about the differences, which is helpful, and clarifies that Level IIC is for those who have already studied much mathematics. You have, though, to go to the questions to obtain clarification of both the content and standard.

Examination Framework and Exam Papers

For each level, the paper is 60 minutes long and consists of 50 multiple choice questions⁴. To assess the standard of each level, a selection of questions is given on the next page.

⁴ Most exam boards are now reluctant to use multi-choice questions as the research indicates some unreliability; for example, boys, without knowing the right answer, are better at guessing the correct answer than girls, who are more likely to leave it blank.

Comparing Standards

Level IC

(a) If $2t + 3t = 4t + 6t - 10$, then $t =$

- (A) -1 (B) 0 (C) $1/2$ (D) 1 (E) 2

(b) If $12x^2 = 7$, then $7(12x^2)^2 =$

- (A) 49
 (B) 84
 (C) 98
 (D) 144
 (E) 343

(c) If $x + y = 5$ and $x - y = 3$, then $x =$

- (A) 4 (B) 2 (C) 1 (D) 0 (E) -1

(d) For three bins, A , B , and C , the volume of A is one-half of that of B and the volume of B is two-thirds that of C . If A has a volume of 210 cubic meters, what is the volume of C , in cubic meters?

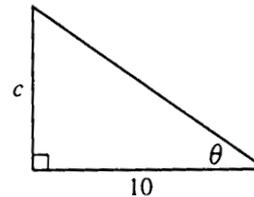
- (A) 630 (B) 315 (C) 280 (D) 140 (E) 70

(e) What are all values of x for which $|x - 2| < 3$?

- (A) $x < -1$ or $x > 5$
 (B) $x < -1$
 (C) $x > 5$
 (D) $-5 < x < 1$
 (E) $-1 < x < 5$

f) In Figure 7 to the right, if $\theta = 44^\circ$, what is the value of c ?

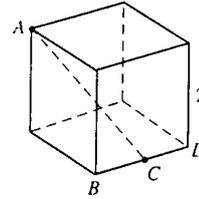
- (A) 6.94 (B) 7.19 (C) 9.66
 (D) 10.36 (E) 13.90



Academic and Vocational, 16-19 year olds

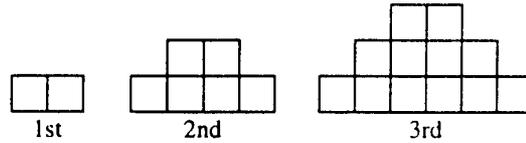
(g) In figure 11 to the right, the cube has edge of length 2. What is the distance from vertex A to the midpoint C of edge BD ?

- (A) $\sqrt{7}$
- (B) $2\sqrt{2}$
- (C) 3
- (D) 5
- (E) $\sqrt{29}$



(h) Sequential arrangements of squares are formed according to a pattern. Each arrangement after the first one is generated by adding a row of squares to the bottom of the previous arrangement, as shown below. If this pattern continues, which of the following gives the number of squares the n th arrangement?

- (A) $2n^2$
- (B) $2(2n - 1)$
- (C) $n(n - 1)$
- (D) $\frac{1}{2}n(n + 1)$
- (E) $n(n + 1)$



Level IIC

(a) If $1 - \frac{1}{x} = 3 - \frac{1}{x}$, then $1 - \frac{1}{x} =$

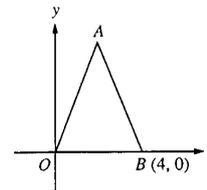
- (A) -2 (B) 0 (C) 2 (D) 3 (E) 3

(b) If $\sqrt{6}y = 4.73$ then $y =$

- (A) 0.62 (B) 1.93 (C) 3.73 (D) 5.33 (E) 11.59

(c) In the triangle in Figure 3, if $OA = AB$, what is the slope of segment AB ?

- (A) $\sqrt{2}$
- (B) $\frac{\sqrt{2}}{2}$
- (C) $-\frac{\sqrt{2}}{2}$
- (D) $-\sqrt{2}$
- (E) It cannot be determined from the information given.



Comparing Standards

(d) If $f(x) = 3x + 5$ and $f(g(1)) = 11$, which of the following could be $g(x)$?

- (A) $7x - 5$
- (B) $5x + 7$
- (C) $5x - 7$
- (D) $5x + 3$
- (E) $-5x + 3$

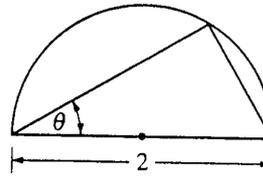
(e) Which of the following lines are asymptotes of the graph of $y = \frac{1+x}{x}$?

- I. $x = 0$
- II. $y = 0$
- III. $y = 1$

- (A) I only
- (B) II only
- (C) I and II only
- (D) I and III only
- (E) I, II, and III

(f) Figure 8 shows a triangle inscribed in a semicircle. What is the area of the triangle in terms of θ .

- (A) $\frac{\theta\pi}{2}$
- (B) $\frac{\pi}{2}$
- (C) $\tan \theta$
- (D) $\sin \theta$
- (E) $2 \sin \theta \cos \theta$



General Comments

A very different form of assessment is used in the USA. Standards, particularly with the levels offered, are difficult to assess, partly because we no longer use multiple choice questions (where the development of the incorrect choices is one of the key problems). However, I would say that undertaking 50 questions in one hour provides a rigorous framework and it would be interesting to see how our A-level pupils would cope with these questions.

*Academic and Vocational, 16-19 year olds***Germany****Curriculum Framework and Syllabus Content**

Details here are taken from the region of Bavaria. German children are streamed at secondary into three types of schools:

- Gymnazium (academic)
- Realschule (technical)
- Hauptschule (vocational).

The syllabus and exam papers considered have one for the Gymnazium students, who have been following an academic maths course for some years (about 25 per cent of the cohort, although this is further complicated by the fact that pupils failing in either Maths or German in end-of-year tests have to repeat the year). Consequently, it is no surprise to find a very mathematical syllabus which stresses rigour and notation. There are two syllabuses:

1. Basic Level Maths (2 hours per week over 2 years at age 16+)
2. Advanced level Maths (6 hours per week over 2 years at age 16+).

Both syllabuses build upon the earlier academic work and even the Basic course seems to be of a considerable standard, although on a substantially reduced syllabus. In each syllabus there are 3 sections:

- Infinitesimal Calculus
- Probability and Statistics
- Analytical Geometry

Examination Framework and Exam Papers

For both exams, it was a surprise to find a theme running through the assessment of each section. On the Basic course, one of the questions (or rather series of related questions) is given below.

- 1) There are 10 seats on a bench located on a platform in a tube station. 10 people of which 2 do not have a valid tube ticket (fare-dodgers).
 - a) In how many different ways can they be seated if we only differentiate between persons with or without a valid ticket?

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In how many cases will the fare-dodgers sit next to each other?

- b) Of the 10 people 2 are randomly selected and controlled.

With what probability will there be exactly 1 fare-dodger amongst them?

2. How high must the proportion of fare-dodgers in relation to all passengers be so that with a probability of at least 99% amongst 100 passengers there is at least 1 fare-dodger?
3. 97% of all passengers have a valid tube ticket. A tube inspector checks 5% of the passengers. The probability that a passenger is a fare-dodger and is checked by him is 0.20%.

Examine whether the inspector has a refined view for fare-dodgers or whether the selection of the checked persons is entirely incidental.

4. The probability that a passenger reveals himself as a fare-dodger is 5%. 100 single inspections are carried out.
 - a) With what probability are a minimum of 3 and a maximum of 8 fare-dodgers amongst them?
 - b) With what probability will exactly 3 be caught, amongst the first 20 inspected?
5. It is assumed that due to the reinforced tube inspections the proportion of fare-dodgers sank below 5%. To test this 200 single inspections are analysed. The probability for erroneously assuming that the proportion of fare-dodgers has sunk is at the most 10%. Investigate using the decision theory / rule.

There is a total of 40 marks for this, as also for the questions in the other two sections in which the themes are mathematical and only in a mathematical context. The questions on the advanced paper are very much more mathematical but still with a theme running through the questions in each section.

*Academic and Vocational, 16-19 year olds***General Comments**

The mathematics here is academic, rigorous and also practical through the Probability and Statistics sections. It is impressive in comparison with the E and W modules but this is in no small part due to the early mathematical education, including [insert section] at secondary school (and the repeating years policy for failed students). It is also impressive, like the New Zealand offering, in its simplicity of assessment.

Switzerland**Curriculum Framework and Syllabus Content**

The details for Bern were provided and the curriculum followed a similar style to that of Germany, although not so strongly mathematical in its description. As with Germany, there are two courses, Basic and Advanced. There were, though, more sections and probably more content than its German equivalent.

Examination Framework and Exam Papers

Here again the questions speak for themselves. Each examination is 4 hours and there are threads running through most questions, as can be seen from the example below.

Q.1 Two real functions, f_1 and f_2 , are, for $0 \leq x \leq 1$, given by

$$f_1(x) = \frac{1}{e-1} (e^x - 1) \text{ and } f_2(x) = x - f_1(x)$$

- Describe and represent in the same cartesian coordination system the curves k_1 and k_2 respective to these functions. (Length unit 10 cm)
- Determine the equation of the tangent at the curve k_1 in the point P with abscissa 1.
- Calculate: $I = \int_0^1 f_2(x) dx$
- Hatch an area in the figure which has content 1.

Comparing Standards

The Advanced paper was clearly more challenging and only appeared to test a limited number of concepts in a very full syllabus. The questions ranged in length and here is a short (but challenging) one.

Q.4 With one of the three real functions, $f(x) = a \times 4^x$, $g(x) = 4^{a+x}$ and $h(x) = 4^{ax}$, a number $a \in \mathbb{R}$ can be chosen so that the function agrees with the function $y = 10^x$.

