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An international educational perspective on technology and change

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Abstract

For a number of reasons design and technology has over the past decade played a very central and key role in educational reforms. Notably being at a pivotal point between core and foundation subjects, academic and vocational education and science and arts.

This paper will research, reflect and synthesise other approaches to technology education in a number of other countries including England and Wales, Scotland, France, Germany, Denmark, Italy, Russia, Japan, USA, Canada, Australia plus one developing and one Eastern European country.

Each of the selected countries will be analysed on the following profile along with a schematic over view of the educational system from its early years through to degree level.

Historical perspective

Overview and educational structure

Technology including Information Technology and Vocational Education

Key Points and Future aims

FRANCE

attend lycées.²

Historical Perspective

1794 the creation of the Ecole Polytechnique to train Engineers

1881 - 1889 organised public primary education

1946+58 new constitution guarantees access to education.

1975 Act based on three principles.

1. Common course of education with a series of options
2. Balanced general education for a modern world, manual and technical education, and a general education in the arts.
3. Greater schools educational independence.

1980s General reform of baccalaureate including new professional bac.

1992 Ministry of Education absorbed into enlarged Ministry of Culture.¹

There is a national curriculum laid down by the Ministry which gradually builds with each year. The first primary year covers reading and writing; the second introduces maths, history and geography, then grammar, science etc.²

Generally there are no final exams at the end of each year but regular teacher tests. The class teacher can decide if a student has not reached the required standard. Approximately 1 in 10 students are asked to redouble (repeat a year), this figure has been dropping in recent years and the Ministry is trying to phase out the system.

Technology and Vocational Education

From the age of 11 all pupils have technical and vocational subjects. After 15 students follow either one of the 3 Baccalaureate: Général, Technologique or Professionnelle or one of a number of occupational, pre vocational certification courses. Selection for a particular course is by teacher assessment and recommendation. In 1991 some 600,000 candidates, around 50% of the cohort, took the bac which is a criteria referenced exam and general entry requirement to Higher Education.²

Overview and Educational Structure

Education is centrally controlled. The State takes almost total responsibility for staffing and funds between 60% and 80% of running costs - buildings and transport, with local authorities making up the remainder of these costs.

Almost 90% of French children attend state run 'maternelles' from the age of 3 to 6 when they move on to 'primaries'. At 11 they enter secondary schooling, which is comprehensive, and then at 15

Key Points

Main aim for future is 80% of population taking Baccalaureate by year 2000.

Classes are not necessarily linked to age because of redoublement.

Some 74% of 16 to 18 population are involved in education and training 64% full time, 8% part time.³ The 15 to 18 curriculum is kept broad and balanced with students studying 7 or 8 subjects.

Approx. 15% students attend fee paying private schools which also receive state funding and often have a particular focus eg agriculture.

rolls in from year 1 to year 10.

Private schools (free schools), provide education for 8% of the population. These schools receive state subsidies of up to 75% of their running costs.

No class may exceed 28 and average numbers are approximately 20 to 23⁶. Almost all the school structure is based on a tutor group system and pupils can stay in the same group with the same teacher from the age of 7 through to 16.

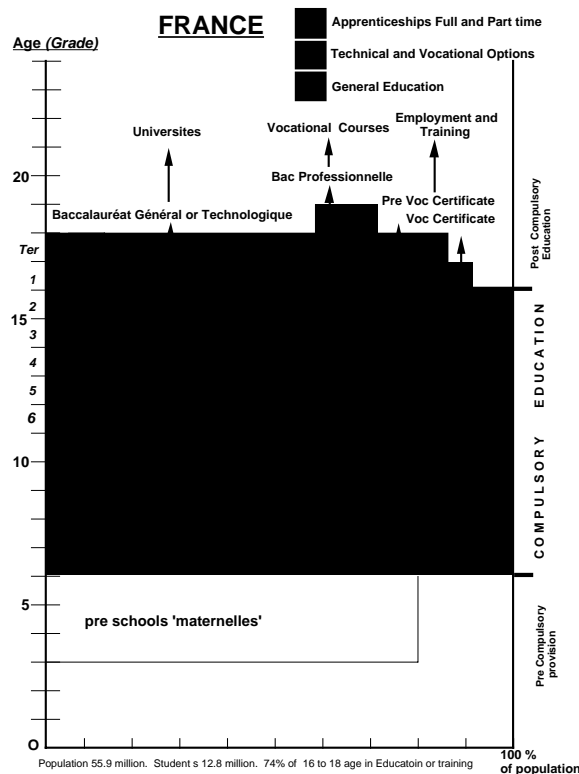
Technology and Vocational Education

Vocational guidance is an obligatory study from the age of 14 with options being available from 16. In the last 3 years, of compulsory education 13 to 16 Woodwork, Needlework and Home Economics are offered to all children. Computer Science is also available at some schools. Higher Education courses are typically five years long and a combination of grants and loans are available and can be used by students at any time.

Key Points

“It is a fantastic principle to have a well educated population, but also necessary if we are to get by in Europe in the next 20 years” Jakob Lange, Coordinating Registrar for further education in Denmark, August 1991. Almost one fifth of the adult population are undertaking some form of education.⁷

Recent reforms are designed to inject a greater



DENMARK

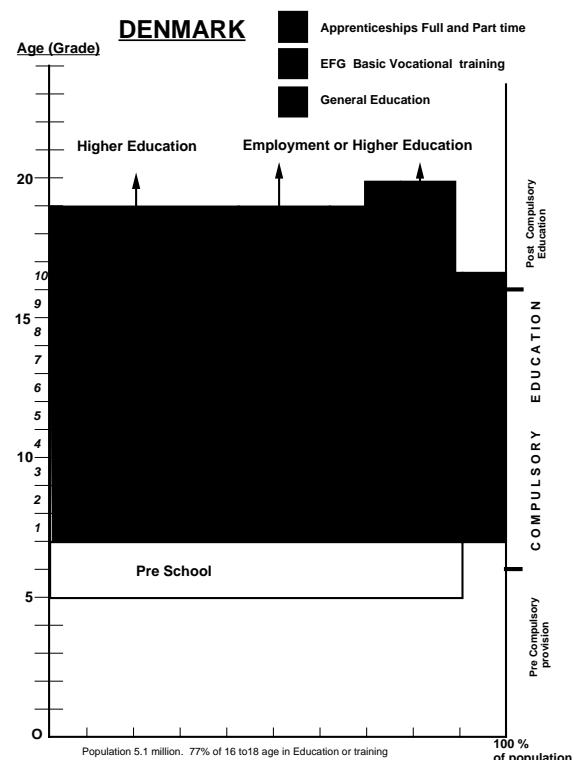
Historical Perspective

- 1814 seven years of compulsory education enacted.
- 1844 first folk high schools.
- 1975 reform of folkeskole.
- 1991 reform to school curriculum and teacher contracts.

Overview and Educational Structure

Grundtvig, in opposition to the concept of “academic culture”, advanced the ideas of “popular culture” through the folk high schools, first established in 1844. For almost 150 years the Danish educational system has been eroding the academic vocational divide.⁵

Danish education is compulsory from 7 to 16 with a common national curriculum that progressively



degree of parent power and greater autonomy for individual schools.

Denmark spends 7.3% of GNP on education. By comparison Britain spends 4.8% of GNP. The Danish government boasts that this is greater than any other country.⁷

Some 77% of the 16 to 18 population are involved education and training - 70% full time, 6% part time.³

SPAIN

Historical Perspective

1857 Ley Moyano act prescribing 3 level - elementary, secondary and university.

1931 Second Republic- wide range of educational reforms to primary education - teacher training and the schools inspectorate.

1970 General Education Act - national free education for all children up to 14.

1989 to start 1992. Pre school education free for all 3 to 6 year olds, leaving age raised to 16. Compulsory comprehensive secondary education, 12 to 14; new Bachillerato course; reformed vocational training.

Overview and Educational Structure

Compulsory education in Spain begins at the age of 6 and extends to 14 at present but will be raised to 16 this year. A centrally administration system exists with a compulsory curriculum. A system called repetidores operates of making pupils retake a year if they do not reach a set standard; about 10% of pupil are involved.

The 1970 reforms to Spanish education created such demand for schools that private schools were helped to developed with the aid of state funding. Today more than 90% of private schools receive state funding.

The latest reforms to Spanish education are only just beginning and will not be fully implemented until the year 2000. However, many of these changes have remarkable similarities with the reforms in England and Wales. Under the new system Primaria education will be organised in two 3 year cycles from 6 to 12 years of age including a foreign language from the age of 8. Educacion Secundaria will be organised in two 2 year cycles up to the new minimum leaving age of 16, broadly on comprehensive lines with a common national curriculum with stipulated time allocation. At the age of 12 some 90% of the timetable is common, dropping to 65% for pupils at 16.

Technology and Vocational Education

The selective separate routes of 'Bachillerato' and 'Formacion Profesional' (academic and vocational) of the past will be given equal status. The common curriculum for 12 to 16 education is organised in ten content areas: Natural Sciences, Physical Education, Visual and Plastic Expression, Geography-History-Social Science, Foreign Languages, Language and Literature, Mathematics, Music, Religious Education and Technology. There are options which allow extension work in either Scientific, Technical, Artistic or Social fields.