In which of the three functions is this the case and which value must a have in this case?

General Comments

As with Germany, the students, particularly those taking the Advanced course, are working at an impressively high level. However, this must in part be due to their early mathematical experiences. The standard of questions on the Basic paper seemed close to E and W modules but the questions on the Advanced paper were far more challenging and looked less accessible than E and W questions.

Concluding Remarks

This was a fascinating exercise for the researcher and the main points which stand out for me are the following:

1. There is strong agreement between countries about some of the content, particularly in topics in Pure Mathematics, although the approach taken in many other countries appears to be rather more formal or academic.
2. There are other areas where the content is vastly different; in the UK, Mechanics plays a key role for some students, which is not mirrored elsewhere (perhaps this means that we have strong Applied Mathematics departments in British universities but its prominence in post 16 provision in mathematics should be reconsidered).
3. The assessment framework is vastly different in all aspects (apart from Germany and Switzerland which in all aspects are very similar) and it is certainly not clear to me that we have found in E and W the ideal system (but more of that below). The simplicity of some of the other systems stood out as a very positive aspect, whereas recent trends in the UK have continued to complicate the system more and more.

Academic and Vocational, 16-19 year olds

4. The standard of questions in exam papers among the countries was also variable, with England, Wales and Scotland on the whole providing either simpler questions or more accessible questions through their wording, or intermediate steps given in the question.
5. Unlike other countries, E and W have now opted for a total modular route (although all the modules can still all be taken at the end of the course) which does increase success rates, but questions need to be raised about the overall effect on the long term mathematical competency of students who have gained an A-level qualification in this way.

These points, together with my experiences both as a former examiner and Chair of Mathematics for one of the exam boards, and from my teaching in preparing students for A-level exams (part-time) and undergraduates for teacher training in my university, lead me to make the following recommendations.

Examination framework

The current and new system of modular exams at AS/A-level with AS and A2 modules, restricted combinations, strange resit conditions, is getting out of hand and does not, as its advocates would argue, provide a framework for all to show their ability.

The New Zealand system, with only 2 exam papers (candidates taking just one) seems ideal for a country which, at least for some time, will not be following the streamed routes seen in Switzerland and Germany (and many other European countries).

Questions

It is time to reduce the accessibility of some but not all of the questions on exam papers. There needs to be at least some with a challenge for the most able candidates and the proposed Advanced Extension paper just adds another assessment tier, complicating an already complex framework.

Here the New Zealand scheme again seems suitable, with shorter questions that examine knowledge rather than skills and longer questions on content becoming progressively more difficult.

These types of questions were also seen on the German and Swiss exam papers. The most inspiring aspect of the New Zealand paper was that the

Comparing Standards

contexts were meaningful, not unrealistic, and you really felt that mathematics had a role to play. This is motivating for both candidates and their teachers and moves maths away from being a rather dull, uninspiring (and difficult) subject, an opinion all too prevalent in today's students.

Curriculum

The New Zealand framework of progression from Y1–13 was interesting and one that I would like to see here. Too often we start again both after Key Stage 3 (age 14+) and GCSE. Continuity of progression would be a real improvement on our current model.

Calculators

We now have a complicated system of only allowing scientific calculators on some papers but everything goes on the others. Surely a rational policy of just a basic scientific calculator is what is needed for all our maths exams, whatever the assessment framework.

Postscript

The introduction of the new modular scheme in E and W in 2001/2 has led to a disastrous situation in which, unlike ALL other subjects, AS examinations kept to full A-level standard. Other subjects provided an assessment appropriate for the end of the first year of study. This has led to "passing" candidates with only 25 per cent of the marks, so that even if the candidates gained good grades, they left the examination sessions totally demotivated.

It is anticipated that there will be a significant drop (up to 20 per cent) in the number of candidates who complete a full A-level this summer, and it is likely that this will have a knock on effect with even less candidates for mathematics in future cohorts. At a stroke real damage has been done and it will take many years to put right. Indeed the current perturbation to the assessment schemes that are now taking place may well not help at all and it is a complete rethink that is needed.

It should be added that this study of sixth form provision is only modifying a system of mathematics education in the UK that needs far more intervention at an earlier stage. We spend most of the secondary years, Y7–11, struggling to teach much of what pupils have been taught at an earlier age; we repeat the KS3 course again at GCSE, but yet still the average attainment at GCSE is pathetically low after 11 years tuition. A grade C in

Academic and Vocational, 16-19 year olds

GCSE mathematics, for example, does not show that you have gained competence in mathematics but that you have struggled to get a respectable core on some relatively easy questions. We have such low expectations throughout the age range 11–16 and my view is that reform would be best done by adopting some form of streaming rather than the current obsession with setting.

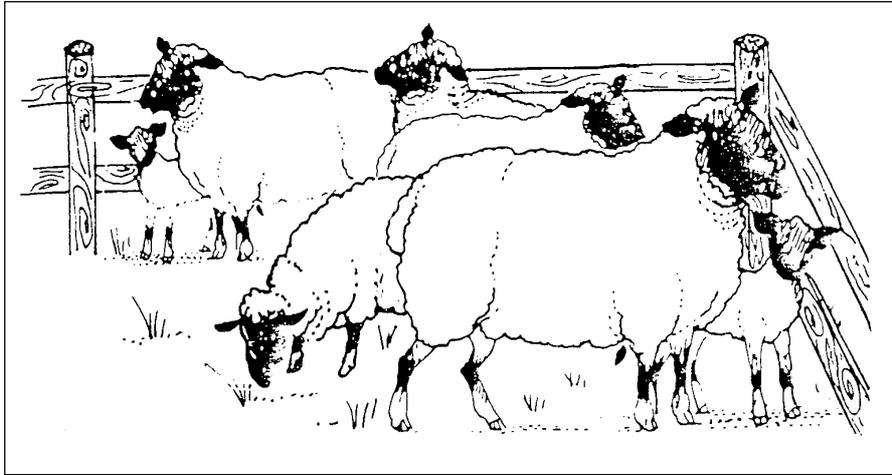
My own preference would be a streaming system inside comprehensive schools, so that academic, technical and vocational faculties can co-exist in one schools, with perhaps choice at age 14 for the appropriate faculty for a pupil. In this way pupils can take the appropriate mathematics for their talents and interests. Those in the academic stream would be able to specialise and gain a respectable foundation in mathematics, suitable to be built on in sixth form studies, matching the attainment of pupils in other countries, whilst pupils in the technical and vocational streams can take genuinely applicable mathematics.

Added to our problems in mathematics are the difficulties already experienced in getting talented and enthusiastic students to enter the teaching profession and this will be made even worse in the future by the actions that have taken place with a significant drop in the numbers taking a full A-level qualification. However, this debate has take me far from the original brief which was to compare and contrast the post 16 mathematics provision. I hope though that I have succeeded in addressing this brief, even though it has been difficult not to go beyond the remit!

Appendix 1

SCE Higher Grade Assessment

Suggested Coursework



Fencing them in

Making the best use of available fencing provides some interesting situations of investigation. For each of the situations you are asked to explore the problem to find the best solution. (This could be done informally eg by drawing or calculation.) You should try to prove that your result is correct and you should also try to generalise the solution for any length of fencing and not just for the specific numerical values given.

Note: This investigation is based on an idea from The Spode Group.

Situations for investigation

1. A farmer from the Borders is staking as many of his sheep to market as can possibly be penned in with 40 metres of fencing. What is the largest rectangular pen that he can make with this length of fencing?

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2. If he uses one long straight wall of his field as one side of the rectangle, what is the largest rectangular pen he can now make with his 40 metres of fencing?
3. Using only one 20 metre and one 10 metre section of fencing as well as the boundary walls of his rectangular field investigate the largest areas that he can now enclose with 3-sided and 4-sided shapes.
4. The farmer no longer wishes to use the boundary walls of his field but to use only four straight lengths of fencing. two 20 metres long and two 10 metres long. Investigate the largest area that he can now enclose.
5. Given only one length of fencing. Investigate the situation when two straight boundary walls are used that are not at right angles.

Appendix 2 New Zealand Y1-13 Framework

Format and Presentation of this Document

Strands

There are six main achievement aims of the mathematics curriculum. Accordingly, the curriculum statement is presented in six “strands” each of which reflects a particular aim of the curriculum. The strands are headed:

- mathematical processes
- number
- measurement
- geometry
- algebra
- statistics

This division is a convenient way of categorising the outcomes for mathematics education in schools. It emphasises that there are a number of aspects which are all equally important. The division does not mean that mathematics is expected to be learned in discrete “packages”. On the contrary, the mathematical processes strand is deliberately intended in encourage teachers and students to make connections between the other strands wherever possible.

Achievement Objectives by Levels

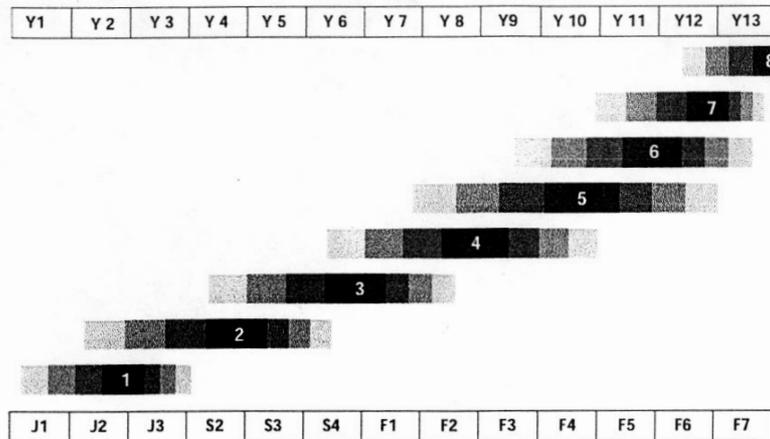
Each strand, other than “number”, is divided into eight levels describing the development of the mathematics curriculum from junior primary school (Year 1) to seventh form (Year 13).