The two year post compulsory education will continue with the two routes of the Bachillerato and Profesionales, the new features being equal value and modules from the practical curriculum available to the academic students. The Bachillerato is the general route into Higher Education and requires all students to study some 7 or 8 subject including technical - vocational studies.⁹

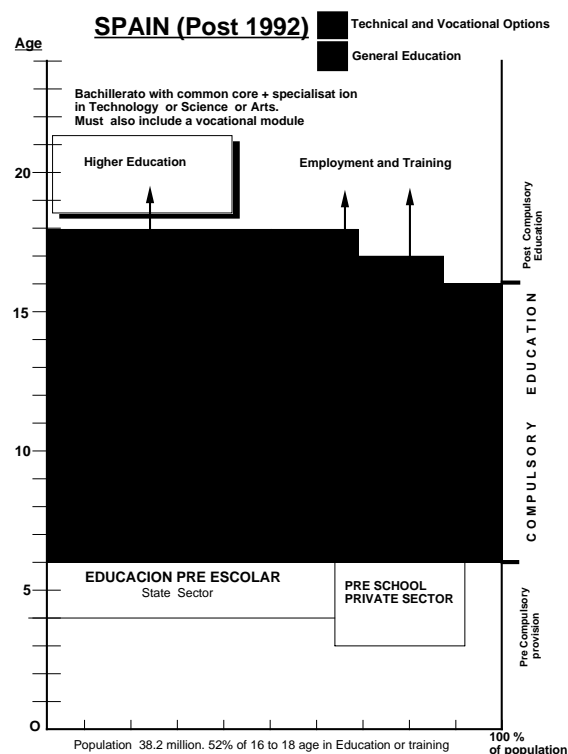
Key Points

Major change now taking place after long consultation with students and parents associations, unions, church and political parties.

Technology for all from 12 to 16 and broad common curriculum through to 18.¹⁰

Moves to erode academic vocational divide.

Major investment programme for education - £6.5 billion by the year 2000.¹⁰



GERMANY

Historical Perspective

1872 New regulations for the Volksschulen, curriculum includes natural science.

1910 New curriculum to meet the needs of industry.

1919 Ending of conscription and overhaul of school system.

1933-38 Many changes - mainly Nazi orderd.

1949 Federal Republic of Germany founded.

1969 Vocational Education and Training Act.

1990 Germany reunification moves to amalgamate the two systems.

Overview and Educational Structure

The Germany education is not easy to understand or explain. Re-unification and the speed of political change also complicates any summary of the system. Education remains in the hands of the 16 federal states or Länder (11 in West Germany, 5 in East Germany). Any National system derives from liaison between federal states and this occurs through the Conference of Education Ministers.¹²

The general picture, with some variation is as follows:- Kindergartens from the ages of 3 to 6 provided by both local authorities and private organisations; these are followed by primary schools - Grundshule - from 6 to 10 with a compulsory curriculum including handicraft and practical work. Secondary schooling is provided through a wide variety of institutions including comprehensives (Gesamtschule), being developed and introduced over the last 15 years, Main schools (Hauptschule) and Intermediate school (Realschule) these generally cover the 10 to 16 age range. The Grammar School (Gymnasium) covers ages 10 to 18 and leads to the Abitur examination and higher education¹⁴. Selection for these schools is through negotiation and recommendation rather than tests.

Technology and Vocational Education

About 60% of school leavers continue their education through the 'dual system' in a wide variety of different vocational schools, supplementing the above secondary schools and covering the 15 to 19 age range. This system encompassing some 370 training occupations and 1.5 million trainees¹². Again reform, including broader training, more flexible routes, and relating work, economics and society, are taking place. In the secondary schools technology education very much depends upon the Länder. Some are developing on similar lines to the U.K. Design and Technology with the integration of subjects and others with little or no development.

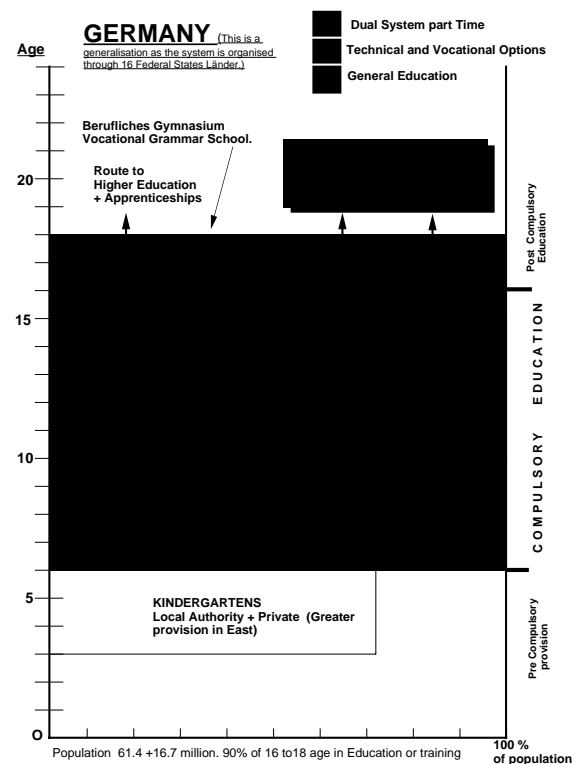
Key Points

There are some 31% of 18 to 21 year olds in Higher Education. This is expected to reach 40% by year 2000. The number of pupils taking Abitur rose from 16% to 26% through the 1980s.¹²

In West Germany concern about reading standards, seen as a consequence of a visually obsessed television culture, is making headlines; in the East there is no perceived fall in basic standards.

The East German model of providing academic / vocational education in a combined course is being looked at by Ministers.

A very large number of students receive quality apprenticeships linked to part time education. A significant number of academically able leave education at 18 to take abbreviated apprenticeships before returning to full time age education.



JAPAN

Historical Perspective

1872 First unified state education system aimed at literacy for all.

1946 General reforms and so called 6 - 3 - 3 - 4 system.

1960s and 70s Minor reforms.

1980s Much debate with minor reforms.

1987 General reforms.

Overview and Educational Structure

The so called 6 - 3 - 3 - 4 system consists of kindergarten for most pre school children, primary

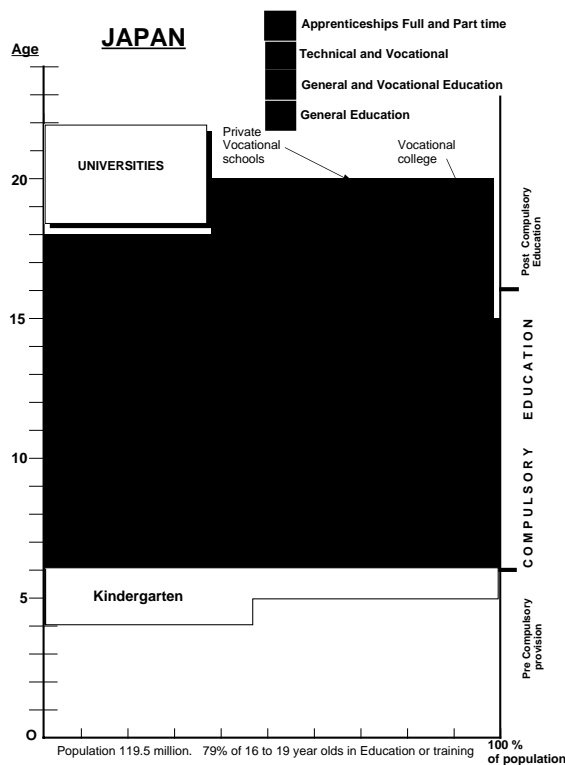
(6 to 12), middle (12 to 15), high school (15 to 18) and 4 year University courses.

The Japanese system is characterised by a rigid national curriculum and intense interest in schooling by parents, industry and students. With a longer day and school year than in U.K., most learning takes place in large classes with formal methods and testing by multiple choice questions. However, little streaming occurs before high school, for which there is normally competitive entry through examination.

Compulsory education is virtually free and accounts for 16% of government expenditure. Universities charge fees; there are no grants but students receive interest free loans from a Scholarship Foundation.

Technology - Vocational Education

About 2% of 15 to 18 year old students attend vocational high schools and technical colleges. In recent years the vast majority of 15 year olds, some 95%, go to mainstream high schools. Some 16% of these run only vocational courses with over 30% providing a mixture of general and vocational. Private schools for post 18 year olds called senshu gahho attract about 18% of the age group and provide mainly short vocational courses¹⁶.



Future Aims

In 1955 only 4% of the manufacturing workforce were graduates; by 1985 some 23% were university graduates¹⁶. The Japanese intend to continue this trend.

The 1987 act set out to reform teacher training and the examination system (which is very knowledge and recall based). There is also pressure for more liberalisation and internationalisation of education in Japan, particularly to encourage creativity.¹⁷

RUSSIA - C.I.S

Historical Perspective.