A number of achievement objectives are described in each strand, and at each level. The objectives define what students should be able to achieve after appropriate learning experiences in mathematic. They define the progression of leaning outcomes which is the core of this curriculum statement in mathematics.

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At each level the objectives are quite broad. It is expected that, in assessing students' progress, teachers will make judgements as to an individual's degree of achievement of particular objectives and will include commentary on that degree of achievement when reporting to parents.

The number of levels has been chosen for consistency with the New Zealand Curriculum Framework. The division of the school mathematics curriculum into eight levels does not mean that there are eight well-identified stages, which learners pass through in the development of mathematical understanding. However, it is accepted that some ideas depends on a prior understanding of other ideas. The judgement of experiences teachers as to what students can do at various ages has been combined with recent research into mathematical learning to place material into levels. The general relationship between the levels and years at school is described in the diagram on the following page.



This scheme explicitly recognises that each learner is an individual whose learning development and rate of progress is different from others. Different students will be ready for particular mathematical content and experiences at different times. It is not expected that all students of the same age will be achieving at the same level at the same time, nor that an individual student will necessarily be achieving at the same level in all strands of the mathematical curriculum.

Comparing Standards

The levels are not meant to be interpreted as the rungs of a ladder which is to be climbed as quickly as possible. Nor are they meant to be interpreted as hurdles over which each student must pass before moving to any new work. Rather, they are meant to focus the mathematics programmes of schools in a consistent way. They provide a basis for reporting students' achievements to parents in a way that is clear and demonstrates progression in learning.

The number strand is divided into six levels only. Most of the important achievement objectives for number are to be met in the early years of schooling. In later years, the classification of mathematics into strands is somewhat arbitrary. Some work, for example, numerical analysis, calculus, and complex numbers, which might have been classified under "number", has more usefully been placed in other strands, for example, algebra.

Suggested Learning Experiences

In each strand and at each level, a range of suggested learning experiences is suggested. The activities and experiences which are included are drawn from the best of contemporary teaching practice, and are intended to help students meet the aims and achievement objectives of the mathematics curriculum.

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4

Language

John Marenbon

Introduction

Anyone who has studied English at A-level in England or Wales – especially if it was twenty or thirty years ago – will be likely to feel a certain sense of national pride and superiority when first looking at the examination papers from other countries testing 17 or 18-year-olds in their native language and literature. The feeling will even survive a glance at recent A-level English papers, which seem at first sight to have changed little over the decades. A-level English candidates, so it seems, are tested on their grasp of a demanding academic subject, based on close study of works of English literature, not at all unlike English as studied at university. By contrast, their coevals in other countries are, to a greater or lesser extent, tested on their aptitude in reading and writing their native languages, and on some apparently less specialized literary study.

A more careful look at the international material shows, however, that such pride is misplaced. It is by no means clear that the A-level examinations (that is, now AS and A2 papers) provide better assessments than some of the simpler types of tests used abroad, nor that what schoolchildren study for English A-levels is as intellectually valuable as the equivalent courses in other Western countries, either as a basis for further academic work in the same field, or as a preparation for other academic courses, vocational training or work. The recent changes to the form of the A-level examinations (see above p.7) do not assuage these doubts.

In order to explain the reasons behind this judgement, I shall begin by surveying the native language courses in England and Wales, and in six other countries, three anglophone – Scotland, New Zealand and the USA – and three in continental Europe – Germany, France and Switzerland. Their differences are various and interlinked, bearing on the conception of the subject, methods of examination and the choice of literary texts. None the less, they generally fit into a three-way contrast, with considerable similarities between England and Wales, Scotland and New Zealand, considerable similarities between the Continental European countries, and striking differences between both groups and the USA.

*Academic and Vocational, 16-19 year olds***Subject-matter: the balance of literature and language**

The first and most important difference is the extent to which English (or in France, French etc.) has become by this stage purely a study of English *literature* (or French *literature* etc.), or rather continues to involve, as in the earlier years of school, a mixture of language and literature. As already indicated, only in the case of England and Wales is the course devoted entirely to literature. And, even here, this position is no longer universal. Recently, as well as A-levels in English Literature, there have been introduced A-levels in English Language, and in English Language and Literature or English. The overwhelming majority of candidates, however, still take just English Literature. Across the border in Scotland, 'Highers' – the usual pre-university examination – has one literature and one language paper, with a similar sort of mix in the coursework. The Certificate of Sixth Form Studies, taken by some pupils a year later (at roughly the same age as English A-levels) does, indeed, allow students just to study literature, but they are also permitted to spend one third of their time on creative writing or media studies. In New Zealand, for university-entrance pupils study of the language is an integral, though lesser part of the course.

In France, those who choose a literary *baccalauréat* are tested both on their knowledge of the language and literature, but there is a strong literary emphasis, especially in the final stage of the course. In Germany (or, more precisely, Bavaria, since the system differs between *Länder*), there is a choice between analysing a literary text and writing an essay, often but not always on a literary subject. In Switzerland – where, of course, there are three different possible native languages: French, German and Italian – language and literature each take about half the course (although students can choose to analyse an unseen piece of literature for their language paper). The USA differs from all these countries, because it does not have any national (or regional) system of school examinations. But SATs, run privately, are widely used by universities and others, and the SATs produced by the College Board, a non-profit-making association, which are used by about 300 universities, including Yale, Princeton, Harvard, Stanford, UCLA and Columbia, give a good illustration of the system. For English it has two SATs, one in language, one in literature.

Comparing Standards

Methods of studying and examining native language

What is involved in language work in a person's native language at this level? In most countries, the aim seems to be that of gaining and demonstrating proficiency in understanding and using the language. The country where this aim is most clearly and exclusively targeted in the language testing is the USA. The test consists of a very short essay (20 minutes) on an extremely simple, non-technical subject (e.g. describe an experience which made you feel especially worthwhile). The aim is to test correct use of language, good organization and the ability to 'give pertinent support for the ideas being developed.' Two thirds of the paper, however, is devoted to multiple-choice questions. These usually require candidates to indicate which part of a sentence is ungrammatical and choose from various suggested corrections to it, or to choose which version of a sentence is best in its clarity and structure. For example, candidates are given the following:- 'Although gale-force winds often pass through the Eiffel Tower, causing it to sway no more than four inches.' They have to choose between (A) leaving it as it stands, and substituting for the underlined phrase: (B) 'and yet it sways no more', (C) 'they do not cause it to sway more', (D) 'and they do not cause it to sway more', (E) 'yet causing it to sway more'. By choosing the correct answer, (C), candidates show that they have grasped that, since 'although' introduces a subordinate clause, the second clause must be the main clause and be phrased accordingly. This question is an easy one, and 88 per cent of the candidates answered it correctly. The skill in setting these tests involves having a number of questions, of the same sort, but much harder, so that the very top marks are gained by only a small percentage of candidates.

Outside the USA, the usual methods for testing native-language competence are essays and comprehensions. Swiss students have the chance to answer essay questions such as 'Envy and being envied: discuss these two situations in relation to your personal experience' (Italian, Winter 2000) or the 'Rationing of Medical Benefits (should expensive medicines be provided for the elderly?)' (German, Spring 2000). Bavarian students are asked to write about the theatre and its relation to society today, or to respond to one of Goethe's aphorisms. French candidates are asked comprehension questions on an argumentative passage, including one which demands a reformulation of an idea in the text in their own words. Then they are given an essay based on the subject-matter discussed in the piece for comprehension.

Academic and Vocational, 16-19 year olds

In Scottish 'Highers', the language paper has two elements: an elaborate comprehension, with precise, pointed questions about two argumentative passages, and a 'report' – a factual essay that candidates must write on the basis of material they are given. For instance, they are given a variety of material – newspaper articles, letters and comments – about charitable giving and asked to write a report on the topic. Candidates must also submit in advance a piece of imaginative or discursive writing. In New Zealand, there are two aspects to the testing of language. There is a comprehension exercise, that tests both knowledge of vocabulary (what does 'an illicit thrill' mean?) and ability to analyse the style and structure of a piece of carefully written prose, but there is also a section of the paper devoted to 'Language Studies'. Candidates choose an option in the area: for example, in 1998, the language of advertising, the language of oratory, the language of conversation, 'exploring the variations in New Zealand language'. The first two options invite pupils to apply the sort of analysis usually used for literary works to non-literary texts, whilst the second two introduce them to socio-linguistics at a very elementary level.

The language studies section of the New Zealand examination, which counts for just 20 per cent of the marks, is the one element considered so far in which language study for 17 or 18 year olds is not a test of their ability to use and understand the standard version of their native language, but is designed to teach them about, and to enable them to analyse, the varieties of their language. The fairly recently introduced A-level papers in English Language for England and Wales (e.g. those issued by the AEB and by Edexcel) are entirely given over to this approach, at a considerably more sophisticated level. Pupils have to know some basic linguistic concepts and be able to understand notation designed to show the features of spoken language. Although the questions include exercises in redrafting for particular audiences, even there candidates are asked to comment in analytical terms on how they are writing. They are also asked to think about issues such as gender-bias and racism in language. The English Language and Literature course run by Edexcel has, for the most part, a rather less technical version of this sort of material for their language element, whereas the language element in AEB's English A-level is based around comprehension and essay writing.

To summarize. In the USA ability to recognize and use correct English is tested in a very straightforward and limited way. In most other countries, the more traditional, broader tests of ability to read and write – essays and

Comparing Standards

comprehensions – are the norm. In England and Wales (and to an extent New Zealand), English language work at this level is viewed as, at least in part, a basic introduction to linguistics.

Methods of studying and examining literature

There are great differences between countries both in what literature is set for 16-18 year olds to study (and to what extent there is a set curriculum, and what sort of curriculum it is), and how the pupils are tested on their understanding of it. These differences should not, however, be allowed to disguise the answer to the most important questions about courses of literary study. Is such study based around gaining knowledge of a canon of accepted literary texts? Or is it rather considered that the aim is teach some sort of literary critical skill, which can be applied to any literary work? I shall try to bring out the way in which each country has answered these questions, and at the same time indicate the different methods used for examining candidates on literature.

There is just one country which has no set element for literature, the USA. (The information I have been given for Bavaria does not make clear whether the examinations are on set texts or unseen material, and so I am excluding it from the discussion of literature here.) It might seem that, therefore, what is being tested is a skill, rather than a knowledge of a literary canon. But this impression is to some degree misleading. In the USA, at least to judge from the widely used College Board SATs, literature is tested by giving candidates a short, unseen extract. Although there is no curriculum, and candidates are not expected to have read the pieces set before they encounter them in the examination, the choice of the harder extracts for discussion seems to be made from recognized great works in the literary tradition and, as the handbook for the SATs advises, the best preparation for the questions is wide reading of English literature ‘from a variety of historical periods and in a variety of genres’.

The method of testing literature in the USA in the SATs is, as for the language tests, by multiple-choice questions. Some of these questions are very easy and are more akin to the comprehension tests children elsewhere might be expected to do at a younger age. Some do, however, provide a reasonably hard test of ability to understand complex poetry. For instance, pupils are given Donne’s sonnet ‘Poor soul, the centre of my sinful earth’ and, among other questions, have to select to which of five alternatives the line

Academic and Vocational, 16-19 year olds

'Painting thy outward walls so costly gay' refers – (a) camouflage, (b) writing poetry, (c) attending to physical appearances, (d) pretending to be happy, (e) preparations for a celebration. Careless readers might well fail to choose the right answer, (c). But – and here is the great problem about most multiple-choice tests – an intelligent and thoughtful reader might choose (b), and lose marks for answering wrongly, although he would have been giving evidence of greater skill as a reader than the candidate who gave the preferred answer.

In Switzerland, the literature test in a candidate's first language (which might be French, German or Italian) is based on a long list of texts which seems designed to give a canon of accepted masterpieces of all periods, from the Middle Ages onwards. So, for instance, the list for Italian includes Dante's *Commedia* (from which a candidate would be asked to select five cantos), Petrarch, Boccaccio, Ariosto, Machiavelli as well as a host of more modern writers; the German list has (among nearly 200 authors) Walter von der Vogelweide, Goethe, Schiller, Hölderlin, Lessing and Heine; the French begins with Chrétien de Troyes and goes on, through Montaigne and Ronsard, to Racine, Molière, Corneille and a plentiful selection of eighteenth and nineteenth-century authors. In all the languages the list of authors from the twentieth century is particularly long and includes, not merely undisputed great works, but also some lesser, though esteemed, compositions. Candidates have to choose six works for study. The regulations binding their choice vary between the languages. For German-speakers, no more than two works can be picked from any one broad chronological period, and the selection must also include two plays and two narrative texts. There do not appear to be such restrictions for French-speakers, whilst Italian-speakers are not even bound to choose works from the list of set texts. Literary studies are tested in Switzerland by oral examination. Each candidate is given 20 minutes, and a further 20 minutes before the oral text to prepare his answers. The examiner picks one from among the six works that the candidate has prepared, but also asks about one or more of the others. The candidate has to read from and then analyse an extract of the text and answer questions about its relation to context, and the historical, philosophical, psychological and stylistic aspects of the whole work.

In France, those who choose a literary *baccalauréat* should, from the instructions given to teachers as well as from the requirements of the examination, have studied a selection of the great literature in the language from the 16th century to the present day. For example, the programme of studies for the first year unashamedly lists a canon of great texts from the

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18th – 20th centuries (the earlier writers are to be studied the next year), including works by Diderot, Beaumarchais, Voltaire, Balzac, Michelet, Stendhal, Proust, Beckett and Sartre. Although this list is given as an example, it seems clear that pupils are expected to study the recognized great works of the literary tradition, and to consider works from different periods and in a whole variety of genres. The method of examination is part written (with general questions about the form and historical and aesthetic importance of the texts, more precise questions about themes, technique and characters, and questions involving comparisons between different texts) and part oral.

In the three Commonwealth, anglophone countries – New Zealand, Scotland, and England and Wales – literature examinations (which are written tests, with extensive answers that have to be carefully marked, not multiple-choice questions that can be mechanically assessed) involve two main elements. One is ‘practical criticism’ – commentary on an unseen text, which may require answers to precise questions, or may demand, rather, an extended discursive examination of the piece in question. The other element consists of posing questions about a small range of texts or setting extracts from them for commentary.

In New Zealand, candidates are given a highly directed practical criticism exercise, which has in it some elements of comprehension: it is as much a language as a literature test. They are then tested on one set Shakespeare play (chosen from five). Either they must answer an easy question about a passage or address an equally easy essay question. For instance, for those who have studied *Much Ado about Nothing*, an exchange between Beatrice and Benedick is printed and the candidates are asked to use it as a starting point for discussing the relationship between these two characters. Alternatively, they can discuss whether the play’s title ‘adequately describes’ its subject. Finally, the candidates have to answer essay questions – which are, necessarily, very broad – on whatever text they have studied (there is no list of set-texts) in two genres. The genres include drama, poetry, the novel, short story and non-fictional prose, and also film. For one of these essays, they may substitute an essay on a more theoretical theme: for example, on how literature can help people to understand other cultures, on women’s writing, or on the issues of particular concern at some period to New Zealand writers.

The literary part of Scottish ‘Highers’ is, at first sight, remarkably similar to that in the New Zealand examinations, although the structure of

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the paper is rather different, with some important consequences. The elements are, as in New Zealand, practical criticism of a highly directed sort, passages from set-texts for commentary and rather general essay questions that can be answered about any text with a particular genre the candidate has studied. The set-texts are not, as in New Zealand, limited to plays by Shakespeare, but range from *Romeo and Juliet*, a selection of Burns's poetry and a Victorian novel to five pieces of second-rate or worse twentieth-century literature. Candidates choose either to answer on a set-text – where they must answer precise questions about a passage that is printed – or to tackle the practical criticism. For their essay, they choose to write on one out of poetry, drama, prose and Mass Media. Candidates are also required, in addition to the examination, to submit a 'review of personal reading' – an essay of 1000 –1500 words on texts of their own choice they have been reading. The differences in the structure of the Scottish examination from that in New Zealand mean that a Scottish pupil can easily avoid studying any work of literary substance, whereas New Zealanders have, at least, to have worked on a play by Shakespeare.

Scottish teenagers who stay on to do the more advanced Certificate of Sixth Form Studies have to take a paper and also submit a dissertation. The paper demands three essays on questions, chosen at the candidate's will, on a list of set authors, which include some of the most important English, Scottish and American writers (for instance, Chaucer, Henryson, Shakespeare, Coleridge, Austen), and some moderns, such as Seamus Heaney and Tom Stoppard, light weight but not utterly negligible by comparison with many of the contemporary authors cheerfully set by anglophone examiners. The dissertation, of 3000-4000 words, may be on any texts the candidate wishes, so long as Board agrees that they are 'of sufficient literary and/or linguistic interest to merit serious study'.

A-level in English literature (and the literary element in the English/English Language and Literature examinations, which I shall not consider separately) in England and Wales reflects the same intellectual assumptions as the examinations in New Zealand and Scotland. The main difference – and it is a characteristic of almost every aspect of assessment in this country – is in its vastly greater complication. Some boards have a multiplicity of units into which assessment is divided; some have a mixture between examinations and coursework. There are complicated rules to determine how these elements fit together and how they are to be weighted. The recent changes to the structure of A-levels, which are now divided into

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AS and A2 examinations, have further increased the complication and the differences between the courses taken by different candidates for the same qualification. In essence, however, candidates have to do practical criticism, of a far less directed sort than in Scotland and New Zealand, and to answer essay questions on a set Shakespeare play and on other set books. The set texts include both recognized great works from the past (for instance, poetry by Chaucer, Milton, Donne and Browning; plays by Jonson and Marlowe; novels by Defoe, Austen and Hardy) and usually second-rate modern writing. There is also an element in the syllabus designed to broaden pupils' reading beyond these set texts. For instance, AEB has a thematically based paper, in which pupils can choose from subjects such as 'Black America', 'Twentieth Century Women's Writing', 'Satirical Writing' 'The Short Story'. Each theme has its own set texts, which are mostly works of little literary value. The agreed 'core', accepted by all the examination boards, for English literature, is simply that pupils will study at least one work of poetry, one work of prose and one work of drama, one of which was written between 1370 and 1900, and also a play by Shakespeare. Just that – though some boards tighten this general stipulation slightly: for example, by insisting that candidates should study at least two works from before 1900, and at least one more from before 1770, as well as a Shakespeare play.

It is symptomatic of the general approach to literature in the English system that a new examination, AEA, designed to provide a test for the brightest 18 year olds more rigorous and selective than the A-levels, will not demand any extra reading or knowledge of the history of literature. Rather, candidates will be tested on their abilities in dealing with unseen extracts from texts.