Pre. 1914 Approx. half 8 to 11 year old's attended school.

Oct. 1918 Establishment of 'unified labour school', free education for all

1935 New system of marks, examining, incentives and awards.

1943+44 Re-organisation of schools for working youths and rural youths.

1965 Single Department of Science and Educational established

1968 Post school courses extended by one year.

1977 Compulsory ten year schooling introduced.

1984 Reforms and present system introduced.

Overview and Educational Structure.

The USSR is a vast area with a population of 271 million and a pupil / student population of about 40 million, experiencing major change if not collapse.

Education in this centralist structure, developed and reformed over the past 70 years, begins in elementary schools at the age of 6 through grades 1 to 4 and followed by either incomplete secondary grades 5 to 8 or complete secondary grades 5 to 10 when students taking the Attenstat exam at 17 or 18 years of age.

Students can leave after grade 8 for low skilled work or enter SPTU (Secondary professional technical school) for 3 years education and training to the level of Attenstat (matriculation). A small proportion of students attend PTU (Secondary vocational schools) after grade 8 to follow one or two year vocational courses, some of which are part time. However, these schools are being phased out in favour of SPTU's. Access to Higher Education is through the Attenstat and competitive entrance exam.

The curriculum is again centrally controlled rolling in from grade 1 with Language, Maths, Art, Music, PT

and Labour plus Nature Studies from grade 2 and Geography and Foreign Language from Grade 5 etc.¹⁹

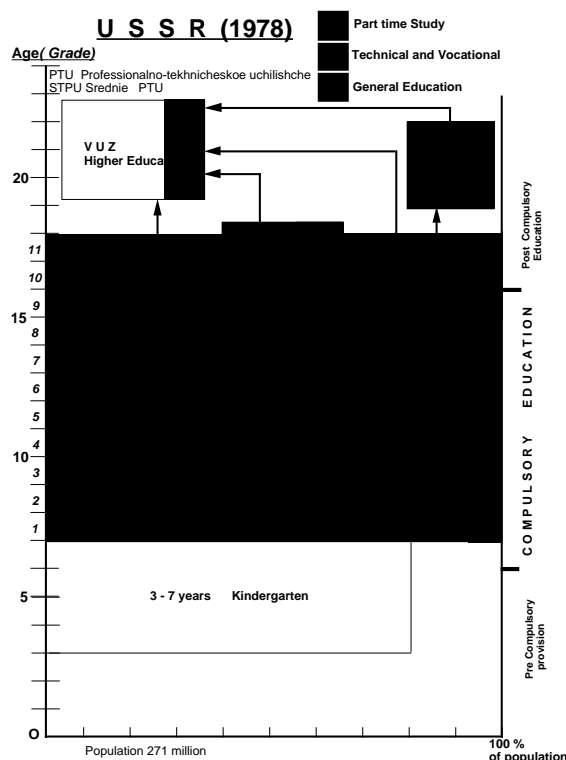
Vocational and Technology Education

A vocational element in education starts in elementary school with basic handicraft skills in a variety of materials. At general secondary schools every child has an opportunity to master a craft skill. Grades 5 to 9 study technical drawing, electric technology, wood and metal; grade 8 emphasises working in teams to produce goods.

During 1985 some 50,000 computer engineering rooms were established in secondary schools and all children in grades 9 and 10 are expected to learn problem solving and informatics (computer studies). SPTU's have included in their programme compulsory 'ABC of Information and Computer Science'. Teacher training now includes compulsory computer literacy and thousands of teachers attend Summer school.²⁰

Key Points

An enormous large educational system that is responding to modernisation, introducing information technology and expanding general education. Communism has embedded vocationalism in the system from grade 1 right through to University level.



KENYA

Historical Perspective

- 1908 European education board to advise Governors in the colonies.
- Pre 1920 Education concern of missionary societies.
- 1920-1963 Racial segregation in education. European, Indian, Arab, African.
- Development of 'bush' or catechetical schools.
- Kikuya Independent Schools Movement.
- 1936 British improvements to African education as a reaction to Hitler's demands for the restoration to Germany of its former colonies.
- 1940+ 45 Two Colonial Development and Welfare Acts passed by British.
- 1961 Primary education same for all races plus 'triple four structure'.
- Addis Ababa conference of 39 African states. Short term aims to develop secondary and post secondary education. Long term aims of universal primary education and develop adult education.
- 1985 Reforms and organised on the 8-4-4 model.