To summarize. There is a stark contrast between the two continental countries examined (France and Switzerland) and the anglophone countries other than the USA. The continental countries accept implicitly or explicitly the idea of a canon of great literature, which should be studied by 16-18 year olds in their literature courses, and they test candidates in a fairly simple way. The anglophone countries do not accept the idea of a literary canon, although they do insist that Shakespeare is studied and usually encourage a little work on pre-modern English literature. They test candidates in an elaborate, complex manner. The USA contrasts with both groups. The idea of a literary canon seems to be accepted, but there is no mechanism to ensure that schoolchildren are introduced to it. The tests, though difficult to

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set, are quickly taken and require no specific preparation by the candidates; they will quickly show up incompetent candidates, but are too crude, because excellent candidates may well score low marks.

A Comparative Assessment

Clearly there can be no question of comparing standards between the different countries. Not only are the content and methods of examination very different; so too are the apparent aims served by the courses of study in the various countries. It is, however, possible to reach a judgement about the defects and merits of different courses and types of examination and so to answer the question which, for most readers in England, gives point to an international survey such as this. What can we learn here from the example of courses and examinations abroad? How can teaching of English at A-level be changed for the better?

One peculiarity of England and Wales is the lack, in the A-level taken by the vast majority of candidates, of any language element: they are examined just on English literature. Is this an advantage or a disadvantage of the system? It is sensible that able and literate 18 year olds are not bothered by extensive preparation for a test of basic abilities in their own language – abilities they should have gained long before. But few 18 year olds, alas, are able and literate, even among those who specialize in English at A-level. Moreover, there is a need for a test of ability to use and comprehend English, more rigorous than that at GCSE, which can be taken by a whole range of A-level candidates, not just those who make English one of their chosen subjects for specialization.

The introduction of separate English Language, and English Language and Literature/English A-levels has not been a good way of tackling this problem. The combined English Language and Literature or English Language examinations suffer from shallowness as a result of trying to fit too much into a single course. The English Language A-level course offers candidates a mixture of supposedly practical skills in using English and a superficial introduction to linguistics. It is doubtful, however, whether classroom teaching of how to write English for various purposes – advertising, for instance, or journalism, or an official report – is ever very effective; far better to learn such skills, if they are needed, in practice. Moreover, the presence of such an element within an A-level syllabus muddles what should be an academic examination with vocational training, debasing the academic

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without producing any worthwhile vocational result. As for the more theoretical element, pupils are not in general in a position to study linguistics in the depth that would make the pursuit worthwhile. They would do much better, if they have a serious interest in language, to spend their time at school learning well a number of foreign languages, modern and ancient.

Perhaps what is needed is a test of literacy that would not require special preparation, and could be taken before the main A-levels. A model is suggested by the multiple-choice SATs in the United States. The great advantage of this method of testing, besides its speed and simplicity, is that concentrates firmly on how well candidates can use language and how precisely they read it. Multiple-choice examinations are sometimes unreliable, because the chosen answer is not the only one that should be judged correct. But this is a technical problem, which intelligent and canny paper setting could avoid.

A-level English Literature candidates seem to enjoy the advantage of taking an examination devoted entirely to literature, but their gains turn out to be illusory, because the A-level courses have been designed according to a view about the nature of literature which, arguably, is false (and which has had less influence in France, Switzerland or the USA). According to this view, becoming a good reader of literature is a skill that can be learned apart from knowledge of works in any particular literary tradition. Since it is believed that young people are more likely to respond to fairly recent works, and to works that are undemanding, a large part of their study is given over to works of little literary merit, written in the last few decades (most of the modern works of merit, and they are few, are highly demanding, and so not set). A Shakespeare play, a Victorian novel and perhaps some Romantic poetry may give candidates a slight indication of the riches of their literary heritage. But nothing in the syllabus encourages, let alone enforces, the careful study of the great works of the past, from the beginnings of English, period by period, until modern times. Yet without study of the literary canon, literary taste cannot be formed. The candidates are left at the whim of fashion and of their personal reactions and attitudes. And they are unprepared for the serious historical study of literature in its context, which is the only justification for specialized courses in literature at university.

It is no accident that, in those countries where a canon of great works is unashamedly acknowledged – that is to say, France, Switzerland and also

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the USA, where no canon is announced but one seems to be presupposed, the method of examining literature tends to be much simpler than in England and Wales (and in Scotland and New Zealand, where the approach is similar). On the view which, rightly so I would contend, sees literary understanding as based on acquaintance with a canon of great works, complex methods of testing response to literature are unnecessary; indeed, what they are seen to measure is merely the acquisition of a technique for writing about other writing that neither establishes truths of literary history, nor fosters literary taste. All that can sensibly be tested is that pupils have read a number of works slowly and attentively, looking carefully at the details of their grammar, rhetoric and literary form. Literary taste itself cannot be assessed in an examination, and is in any case unlikely to be more than inchoate in an 18 year old.

The courses and tests in France and Switzerland are by no means ideal, and the SATs in the United States, although leaving open the possibility for sensible and wide-ranging teaching, do little to enforce the wide reading in the literature of many periods which they advocate. There is room to wonder whether study of literature in one's own language should be a main topic for 16–18 year olds. None of its aims is achieved so well as it would be by the discipline of studying Latin or Greek, or even the literature of a modern foreign language. None the less, the present A-levels in English Literature could be much improved by looking to the examinations set in France and Switzerland, or even at the US SATs. Such improvement could not, however, take place without the co-operation of government. The complex assessment objectives and criteria imposed by government on the examining boards make it impossible, at present, for anyone to draw up an A-level English Literature syllabus that would aspire to the superior cultural level of our continental neighbours.

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5

History

Robert Tombs

Knowing more about less

The history courses sampled announce similar aims: to provide knowledge of the past, understanding of processes of change, and insight into methods of analysing historical evidence. But differences of emphasis and approach are enormous. On one hand are those that require systematic *breadth* of study (particularly Switzerland and the United States as well as several European countries not covered in our sample such as Italy). On the other are those that teach *specialization* (particularly England and Wales, Scotland and New Zealand). This difference is paralleled by a relative emphasis on *knowledge* (factual and conceptual) in the former case, and on *skills* in the latter. These contrasts are reinforced by methods of examination. In the 'breadth' model, candidates may have a restricted choice of questions to answer or alternatively be required to answer a large number of questions. In the 'specialization' model, they have an extensive choice of questions from which they select a small number to answer at length and/or they may submit project work of their choice. Other countries, notably France and Germany, lie in between.

Switzerland provides a good example of a coherent syllabus explicitly based on breadth of knowledge. Students are required to study one topic chosen from ancient and another from medieval history, but the core of the syllabus covers European (including British) history from the Renaissance to the present day. It is structured thematically as well as chronologically (for example 'The Age of Revolution' and 'The Century of Ideological Confrontation') so as to permit concentration on major historical problems and concepts rather than mere narrative. It also goes beyond the boundaries of Europe when necessary, including America and the Third World. The examination system (similar to that in other continental countries) seems particularly rigorous in its requirement to master the whole syllabus: it includes an obligation to draw a single question by lot, and be examined on it orally, as well as being questioned generally at the examiners' discretion. The aims of the history syllabus are clearly articulated: to provide a

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necessary part of 'l'éducation citoyenne'. The Swiss concept of the education of its citizens requires a knowledge of key developments in Swiss history set within the general development of European and world history. This approach seems to be influenced by both French and German traditions of education in the humanities, though carried out to a degree that few school systems would find easy to equal.

The American syllabus embodied in the independent SATS examination system does not articulate such general aims, but it does demand a considerable breadth of knowledge on the part of successful candidates, while allowing latitude to schools in the precise syllabus and teaching methods. They have a choice of an American or a World History examination, the former covering the history of the country from pre-Columbian times to the present, and the latter containing 95 multiple-choice questions on a very wide range of topics from Ancient Egypt to the Twentieth Century. It is common in British circles to scoff at multiple-choice questions. However, SAT history examinations (formulated by professional history scholars) show that these can require a sophisticated level of judgment and interpretation of evidence that would challenge many A-level trained British undergraduates. For example, to identify a legal issue not pronounced on by a certain Chief Justice; to recognise the country of origin of the anonymous author of a political declaration; to interpret statistics; to recognise the style of a work of art. But the main feature of such a system is that it tests the extent as well as the depth of candidates' knowledge, which essay-based examinations cannot do.

The greatest contrast with this approach is the English system, though those drawing on a similar educational tradition (Scotland, New Zealand and other British-influenced countries not included in our sample) are similar. One element of the present A-level course consists of a chronological period, usually of only one or two hundred years, which is examined by a one and a half hour essay paper (formerly three hours). The chronological period is fairly short by international standards; moreover, though it can cover European history, candidates may choose to study only Britain, or indeed only certain types of British history (such as social or economic). Moreover, the questions and format are such that only a partial or schematic knowledge of the syllabus is required. The explicit intention in the AS-level is to cover less material at less depth so questions require coverage of 'rather less of the subject content'. The new AEA is not designed to alter these characteristics. The other elements of the English system are

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coursework and individual projects on specialized topics, which do not have to be related to other parts of the course.

Another striking feature of the English and similar systems is the explicit emphasis placed on the acquisition of 'skills'. These include the writing of short essays and of longer individual projects (of up to 4,000 words), and also facility with source material broadly interpreted as 'any material produced during the historical period being studied'.

The in-between cases – notably France and Germany – focus at this culminating stage of secondary schooling on a fairly narrow period (the 19th and 20th centuries, or only the 20th), but it must be stressed that this follows a systematic study of earlier periods in preceding years, as indeed is common in other continental systems. Although there is a degree of emphasis on the history of their own countries, this is set in a broader world-history context. The French examination system shows a distinctive style (which has deep cultural roots) in that it stresses the logical organization and presentation of data and ideas rather than argument or searching interpretation. The German system is a diverse one, as the *Länder* have their own variations. Taking the example of Bavaria, students when examined have to choose work-sheets relating to two out of four periods within the history of the 19th and 20th centuries, and to complete these by commenting on a text or other piece of evidence (e.g. a statistical table) and also by answering a series of fairly sophisticated detailed questions.

Judged within this comparative context, the most problematic features of the British A, AS and A2-level and Highers syllabuses are the limited range of knowledge that they impart, and the decontextualized, fragmented and amorphous nature of that knowledge. 'The emphasis ... is upon history as an approach to, rather than a body of, knowledge.' The epistemological assumption seems to be that a borehole of detail will bring the student into contact with the genuine historical coal face; it seems not to matter much what it is that is known. Hand in hand with this approach is a utilitarian emphasis on 'skills', seen as an end in themselves rather than as a means to historical knowledge and understanding.

Both intellectually and practically, this combination is open to fundamental criticism. First, specialization, fragmentation and decontextualization. I doubt that any professional historian regards specialization as a virtue in itself, as opposed to a practical professional necessity. It is difficult to see why specialization is beneficial to adolescents who are not and will not be historical researchers. The Scottish Examination

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Board offers candidates the prospect of becoming 'an expert in your particular field of historical study': this is certainly true in the proverbial sense of knowing more about less. Moreover, this level of specialization implies - and the practicalities of the examination system require - decontextualization, for no chronological or geographical perspective is or can be acquired. The 'expertise' is thus intellectually sterile.

Second, the emphasis on skills. The use and interpretation of evidence as required for A-level examination may impart useful skills, but they bear small resemblance to genuine historical research. The impression given is that historical documents provide simple answers to simple questions; whereas in reality their meaning is often indeterminate, complex and only comprehensible in the light of other evidence and existing knowledge. The long coursework essays, again, though they sometimes produce impressive work, do so at the cost of absorbing a great deal of time and further narrowing the perspective - what is commonly called 'the Hitlerization of A-level history', after the most popular choice of topic. Yet individual projects of this kind are in most cases inevitably based on a very limited range of secondary reading, usually of textbooks available in school or local libraries. The teaching of historical skills also emphasises differing interpretations - again a useful insight. But the stress in the syllabus seems to be on the (usually minor and ephemeral) debates among present-day professionals. More fundamental problems of knowledge, truth and relativism appear to be absent. Broader intellectual skills associated with the study of history - such as the ability to conceptualize, to synthesize, to comprehend the unfamiliar and to make critical comparisons - seem possible under these conditions only to a very limited extent.

Taken together, these features provide a very impoverished historical education, in spite of the best efforts of teachers and students. Its virtues are clear: it provides a fairly detailed level of knowledge of a narrow range of topics, and training in essay writing and elementary interpretation of sources. These are not negligible acquisitions. But the price paid for them is high. It is hard to imagine a mathematics course in which students were allowed to solve any three equations of their choice; or a chemistry course consisting of a simplified version of professional training in pharmacy. Those students who read history at university will (eventually) undertake specialized study and experience research methods. At best, A-level anticipates in simplified form what they will do again. It is not insignificant that the History Faculty at Cambridge, for example, one of the largest

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history departments in Europe, does not require A-level history as an entrance qualification. And what of the majority of students who will not read history at university?

The question that comparing these syllabuses gives rise to is 'why study history at school?' Is it to acquire a necessary foundation of common culture, and some understanding of the characteristics and workings of one's own and other societies - that 'éducation citoyenne' prized by the Swiss? Is it to acquire at a rudimentary level the specialized knowledge and practical skills of a professional historian?

The answers that different countries and education systems give, implicitly or explicitly, to these questions are themselves deeply influenced by cultural traditions and political ideas; by the relative value given to written or oral expression; by empirical or theoretical habits of mind; and probably not least by pedagogical routines, teaching capacities and systems of examination. In the British systems, it nevertheless seems a reasonable request in the first instance that further narrowing of the range of study (for example at AS-level) should be reversed, and that the emphasis on 'skills' should be kept within bounds. It must be hoped that the proposals outlined in the Green Paper *14-19 extending opportunities* raising standards will be flexible enough to make this change of direction possible.

A fairly simple means to these ends would be to introduce an element of testing on the SATS model, which would encourage and reward breadth and accuracy of knowledge, and not only a worm's-eye view of history. Other advantages might include a simplification of the curriculum and the examination system, and consequently greater freedom for teachers and students. An approach to history that encouraged wider reading and broader awareness would, I believe, provide a better preparation for life, work and further study.

6

Electronics

Herbert Lutz

Introduction

This study compares the standards of vocational education and training in Electronics in the UK with those in Switzerland, Germany, France, the Netherlands, New Zealand and the USA. The difficulty of a comparative approach is that the content and structure of the vocational routes and qualifications differs greatly. Germany and Switzerland, for example, offer a system of dual training carried out in industry and college - with the syllabus set by industry and the exam based on knowledge acquired by work. In the UK the National Vocational Qualification route is college or centre based. Different definitions of the Electronics profession are reflected in the contents of curricula and examination papers. In some countries, such as Germany, there is a variety of qualifications within the entire field of Electronics. The NVQ/SVQ system in the UK and Scotland has a single qualification structure divided into levels. Moreover, entry and requirements vary by qualifications and level of knowledge.

This report does not, therefore, draw direct comparisons, but considers the professions, their contents, and certificates individually, providing a technical and objective appreciation and judgement. The report does not examine school preparation, although it may be of significance when comparing the dual training systems (Switzerland and Germany) with the curricula of all the other countries.

Switzerland

The qualifications considered are:

- Elektroniker/ Elektronikerin
- Modell- Lehrplan Elektroniker/ Elektronikerin
- Elektronikmonteur

Switzerland operates a four year vocational dual training system which is divided up into vocational education in the *Berufsschule* from age 15-17 (a specialised college) and firm regulation for practical training. Curricular

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targets are flexible. The theoretical examination is the responsibility of the cantons and individual practical examinations take place at an industrial workplace. There are two parts: the first practical and tested in employment, the second tested in school; and both are put together for the qualification. Candidates can only take the exam if they have trained for four years, spending four days in work and one day in school.

Students choose between two levels. The higher level involves an additional number of hours at the *Berufsschule*. About a third of the education and training programme consists of technical English, open training and general education. There are few differences in the area of computer science between the two levels, whereas there are clear differences in other subjects such as mathematics, general natural science and technical subjects.

The possibilities for employment in the field of Electronics are very limited without the necessary vocational leaving certificate and it is a precondition for a vocational qualification in the field. Qualification as a *Meister* (master craftsman) is required for self-employment.

England, Scotland and Wales

The qualifications considered are:

- NVQ (National Vocational Qualification)/ SVQ (Scottish Vocational Qualification) in Electrical and Electronics Servicing Level 2;
- NVQ (National Vocational Qualification)/ SVQ (Scottish Vocational Qualification) in Electrical and Electronics Servicing Level 3.

Unlike the training systems in Switzerland and Germany, where the exam is practically based and later judged by examiners chosen by the trade, NVQ/SVQ qualifications are based on standards prescribed by the industry and relate to skills and capacities. There are obligatory and optional units with the focus on vocational practical work such as diagnosis of errors, installation of products and the needs of consumers. A certificate is awarded on completion of the qualifications.

The individual skills and capacities attained are to be demonstrated in detail within a clearly defined plan. Training is usually college or centre based and targets are clearly defined by NVQ. Included in these are 'additional knowledge foci' from the working environment. Customer

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orientation is clear: the technical contents focus on the finished product (the service and repair process).

The NVQ/SVQ qualification process is strongly orientated around very formal and detailed assessment of the training components and characteristics, in contrast with Germany and Switzerland.

Germany

The qualifications and material considered are:

- Curricula guidelines for the *Berufsschule Fachklassen* - Vocational College (technical classes);
- Informationselektroniker/ Informationselektronikerin - Informationelectronics (Bavaria: Curricula for Vocational Qualification in Information and Telecommunicationssystem Electronics);
- Elektroniker/ Informations - und Telekommunkationssystem-Elektronikerin- Electronics/ Information and Telecommunicationssystem (Germany).

In German-speaking countries, e.g. Germany and Switzerland, vocational training and education is conducted in a system of dual training. Training is carried out in the work place (in a company, business, etc.) for four days per week and trainees attend a vocational college for 1 day per week. The course lasts for three and a half years and the examination is done in the work place and *Berufsschule*. The academic focus is on the technical qualification in arithmetic and technical theory as well as on other vocational subjects (technical design, construction, etc.). The first exam is taken after the first year. The basis is then broadened over the next two and a half years and the final vocational test is complemented by the general middle school test. German and political and social studies complement the timetable, making up about one third of all available courses. However, they cannot be compared to the other countries studied in terms of breadth and intensity since they are only offered for 1 hour per week. Foreign Language teaching takes place to improve English.

After passing the intermediate qualification test, including Maths, technical drawing and a practical test, at the end of three and a half years training trainees take the '*Gesellenprüfung*'. This is the standard exam for receiving this vocational qualification. The higher qualification leading to a *Meister*

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(master craftsman's diploma) involves several additional years of training, including proof of appropriate practical competency and qualification.

The theoretical requirements for the '*Gesellenprüfung*' are based on the curricula guidelines of the *Berufsschule*. Practical standards are specified in the compulsory training guidelines. Workplaces also receive guidelines for the content of the training. Although the *Berufsschulen* do not have a direct influence on the organization of vocational examinations, their examination is a precondition for a qualified vocational occupation.

Currently, new curricula plans and regulations are being introduced and classes will orient themselves along '*Lernfeldern*' ('learning fields'). There will be a gradual detachment from rigid curricula plans consisting of individual subject courses, and an extensive linking up of curriculum contents. There will be a change from subject based teaching to project based, which will bring together a number of subjects in one project.

France

The qualification considered is:

Brevet d'études professionnelles Electrotechnique (college based).