Overview and Educational Structure

Kenya, situated in East Africa between Ethiopia and Tanzania, has a long history of education based upon missionary and colonial control until the early 1960s. The colonial educational structure was very academic with pencil and paper tests to select and reject for the next phase of the system. There was also no place in the curriculum for vocational or practical subjects. The main purpose of this system was to educate a small proportion of the population to act as middle level management for the Empire, rather than basics for all.

In Kenya there is no compulsory period of education but a policy of free education for all. The present system, developed after independence in 1963, was re-organised in 1985 on an 8 year Primary, 4 year Secondary, 4 year Higher Education model.²³

Technology and Vocational Education

From the beginning of the 1970s there was increased criticism of the school curriculum for its lack of vocationalism, which led to the 1985 changes. After 8 years of primary education pupils can enter secondary school through competitive exams or enter 'village polytechnics' (set up in the late 1960s), or leave for employment / unemployment. Some 70% of the curriculum in these 'village polytechnics' is practical and vocational and generally continues for 2 years. Harambee Institutes of Technology (H I T) are similar to the village polytechnics, being community based and developed in the 1970s to counter unemployment among secondary school leavers. Harambee offer specific courses include

Building Technology, General Engineering, Business Studies, Textiles and Home Economics which usually last for 3 years with 40% of time for general education and 60% for practical.²²

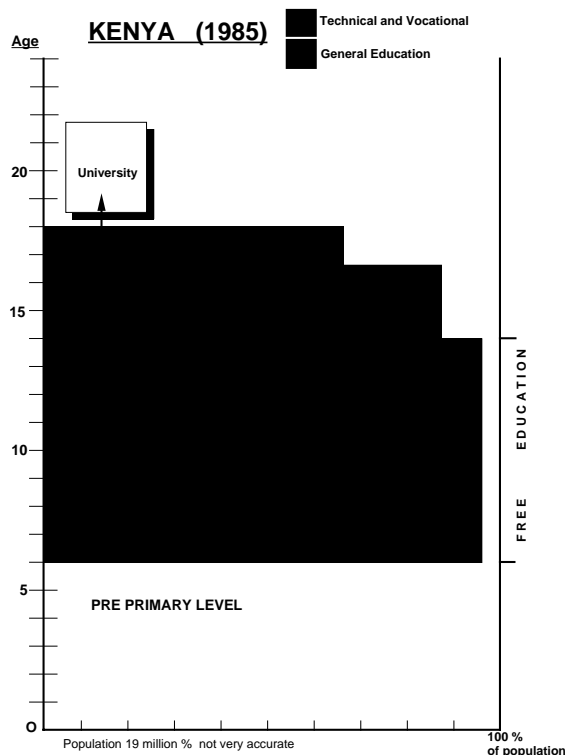
Key Points

Recent reforms to aid the continuing expansion and modernisation.

Striving against a colonial past that imported a narrow academic education and curriculum for a small proportion of the population.

The programme to develop the village polytechnics and Harambee across rural areas of the country has succeeded in importing technical skills and helped transform attitudes towards education.

U.S.A.



Historical Perspective

- 1914 Smith Lever Act funds for Agriculture and Home Economics
- 1917 Smith Hughs Act promote vocational education below college level
- 1918 Regulation of Secondary schools
- 1946 George Barden Act extends 1917 Act
- 1954 Negroes admitted to white schools
- 1958 National Defence Education Act aid for Science, Math, Language etc.
- 1963 Vocational Education Act
- 1964 Amendment to National Defence Education

Act to support more subjects

Overview and Educational Structure

The control of education in the U.S.A. is through the Bill of Rights legislation at a national level followed by state legislation, local school districts, boards (groups of schools), and finally schools. There are no local education authorities as such but schools do group together to share and develop as required. Funding is through State tax and local tax based on property values. College and University courses can be supported through means tested grants, loans, parental support or working on campus alongside study.

Schools seem to have a great deal of freedom in both curriculum and testing with many schools operating a modular curriculum. Schools can also select from a variety of different tests, many of which are multiple choice type, available on the open market from exam and testing businesses.

Elementary education begins at the age of 6 through to either 12 Junior High school and 15 Senior High school or 14 High school. A small proportion of the age group attend more specialist schools called Technical and Vocational High. Almost all pupils stay in the system through to the age of 18 with about 75% graduating. Between 30 and 40% of a year group go on to University.²⁵

Vocational and Technology Education

Looking through the historical perspective it is clear that Science, Technology and Vocational education have all received national attention, particularly at times of international conflict.