Vocational training and education advances through levels of higher (theoretical) standards from around age 16. There are 115 establishments for education and training in the electronics profession. The compulsory learning components are specified in the curriculum. Vocational technical knowledge is divided up into:

- Basic electrical engineering and experiments including measuring technique experiments (with a strong weighting);
- Transmission of electric energy;
- Utilisation of electric energy;
- Basic installation technology;
- Electrical energy activities;
- Electrical control systems;
- Security regulations;
- Economy aspects and technical preconditions;
- Tagging and sign-posting, communication, and management;
- Design.

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These areas have very different weightings depending on content. The curriculum also includes general subjects, for example:

- Native language including history and geography;
- Other modern languages;
- Mathematics and physics;
- Society, social structures, and life sciences;
- Arts;
- Physical education.

These make up about 40 per cent of the curriculum. They are examined in both written and practical tests - with ten hours practical and eight hours written, although this can be broadened for French, mathematics, physics and foreign languages. 'Additional modules', can also be chosen. The examinations are held by a jury at the educational establishments.

The Netherlands

The qualifications and curricula guidelines considered are:

- Het examenprogramma Elektrotechniek;
- De examenbeschrijving Elektrotechniek;
- Het gemengde programma Elektrotechniek.

These programmes are college based. The guidelines cover training in the following subjects: basic electronics, electronics and automation, telematics (*Telematik*) and installation technology and mechanical engineering. The curricula offer a very detailed list of compulsory skills: 20 different subject areas (such as information technology, electrical installation, special electrical switching and computer aided design) and '*Lernfelder*' (learning fields). There are three standard levels. Full examination guidelines are given for the examiner.

Unlike the German programme, the Dutch training involves a general or basic electrotechnical training rather than a training in electronics. Nevertheless, the subject focal points in electronics take up a considerable part of the training (such as computer aided design and automation and electronics). The preamble of the examination programme states that candidates are also to acquire skills related to one's occupation, for example communication and learning ability. These are common, but not universal.

Academic and Vocational, 16-19 year olds

The school examination consists of a written and a practical part, along with a central examination. The theoretical demands set for the Dutch qualification are higher than the ones for the German and Swiss dual system training. The curriculum splits up single areas (such as electrical installation).

USA/ Florida

Since most states delegate the operation and much of the policymaking in education to local educational districts, the courses and titles of qualifications vary. Therefore, for the qualifications, Politeia took as an example the Vocational Curriculum Framework and Qualifications for Electronics Technology in the State of Florida.

Vocational education in Florida is school-based with an industrial outlook, 'industrial education', and a clear emphasis on 'electronics'. The curriculum content is at the same time limited. All the key areas of a specialised training in information technology are covered and there are many detailed objectives. A prescriptive curriculum, including the formulation of single subjects, is set up for the training. Qualifications can also be gained at work.

Trainees can choose between different specialisations within the framework of the whole training programme: for example between 'electronics technology' and 'electrical trades'. The training for electronics technology emphasises technical processes especially in abstraction and theoretical understanding. Both training paths follow a course structure. The electronics technology course prepares candidates to be electrical engineers, whereas the electrical trades course prepares candidates for an occupation in manufacturing and production. In this way, the course curriculum framework and training contents differentiate between occupations in the service sector and those in the production sector.

Certificates can be obtained at each level. The entry qualification is the 'Associate' level. This is attained either by following a college-based route or through a combination of practical professional occupations and training courses in electronics.

The examinations are carried out at a higher (privately organised) institution and the certificates are recognised by industry. The examinations are subject to fees, although targeted encouragement, promotion and funded support is provided by associations and corporations. To what

Comparing Standards

extent this takes place and which elements of a targeted exam preparation are made available is difficult to determine. The content of the examination is defined in very broad terms. The curricula guidelines and examination papers indicate that the vocational qualification attained is not structured around a work placement or organised in co-operation with industry.

The USA has a greater variety of course structures for vocational qualifications and considerable variation within the individual states.

New Zealand

After attaining the 'New Zealand Certificate' at age 16, students can choose various routes towards vocational qualifications. There are two different levels (A and B) for different electrotechnical occupations. The vocational qualification structure distinguishes between electronics, telecommunications and (basic) electrical engineering. For these qualifications detailed curricula and clearly defined training contents and guidelines are provided. The timetable for the main subjects contains not only the number of school hours but also defines exactly what percentage is to be spent, for example, on practical work, on preparation and on revision and exams.

The examination papers accurately follow the guidelines. There is a clear difference between Levels A and B: for example, in the examination paper for electronics between the quantity (number of questions), quality and theoretical abstraction. Within the different levels additional qualifications are offered - though partly at a very high level - which follow a modular structure.

From the material provided it is not clear what preparation is possible for the 'Certificate-Examination'. The curricula only concentrate on the technical content; other qualifications are not described. Similarly, there were few indicators about how skills and capacities resulting from practical work are assessed or their relevance for examination.

Conclusion

The individual countries considered implement an array of different vocational training and qualification routes. The requirement criteria differ considerably between countries. The training leaving certificates (with respect to content) are virtually incomparable.

Academic and Vocational, 16-19 year olds

Only at a basic level would the leaving certificates provide comparable occupational opportunities, though in different professions and employments. The same does not apply to higher qualifications where the requirement criteria deviate to a considerable extent from each other.

In general, basic electrotechnical knowledge is provided in almost all countries in equal breadth and intensity (with slight deviations in focus). The exception is Germany where a higher vocational qualification (electrician's profession) is provided.

For a more uniform comparison of the qualifications of the individual leaving certificates, compulsory standards would have to be determined. Then, on the basis of the curricula, the evidence for having a certain training level could be determined.

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7

The Chef's Profession

Shyam Patiar

Summary

The hotel and restaurant industry is one of the most significant industries in the UK economy employing 1.78 million people in Great Britain, which is 6.3 per cent of the total Great Britain workforce.⁵ It is anticipated that 300,000 new jobs will be created between 2000 and 2009.⁶

Training and development of the workforce is key to the success of the industry and can directly influence whether a business survives. The employment of young people adds to the vibrancy and 'trendy' factor of establishments appealing to that customer base. This is an aspect that must be capitalised on by young people, particularly those that choose the vocational route. The industry must also play its part, in offering reasonable remuneration packages and working conditions to attract and retain people, alongside considered personal training development programmes.

Qualification Structure

In the UK, the qualifications are not transparent and lack consistency. The curriculum content is narrowly focused with no depth of understanding or application of technical knowledge and little development of practical abilities.

The qualification structure has been a competency based model since National Vocational Qualifications (NVQs) were introduced in 1988. In reality, NVQ is a system of accreditation and the biggest advantage of this system has been to award qualifications to those chefs in industry who probably would never have attended college or have had their many years experience recognised. The qualification is supposed to be a nationally recognised qualification and it should have national credibility. The same qualification can be attained by a trainee as a full-time student at a further education college, as a work based trainee in the industry or as a National

5 *Labour Market Review, HTE, 1999.*

6 *Skills and Employment Forecasts, HTE, 2000.*

Comparing Standards

Trainee/Modern Apprenticeship in industry but attending further education college on a part-time basis, at least one day per week.

At the moment, there are very few opportunities for trainees to extend their skills to achieve NVQ Level 4 or Master Craftsmen Award. The NVQ system is based on observation rather than teaching. The assessment of competencies in different establishments are based on 'house standards', which may vary from one institution to another.

In France, Germany, Switzerland and even in the USA the qualifications are clearly structured with greater depth of understanding, knowledge and application in the development of practical skills.

Entry Level

In the UK, entrants joining industry to be chefs are not given adequate opportunities to continue their education and training. Most of the young people aspiring to be chefs join the industry at the age of 16 and carry out their training alongside full-time employment. This leaves insufficient opportunity for education and training from employers. The mode of delivery is work-based training and the employees are registered as National Trainees or Modern Apprentices.

In other European countries such as Germany, Switzerland and the USA, the majority of young people do not enter into full-time employment till the age of 18 or 19 years. There is an allocation of time for these youngsters to attend vocational schools on a part-time basis for one or two days per week to gain further education and training.

There are some entrants to the chef's profession who join full-time educational programmes in further education colleges and achieve NVQ qualifications. Unfortunately, the retention rate on NVQ Level 3 and Level 4 is very low as many of the trainees obtain full-time employment after achieving NVQ Level 2. These trainees supposedly continue as Modern Apprentices on NVQ Level 3 programmes. The total number of NVQ Level 3 and Level 4 awards (7,950) represents only 9.44 per cent of total awards made for NVQ Level 1 and 2 (84,217) before September 1999.

In my opinion, it should be a legal requirement in the UK for employers to provide education and training to young people employed at the age of 16 years until they achieve at least Level 3 standard. It is not surprising that only 5 per cent of the total NVQs awarded were delivered by industry.

*Academic and Vocational, 16-19 year olds****The Industry's Image***

In the UK, the industry does not attract the appropriate calibre of young people to join the chef's profession. The hotel and restaurant industry has a serious problem of recruitment for the chef's profession because of a poor sector image, which acts as a barrier to attracting the best recruits. This is not helped by the view that vocational qualifications are not valued in the same way as academic qualifications. The introduction of Curriculum 2000 in September 2000 was expected to provide 'parity of esteem' to vocational and academic qualifications. Unfortunately, the number of young people opting for vocational qualifications has declined. Consequently, the brightest people do not consider employment in this sector.

The hotel and restaurant industry has added pressure of competition from the retail industry which offers better working hours, straight shifts, and may even have better rates of pay and working environments. In addition, these employers offer a formal training plan, structured career path and variety of incentives.

The hotel and restaurant industry needs to highlight its main strengths. The job in this industry is akin to show business. It is customer satisfaction that keeps the staff motivated. It is important to pass on the experience and enthusiasm of the chef's profession to the next generation. The industry has to become productive and efficient in the utilisation of human resources.