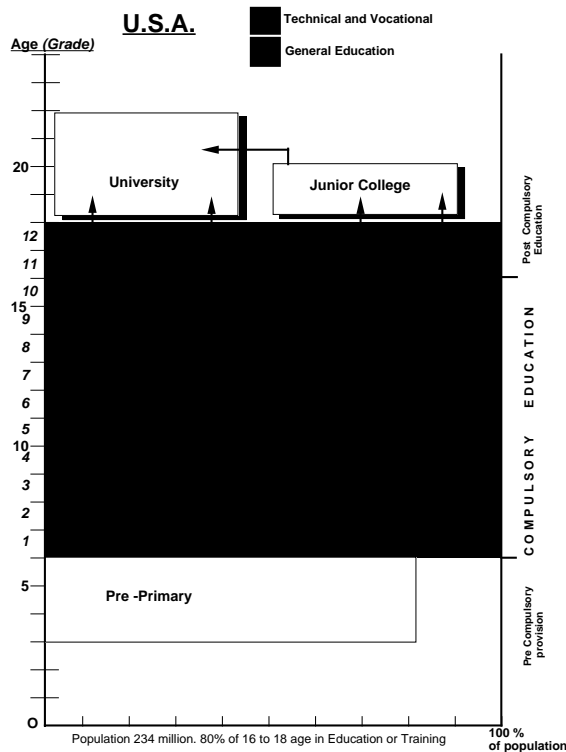
The freedom and local structure of education in the U.S.A. make it very difficult to identify and comment upon pupil access to Technology in the curriculum. However, two major features are worthy of comment. Credit accumulation or modular structure based upon a semester, about 20% of curriculum time, with a free choice after Maths English and Science. Project technology initiatives which are aimed at developing problem solving and project management skills.

Graduation from high school is through credit accumulation base on local models but usually requiring a defined breath of study.

Key Points

A system based on great freedom for individual schools and almost universal modular structure. Numerous initiatives particularly in the areas of science, technology and inner city support.

Reflections and Conclusions



change. Evidence for this can be seen from the periods 1870-72, 1918-19 and 1944-49 when reforms took place in almost every country studied. From these dates it seems evident that economic success and education are linked, and whenever a nation is shaken by conflict that compares its economic, scientific and military strength then re-evaluation of its educational system, structure and performance often follows.

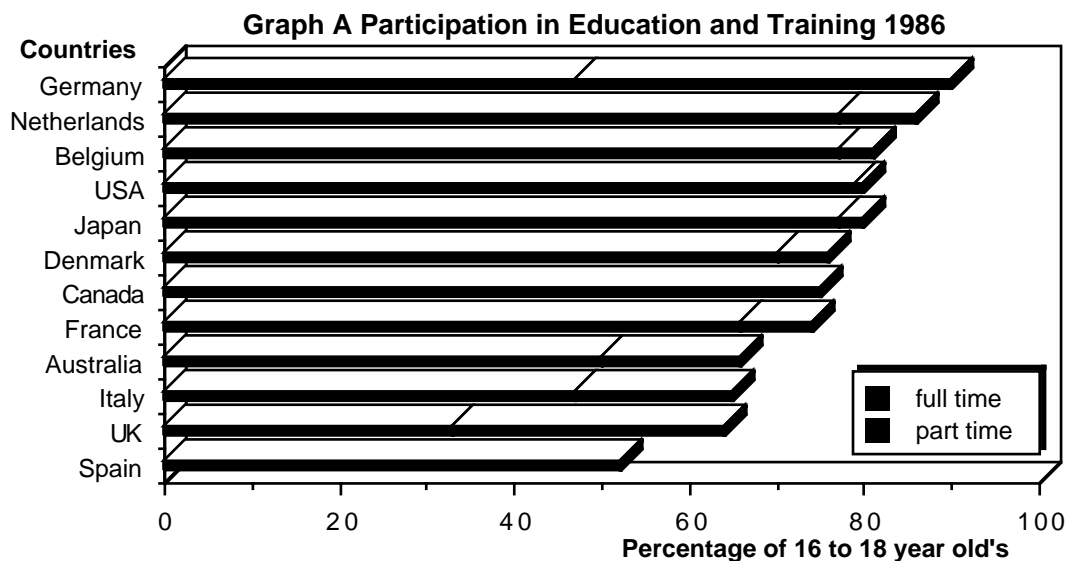
The late 1980s and 1990 again see international change in the economic, demographic, technological and social fields and again all countries investigated are involved in some form of educational change. These changes can broadly be identified under the following six headings.

- 1 Educational structure - delegation of power and responsibility.
- 2 Curriculum content - broad and balanced curriculum for all - modular
- 3 Educational pattern - no longer limited to early period in life - return to learning - adult access - modular courses.
- 4 Interface with world of work - education and training rolled into one - human resource development - modern relevant curriculum.
- 5 Testing and Performance - accountability as a response to the delegation of responsibility.
- 6 Information Technology - the knowledge explosion and pace of change.

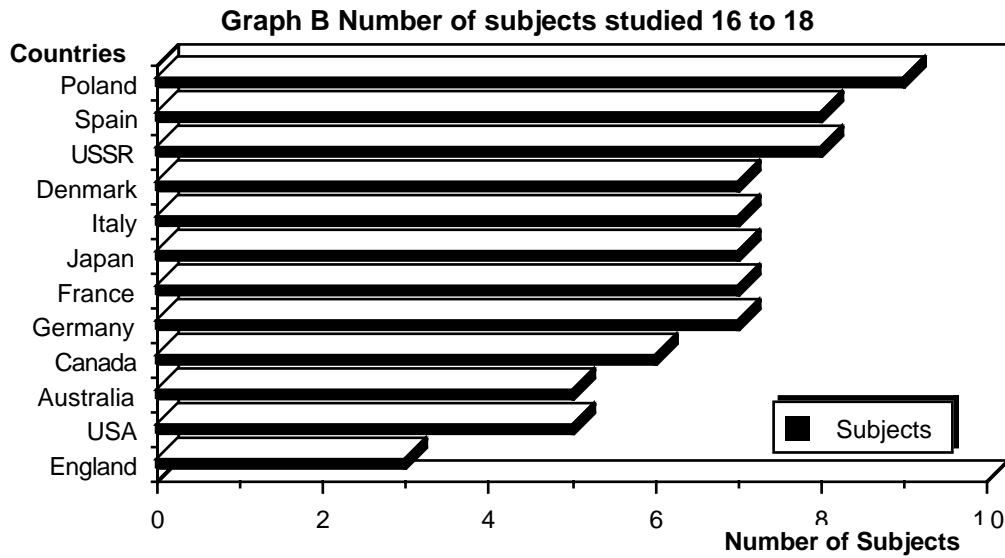
All the countries studied are undertaking some of those reforms but only the U.K. seems to be experiencing all 6 at the same time.

Historical Perspective

Educational change seems to take place when external pressures bring education to the top of the political agenda. These pressures can be economic, demographic, technological or social; in particular when a number of these pressures coincide then the national response is often radical educational



Source DES Statistics Bulletin 1/90 ISBN 0142 5013



Source Postlethwaite and Wiley (1991) +additional research.

International Comparisons

International comparisons of educational performance are always difficult particularly in the area of attainment. We refer the reader to Postlethwaite and Wiley (1991)³⁰ for a detailed discussion. However, there are two particular fields where comparison is somewhat simpler; breadth of curriculum post 16 and participation rates in education and training 16 to 18.

The two graphs show quite dramatically and clearly that U.K. is not performing well in comparison with similar developed countries. Perhaps most worrying is the breadth of curriculum post 16. Only England and Wales of all the countries studied allows students to restrict their education to just three subjects. This narrow curriculum that does not address the art - science or academic - vocational divide, for the majority of student preparing for higher education, disadvantages English and Welsh students within an open European market. The national benefit of this system is shorter degree courses; the negative being a less flexible and responsive human resource.

Technology and Vocational Education

In all the countries studied Technology and Vocational Education is a major element and influence within recent educational reforms. A number of countries notably; USSR, Denmark and Germany have had a long tradition of craft education from the first year of compulsory schooling. Information from the historical perspective shows that the division between academic and vocational paths is a deep and difficult obstacle in many if not all countries.

Information Technology and computers in the classroom again dominates international

educational change. Perhaps, with Information Technology being perceived as modern, clean and of high intellectual status, it may assist in the process of bridging the long division between the parallel educational routes.

The two approaches to Technology and Vocational Education seem to be - technology for all (England and Wales Design and Technology 5 to 16) or a specific technology path or option for a selected group of students. Obviously this second option always occurs at some point, when an individual selects a particular career path.

The important issues are: -

- Timing, at what age does selection begin 12, 14, 16, 18 etc.
- The method of selection; either imposed through tests or negotiated.
- Parity of esteem
- Ability to transfer between paths, credit transfer.

In post 16 education a number of countries and notably Spain are insisting upon a compulsory vocational element for all students within their Bachillerato preparation for higher education entry.

Conclusion

The Design and Technology 5 to 16 National Curriculum is a significant step towards broad and balanced education for all children in England and Wales. However, looking to the future we must be concerned that by 1994 all pupils have studied a curriculum including Technology through to 16. Should we then allow them to select either A levels, in almost any combination, or a vocational pathways with little common content to assist future transfer?

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