In Switzerland, this industry is highly regarded by society. It is the best example of all countries studied in attracting young people to the chef's profession.

Role of Regulatory Bodies

In the UK, there are far too many authorities and councils attempting to represent the interests of various bodies, but without a common vision. The plethora of organisations purporting to represent the interests of industry and education in the United Kingdom are confusing. Each industry is represented by a national training organisation, such as the Hospitality Training Foundation which consults with the hospitality industry and receives feedback on the needs of industry. The occupational standards are set for the qualifications on the basis of needs identified by industry. The qualifications are submitted to the Qualification Curriculum Authority for approval. Once these qualifications are approved the awarding bodies can register the candidates who are interested in pursuing a career in the chef's profession.

Comparing Standards

Vocational qualifications can be awarded by the Hospitality Awarding Body (a branch of the Hospitality Training Foundation), Edexcel, the Assessment and Qualifications Alliance or by City and Guilds of London Institute. There is competition between the awarding bodies and the number of students registering for the qualifications has decreased in comparison with 1990 when chefs' qualifications were only awarded by one body, City and Guilds of London Institute. The curriculum content, examination procedures and award of final qualifications were all controlled by one organisation.

The next stage of control is that of the Learning and Skills Council. Funding is only for those vocational qualifications which are approved by the *Qualifications and Curriculum Authority*. In fact, the funding allocated for chefs' courses to further education colleges has reduced the class contact time for practical classes. In addition, the emphasis of NVQs on observation rather than education has introduced workshop supervisors, instructors, facilitators and assessors instead of quality lecturers in the light of financial restraints. The quality grading of further education in teaching and learning, and standards of achievement, attainment and motivation of students are determined by assessors appointed by the Learning and Skills Council, which also provides funding.

This bureaucratic situation does not exist in France, Germany and Switzerland. The interests of the trade are focused on the design, delivery and final outcome of chefs' qualifications. In the UK, it is vital that the interests of the Hospitality Training Foundation, National Training Organisation, Qualification Curriculum Authority, awarding bodies, funding councils and assessment team converge in satisfying the specific needs of the chef's profession.

Assessment Process

In the UK, the assessment process used in measuring the practical skills is not rigorous enough. In many cases it lacks validity, reliability, credibility and consistency. Assessments are made on a continuous basis. The assessors are appointed on their ability to complete paperwork correctly rather than due regard being given to their technical expertise and industrial experience. The building of a portfolio of evidence is 'candidate-led' and there is emphasis on candidates to achieve the 'minimum laid-down criteria'. There are no time constraints for candidates to complete the qualification and the grade awarded is on a simple pass or fail.

Academic and Vocational, 16-19 year olds

Unfortunately, the assessment process implemented for NVQs is not sufficiently rigorous. It lacks validity, reliability, credibility and consistency. It is interesting to note that in the Netherlands a 'competency based' model was developed in 1999 for the training of chefs. The main reason for delay in implementation of the system is the lack of agreement regarding the mode of assessment used to measure the final outcome.

In most of the European countries, such as Switzerland, Germany and France, and the USA the final assessment is in the form of a written examination and time constraint practical test prior to the awarding of the chef's qualification. The panel of assessors consists of a trade representative, an educationalist and the representative of an awarding body. In addition, the final outcome is graded i.e. Distinction, Merit, Credit and Pass. This mode of assessment would be much preferred by professionals in the hospitality industry in the UK.

Needs of Industry and Output from Colleges

In the UK, there is a mismatch between the needs of industry and output from colleges of trained professional chefs. In July 1999, there were 15,268 full-time vacancies in the chef's/cook's profession. In Wales and the North East around 70 per cent of the vacancies advertised were unfilled. Even in London, which had the lowest percentage of unfilled chef/cook positions, almost 50 per cent were not filled.

In 2000, the shortage of skilled chefs has increased to 60 per cent from 50 per cent in 1999 and the gap in skilled chefs has increased to 70 per cent from 50 per cent in 1999 in the hotel sector. In the restaurant sector the shortage in skilled chefs has increased to 45 per cent from 40 per cent in 1999 and the gap in skilled chefs has increased to 60 per cent from 51 per cent in 1999.⁷

The total number of chefs/cooks employed has increased from 231,100 in 1995 to 235,100 in 1999.⁸ However, the percentage of employment in the chef profession as a full-time provision has decreased from 65 per cent to 62 per cent, whereas in part-time provision it has increased from 35 per cent to 38 per cent.

⁷ 'Forecasting Change', HTE, October 2000.

⁸ Labour Market Review, HTE, 2000.

Comparing Standards

The NVQ Registrations from 1992 to 1999 are as follows :⁹

1992	1993	1994	1995	1996	1997	1998	1999	Cumulative Total
2,591	41,248	23,429	24,468	27,915	35,864	30,960	27,329	213,804

Registrations and Awards by level in Food Preparation and Cooking from December 1992 – September 1999

Level	Registration	Awards
Level 1	76,350	32,663
Level 2	113,229	51,554
Level 3	23,396	7,853
Level 4	393	97
Total	213,368	92,167

The employment flows in the catering and hospitality industry 1994-1999 indicate that there is an average annual replacement need for 86,000 craft and semi-skilled staff in industry. The average output from colleges is 14,000. Thus, there is a shortfall of 72,000 trained and qualified staff. This includes the chef's profession, which accounts for 25 per cent of the shortfall indicated (18,000 vacancies).

Conclusion

The recruitment on chefs' courses is a major issue mainly because of the industry's image and qualification structure. There is now a huge shortage of skilled chefs and the recent survey suggests that it amounts to 18,000 vacancies in the UK. There is a need to build more synergy between the education, training providers and the industry.

The retention rate of students on full-time courses and trainees on modern apprenticeships in industry is very low. Unless the qualification structure is improved it will remain a huge problem.

It appears that the government is considering relaxing immigration controls to allow caterers from abroad to fill the skill shortage of chefs. This initiative has to be reversed, as there are ample career opportunities in the chef's profession, which should exploit the creativity and artistic skills of young people in the UK.

⁹ Ibid.

*Academic and Vocational, 16-19 year olds***Comparative Analysis, Evaluation and Assessment**

The development of training in Britain was a laissez-faire system prior to 1964. The prime responsibility for industrial and commercial training was deemed to rest with industry and commerce themselves. The evolution of formal vocational education and training in the UK had started in 1880 with the formation of City and Guilds of London Institute which was granted the Royal Charter in 1890. The City and Guilds of London Institute looked after the chef's craft education and training for the whole country. The setting up of curriculum content, examination and certification was controlled by one body. The formal training for the chef's profession dates back to the 1950s. The training was organised by the National Joint Apprenticeship Council, which allowed trainees to attend further education colleges on a day-release basis, one day per week, and the trainees were in employment for four days per week.

In 1964, the Industrial Training Act brought in a major change: the financial incentive of the levy-grant system for employers. Each industry had a training board, such as the Hotel and Catering Industrial Training Board (HCITB) set up in 1966. The main function of HCITB was to offer on-the-job training in the industry. It was realised that the chefs' courses offered in further education colleges on a full-time basis were not the only model for providing training. Provision was made for on-the-job training with the delivery structure based on a block-release system – twelve weeks in industry and twelve weeks in college over a two year period. The qualifications gained were City and Guilds of London Institute 147 and City and Guilds of London Institute 151 (now equivalent to NVQ Level 3). The employers were encouraged to carry out the training and the HCITB paid grants to employers. In return, some employers were charged a levy on the basis of their total payroll bill.

Despite the enormous progress made in the training field, many of the firms began a process of disengagement from the levy system. Large firms disengaged as they met the training standards set down over the years by the board. In 1972, it was widely realised that this process had gone so far that 56 per cent of British firms were no longer covered by the levy-grant schemes.

The other issue was of labour mobility from the commercial sector, which paid the levy and trained staff, to the non-commercial sector (hospital catering, prison catering, etc.), which was exempted from levy.

Comparing Standards

The employers who paid the levy and trained their staff found that they were constantly training staff because of the high labour turnover.

This system did work successfully until the Employment and Training Act 1973 came into being.

The task of developing occupational standards began with the advent of the National Council for Vocational Qualification in October 1986 and formation of the National Training Organisation for each industry. The first NVQ qualifications were offered in 1990. In 1997, the merger of the National Council of Vocational Qualification and the Schools Curriculum and Assessment Authority took place to form a single body – the Qualifications and Curriculum Authority (QCA). Standards are approved and controlled by the QCA to ensure the relevance and validity of qualifications to meet the specific needs of industry.

The chefs' qualifications are now awarded by City and Guilds of London Institute, Edexcel and the Hospitality Awarding Body. The control of quality delivery and assessment is carried out by the internal and external verifiers who are qualified and approved by the relevant awarding body. These qualifications are funded by the Learning and Skills Council which dictates the amount of resources which can be allocated in the delivery of courses, i.e. the maximum number of class contact hours per week for a chef's training - 18 hours per week. In other European countries the chefs' courses have a class contact of 30 hours per week. This will certainly produce better-trained chefs. In the UK, the assessment of students is also carried out in the same class contact time of 18 hours per week further reducing the actual teaching time.

Qualifications

The structure of qualifications is very simple in Germany and Switzerland – Chef Craftsmen and *Meister* Craftsmen Chef or *Professionnel Cuisinère* and *Professionnel Supérieur de Chef de Cuisine* respectively. These qualifications are for chef apprentices.

In the UK, New Zealand and the Netherlands chefs' qualifications are offered as a full-time vocational education and training programme alongside the apprenticeship system. The structure develops through Level 1, Level 2 and Level 3. In exceptional circumstances it reaches Level 4 standard.

In France the title of qualification varies, but the levels are equivalent to the above system: