REPORT ON

TECHNICAL EDUCATION

IN TEN COUNTRIES OF EUROPE

SABBATICAL STUDY

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My sabbatical project began with an investigation of the mathematics curriculum used for students in the several countries taking courses comparable with the terminal curricula in our California Community Colleges. In the field I discovered that I was receiving information about the training courses in general and the methods of education. This seemed repeatedly to be more valuable data for our needs in California than a list of the mathematics topics and a record of the degree of emphasis placed on each.

Accordingly, I accumulated information on the plans of education as well as about mathematics curricula. In order to compare national systems, I asked in all cases for the data on preparation for mechanical engineering trades: machine operation and maintenance, and design of mechanical devices.

Literature comparing nations was found in the following libraries: National Department of Education and Science, London; UNESCO, Paris; International Bureau of Education, Geneva; and International Labor Organization, Geneva.

Terminology among nations is somewhat uniform when translated into English:

An operative is unskilled. He learns most of his operations on the job without a knowledge of theory.

A craftsman is educated in a part-time vocational school to become skilled in some manual work such as machine operation or mechanical drawing.

A technician is educated in a technical college to do work which requires mental application and the use of data.
A higher technician is required to use mental initiative to do designing or supervising.
A technologist has advanced work in a technical college which prepares him to do original creative work.

The teaching in skills is called training, in understanding is called education. The former is usually conducted in a shop room set aside for the purpose, the latter in a classroom in a school.

My method in general was to secure background information about the countries from their consulates in Los Angeles. Then, with names and addresses of national offices of education, I visited them, asking for duplicated material on their technical education. All but Italy had good materials in English. I asked the dispenser of literature to name the person whom I should interview. He gave me name and phone number and sometimes called the person for an appointment. If not, I made the call.

I read the material in the hotel and met an appointment the next day or two. To my word of thanks most of them said: "I was in America once and everyone was very good to me. The least I can do is to be helpful to you." This person recommended the schools which I should visit. All the schools visited had teachers who could discuss their work in English.

I was struck with their willingness to do the work at hand in old buildings with rather poor offices and simple equipment.

	Unskilled operative	Skilled craftsman	Technician	Higher tech.	Technologist
Br.	9 years school; training in enterprise	Apprentice course 4 years; to school 1 day/week or block; examination	Tech course; to school 1 day and 1 evening/ week 4 years; examination	Tech course; to school 1 day and 1 evening/ week 5 years examination	11 years school; tech course 1 year part time, 1 year full time
Swit.	9 year school; 3 year specialized	Apprentice 3 - 4 year to school 1 day/week	Evening and Saturday school 4 years or full time 1 year	same and factory training	Full time professional school 4 years
It	8 years school; training in enterprise	Secondary vocational school 2 - 3 years and examination after tests	2 year full time general; 1 - 2 year part time specialized	2 year full time general; 3 year part time	Professional institute up to 5 years
Ge	8 year school then part time to age 17	Employment; after tests To school day or evening 3 years	Craft plus 3 - 5 year experience and school examination	10 year school; 2 year work; 3 year school	13 year school; 4 year full time tech. Diploma
Be	7 year school; last year specialized	4 years in vocational school and leaving certificate	Years 10 - 12 in higher secondary tech school: certificate	Technical institute 3 years: "technical engineer"	Technical institute 4 years: "licensee"

Br = Britain
Swit = Switzerland
It = Italy
Ge = Germany
Be = Belgium

Note: The first column gives the number of years in public primary and secondary school. The other columns give the years scheduled above those, unless specified.

	Unskilled operative	Skilled craftsman	Technician	Higher tech.	Technologist
Ho	7 years school; employment; must allow school 1 day/week to age 16	2 or 3 year lower tech. school	3 to 5 year middle tech. school	6 - 7 year higher tech. school; 1 year practical experience	Eighth year higher tech. school
De	7 years school; short course for each kind of work	9 years school; apprentice 4 years part time school or 1 year full time and work	1 year general and 3 year specialize and examination	Technician and specialized courses	Craftman training plus 1 year general and 3 year special
Fi	8 years school; last 2 practical	9 years school; examination Vocational school; 1 year theory, 2 year practical	9 years school; work 2 years or study and work half-time 3 years.	Industrial foreman's college	Vocational secondary school and 1 - 2 years work and 4 years tech college
Swed	9 years school, some specializing last 3 years	1 year experience, 2 years in technical line	Third year tech. line; certificate	Courses in enterprises	Fourth year tech. line; "Gymnasium engineer."
No	9 years school; some specialization last 3 years	3 year work school 1 day/week, or 1 year work, then 2 year full time school	1 year work then 1 year full time school of high level theory	1 year work then 2 year high level theory	1 year work then 3 year high level theory

Ho = Holland
De = Denmark
Fi = Finland
Swed = Sweden
No = Norway

All English children attend school to age 15..Those who study a general course or who do poorly in science and mathematics are employed and released one day per week to study in the industry's training shop or in a nearby college. They may also attend one evening per week. They receive practical training for a varied number of years, and are "operatives" with special skills.

Those who leave school at age 16, with aptitude in handcrafts or a little preparation in science and drawing, take craft courses on the same schedule of released time. Syllabuses for these are prepared by the City and Guilds of London which also administer examinations and award certificates.

Beginning in September 1969 the system of Engineering Industry Training Boards began the supervision of craft training. The first year provides an induction, training in basic skills and the beginning of special skills. It includes manipulation, theory, liberal studies and physical education.

After the first year the student takes a full-time module of study for six months and then works in production for the second half of the year. The sequence is repeated the third year with and advanced module of study. This completes the routine, but further modules can be chosen later.

School leavers with aptitude in mathematics, science and drawing can take technical courses. If they are weak but promising they have a general introductory course in college, then the prescribed technicians' course with one day and one evening per week in school. Two years in the general course cover the first year in the technical course. After that there is an examination for each two-year sequence. A student may leave after an examination with a certificate. The third two-year program gives a Full Technological Certificate.

Students who do well in secondary school and pass the "ordinary" examinations in mathematics and science can study the "certificate" courses on the same part-time schedule. After four years they earn a technologist certificate. Others enter "diploma" courses in which they sandwich in semesters of full-time school. Five years of this leads to membership in professional engineering organizations with the privileges of college graduates.

Some young people stay in secondary school until they pass the "advanced" examinations in mathematics and science. From there they enter the second year of the certificate or diploma courses.

Students who are the strongest in advanced examinations in secondary school enter universities or the new colleges of technology opened in 1969.

There is opportunity in many places in this scheme for a person to be promoted from one level of study to a more advanced course leading to a higher level of employment. All who are trained on any level have work.

SWITZERLAND

Each canton has its own system. The following is typical of many cantons.

After 9 years of school, the last 3 with some specialization, one quarter of the Swiss youth choose fields of employment which have apprentice training. Since the age of 12, each student and his parents have had access to an official counselor who helps him choose a field, find a job and get scholarships. A probationary period helps him ascertain if he likes the field. After that an apprentice contract is written. In a mechanical engineering field he attends school 2 half days per week and completes the contract in 4 years. A final examination is given by canton authorities and a federal certificate is awarded him.

After apprenticeship a workman may study in evening and Saturday classes to become a master craftsman. In some fields he can, after work experience, gain a master's rating with one year of full-time school.

Major cities have full-time professional schools for students beginning at age 15. These schools give 3 to 4 days per week in practical training in workshops and 1 to 2 day per week studying theory and general subjects. In the mechanical engineering field a student can stay 4 years. Twice a year he completes a unit and is given a certificate of achievement.

He is given a modest salary proportional to his grades. At the end he is given a diploma, with which he is rated a high-level technician.

People preparing for a university attend higher secondary schools for 4 years and then take an apprenticeship. But all who do well in an engineering apprenticeship can be accepted in a university or "Polytechnicum."

ITALY

The Italian government provides eight years of public education, the last three of which have some vocational bias and workshop training, and then vocational secondary schools for three years. The Ministry of Labor determines the courses for the latter and gives leaving examinations. Most of the youth follow this sequence.

Those who leave school after eight years get jobs. If they are employed as apprentices, they must attend school for some technical theory.

Suffering from the lack of trained technicians, eighty enterprises in Northwest Italy banded together to organize an association to arrange for the necessary training. An industry employs a boy at the age of fifteen and releases him for two years with pay to attend a professional institute full-time. The industry gives the perspective employee psychological and technical tests before hiring him.

Those who have finished this sequence, and older working people who want to study more, attend an institute one week of every two months for three years. During this time they are sent to England for one month to perfect their English language.

Students can continue their work at an institute up to five years to prepare for higher levels of technology and supervision.

Governmental units build and equip the buildings and employ the teachers. The Industrial Association arranges the scheduling of students and recommends subject matter. Adults not employed who attend receive grants and unemployment compensation.

GERMANY

Most children attend a combination of primary and secondary school for ten years, and then a part-time vocational school for three years. A physical and mental aptitude test helps to determine the kind of training for which they are suited. The latter continues general education and gives practical education paralleling the employment in which the students are apprentices. A few attend full-time vocational school for a year or two, and shorten apprenticeships one year. All must attend some school until they are 18 years old. Some training schools are within industrial establishments. At the end of apprenticeship the workers try an examination given by the State Chamber of Commerce and Industry. Passing the examination gives the person a journeyman's certificate and admission to a trade union.

After experience at work and part-time school for four or five years a workman may try an examination to become a master craftsman, supervisor or technician.

Some children attend primary and classical secondary school for twelve to thirteen years and then take a "maturity" examination. Success here admits them to universities. Others who pursue the course through apprentice and master craftsman can continue in full-or part-time extension school and take the maturity examination. These extension schools

give courses evenings and week-ends of a nature more theoretical and advanced than those studied for apprenticeship.

BELGIUM

After 6 years of primary education and one year of lower secondary, the Belgian students are separated. The low achievers complete their training in vocational school. Four years of secondary school gives a leaving certificate. A fifth year gives a higher certiticate. A large number of young people complete their education this way.

The higher achievers study a more technical course for 5 years and receive a technical diploma. The largest number of Belgian students do this. Belgium makes little use of the apprenticeship system.

Some students after 3years of lower secondary go on to a higher secondary school for 3 years. They receive a technical diploma. They can continue in a technical institute which prepares in 3 years for the diploma "Technical Engineer". After 4 years a student is a "lincensee". Others from high school continue at a university.

There are special part-time schools of secondary level for adult education courses and special forms of education for the handicapped. A very large number of persons study these courses.

HOLLAND

Following six years of primary education all students take one year of orientation and guidance in secondary school. They are about 13 years of age. The least capable after one or two years in secondary school attend lower technical school. After one or more years here, a worker may serve an apprenticeship in an enterprise, with one day per week or evenings spent in school. Certificates are awarded to those passing the final examination. A government-financed autonimous foundation for each major industry supervises the job training in the enterprise and prepares national standards. The lower technical school course is replacing apprenticeship.

After the first year a large group of students stay in secondary school for two more years and then go on to a middle level technical training for three years.

The most capable study in a gymnasium or atheneun preparing for a university, or take a general secondary school course for four more years and continue in a higher technical training. Most of the higher and middle technical courses are for three years in school, with practical work in an enterprise between the second and third years.

In all three technical levels there is opportunity for the successful student to continue his development at the next higher level. This is the most difficult in the lowest level.

There is special education for those with handicaps or behavioral difficulties. Each one is given training, specifically: a boy for a job, a girl for home economics. There are correspondence courses available at all levels. For older people who have not had it in school, there are classes during working hours and evening.

The trend is toward staying in school longer. The largest number complete four or five years of secondary technical education.

DENMARK

All Danish children attend school for seven years, the last two of which have a little specialization. Nearly all pupils continue on in one of two secondary schools. Here the distinction is in level of achievement and there is some choice in courses taken. After the ninth year and after the tenth, the pupils receive certificates of attainment, choosing whether or not to be tested with an examination. Pupils with mathematics and science may write a technical examination.

After the ninth year some, with examinations, go to the gymnasium to prepare for a university. From both streams the others can prepare for technical employment. The apprenticeship course for mechanical technicians takes four years with 29 weeks in school. A newer plan takes one year in school followed by a year and a quarter at work. An examination gives a journeyman's certificate. Trainees are paid an allowance for their expenses while in study courses.

From these streams with a qualifying examination, a person can go on to technical college, from which in four years he graduates to become a high-level technician.

There are several specialty schools which prepare for some kind of technical work. Special youth schools take an unskilled boy and give him vocational courses up to two

years. They also give short courses-perhaps three weeks long- to improve the skills of adults. A person can take several of these in a progressive sequence.

FINLAND

Most children in Finland complete public school after eight years, the last two of which are practical in content. Many others continue through grade nine. Those preparing to be skilled workers take an examination to enter vocational school. They attend for two years or more, the first year's course largely theoretical. The basic syllabus is prescribed by the National Board for Vocational Education. Tuition and books are provided. Some specialized vocational schools are operated by the enterprises involved. Here workers in a decreasing number of cases, are indentured by contract as apprentices. Employers pay students wages and are partially remunerated by the National Board. Graduates are given examinations and diplomas by the Board. A few graduates go on to specialized vocational colleges to improve their skills.

Students from public school going to technical schools gain work experience for two years, or they can attend vocational school and then work for one year. The technical school course lasts for three years of eight months each. In the other months students find jobs to earn board and room. The school prepares for the technical examination.

The prerequisite for technical college is nine years of primary and secondary school, two years of work and an examination, or one year of work and the vocational school.

The examination prepares for the diploma called "College Engineer". The course takes four years.

Vocational and technical institutions are established and operated by the nation, or by a community or an industry with financing from the nation.

The number of applicants for this education is many times the number which the schools can accept.

SWEDEN

After six years of elementary education a Swedish student takes one course each semester in the line in which he hopes to specialize. For the technical student it begins with a discussion of the industrial structure of the nation and the world. In the eighth grade he makes three visits to commercial and industrial enterprises, after which he studies working life, occupations and the inter-relation between enterprises and the community. In the ninth grade he has two weeks working on the job and studies about the impact of technical development on worker, industry and society. With a career teacher he is planning his own future and seeing the demands for personal behavior and professional performance. In the school workshop he operates machines and faces problems of manual labor. All subjects of theory are introduced as they are needed to apply to problems.

From the seventh grade a few go to independent courses, but most study for two years, or they may enter from grade nine. They take specialized instruction in industry or a craft. A few are on the apprentice system.

In the ninth grade students take an examination to guide their planning for voluntary education. About one third of these go to vocational schools after at least half a year of practical work. They receive general education and technical

theory in school. Some workshops are in schools, some in enterprises. The two-year course is broadly based and practical, leading to direct employment.

A quarter of the students from grade nine take the continuation course in the gymnasuim. It is both theoretical and practical. It requires nine months of experience in an enterprise. It gives two years of school plus four weeks in one summer. It gives the graduate the title "Continuation School Engineer".

A third of the students from grade nine graduate to the gymnasium for theoretical courses. The technological line of three years imparts general knowledge common to all technology and develops the ability to use it. Theory is introduced as it applies to the working example of a problem. Practical training in the school workshop and an industry is required during the summers. Specialization increases each year. The only examinations are limited periodic ones. Graduation makes all eligible for a university or Engineering Institute.

A fourth year in the gymnasium is specialized. It prepares for high-level technology and leads to the title "Gymnasium Engineer."

For an adult wishing further training there are "Folk High Schools" without requirements for admission. They specialize in social, aesthetic and practical courses of eight months each. For advancing to higher levels profes-

sional associations and enterprises have courses. The National Board of Education arranges for special courses when people are needed to learn new techniques.

All schools are tuition-free, students get national allowances, and room and board are provided for students coming in from a distance.

NORWAY

After six years of general education students begin to make choices of courses. In the ninth year they take separate syllabuses. The National government provides literature about all educational and professional opportunities, and guidance officers for consultation. When asked, the officers give psychological tests in order to help students make decisions.

After this primary school the students receive a report including teacher estimates of their work and the results of a leaving examination. The poorest students may repeat the last year or go to training for skilled manual labor.

An apprentice course takes four years on the job with one day per week in school. A national board regulates time, wages and working conditions, and gives a subsidy to employers for their expenses. A more thorough course is given in a three-year workshop school full-time. These courses have mostly practical content.

From the primary school students of average achievement may attend a technical vocational school. The full-time course takes two years. The first half may be taken part-time. The course is half theoretical and prepares technical assistants.

Students of higher achievement from the ninth grade or from workshop school may attend technical school after a year of working. This gives an advanced theoretical course.

The curriculum includes the study of economic problems. The first year is also included in the secondary school. The two-year leaving examination gives the title; "Technician". The three-year leaving examination has the science part given by the National Assembly, which confers the title; "Engineer".

The best students from the ninth grade can take the science course in the three-year secondary school. After this they can take the technical school course in two years. Graduates from the secondary school or the technical school can enter the National Technical Institute or a university.

There are several opportunities for adults needing further training. A folk high school receives people seventeen years of age or above. A course of one or two years trains in skills. The practical part may be in workshop schools. Correspondence courses, giving government recognition, can raise the level of technical workers or help them become supervisors. There are special school-shops for handicapped workmen.

All education is tuition-free. The state and municipalities give grants for students living away from home and those with financial need.

The following is a statement of the high points of discovery which I made during the year, first for all countries in general and then with respect certain topics which may be of value to us in California Community Colleges. Following this is a report on a former study of European Apprenticeship, published by the International Labor Organization.

ALL COUNTRIES

Along with the technical training they give a generous amount of general education for one's living as a happy cooperative citizen. This includes education in morals and religion.

Common education is usually in primary school for six years and then in lower secondary for three years with some specialization. Technical education as discussed here follows this nine years of general education.

They give free tuition and other financial aids. In many countries the youth are employed and paid while taking specialized education within the hours of employment.

They emphasize giving each individual the chance to work at the highest level of his ability and motivation. They provide the means to transfer to schools which prepare for higher levels of achievement. This is done best in England. They give courses for adults who want to improve, and special courses for new skills or for retraining. Yet the manpower needs of technology are not being met, and all levels of trained persons are employed. Many countries import unskilled labor.

Students in the lower secondary school visit the higher secondary technical school once a week to learn of skills for which training is available and visit enterprises where these skills are being used. (England)

Grade 7 studies the intimate relationship between manual and intellectual work. Grade 8 visits business and industry, then discusses problems of production, labor relations and the interrelation between business and the community. Grade 9 has two weeks of work on a job, then studies technical theory, personal behavior and professional performance. (Sweden)

Each community has a counseling service for youth in lower secondary school and their parents, with orientation, helping a student choose a vocation and arranging scholarships, (Switzerland, Norway)

Youth undergo physical and mental aptitude tests before employment. (Italy, Germany)

TEACHING MACHINES AND AUDIO-VISUAL AIDS

Individual lessons by appointment are advantageous. Small films highly magnified have the most expensive projector but take the least room to store. (Scotland)

Teaching books are about as practical as projection machines and much less expensive. There are many good ones. Research has shown that a teaching program book and a live teacher are better than either one alone. The teacher points out links and relationships. It requires the least time to study in large steps rather than small ones, with comprehension almost as good. Most important is review. Children with reading handicaps do better with the help of audio-visual

aids. Youth who have mastered reading can do no better with them. (England)

A studio makes television programs with closeups which few students could see directly, and with animation. The teachers venture with their best attempts and then perfect the programs with experience. (Scotland, Germany)

ALL-SCHOOL PROJECTS

Each year students make some intricate mechanical device such as an operating steam locomotive. (England)

Students make bench vices and power hack saws. The income from the sale pays 30% of the cost of the shop. The school has done some original scientific research in compressing air with falling water. The students participate in an international competition annually. Each competitor makes a craft object during the competition. (Switzerland)

SAFETY TRAINING

Workmen are prepared with emphasis on precaution and a predisposition to think safety before employment begins, (England, Finland)

Engineering Industry Training Board
ENGINEERING INDUSTRY TRAINING BOARD

Beginning in September 1969, the Board is responsible for the quality and efficiency of training and the equitable distribution of the cost. It collects fees from each enterprise which uses students in its field and pays each school from this fund.

The course: Year 1: Induction, training in basic skills, the beginning of specific skills. Year 2: Six months of full-time training in one skill module and six months of work in an enterprise. Year 3: Like year 2. This is followed by full employment and a chance to take another module later on a voluntary basis.

INDUSTRIAL SPONSORSHIP

An association of eighty enterprises arranges for technical training, secures employment, schedules time in school and recommends subject matter. (Italy)

RESEARCH ON EDUCATION

The result of research indicates that, in addition to technical knwoledge, the most important ability needed by technicians is to understand and explain diagrams and tables. The abilities for which school graduates are least well prepared are: to take part in discussion, to work independently and to make laboratory reports.

EDUCATIONAL TECHNIQUES

Attempts are being made to use the methods of group dynamics to cause a youth to realize his possibilities and contribute to the solution of social problems. (Holland)

Technical training is theory applied to projects. Mathematics is taught in the context of the course to which it applies. (Holland, Sweden)

Students are given projects which include sociology, economics and engineering, called "function value analysis". (Sweden)

A state Council for Experiment in Education uses the resources of the whole country to determine the advisability of innovations. (Norway)

A technical school has motion-time-method studies in its laboratory for industry. (Norway)

Folk High Schools without prerequisites are provided for adults who had limited education. They have cultural and technical courses. (Denmark, Sweden, Finland, Norway)

Special education with attention to each individual is provided for those with handicaps or behavioral difficulties. (Holland, Denmark)

In a laboratory the teacher demonstrates resources. The student group explores possibilities and studies the literature for background information. The teacher gives the group a problem to work out. (Germany)

The teacher reviews old theory and intrudices new. The student group study and interpret textual material without the teacher. Students explain to each other what is poorly understood. The students prepare questions for the teacher. (Italy)

PHILOSOPHY OF EDUCATION

From the point of view of industry: The industry should choose the time schedule and release students to college in large blocks of time. The college should provide theory in the sequence of industrial work.

From the point of view of the college: It is more im-

portant to have educational courses suited to the student's ability than to have them matched with industrial training. The college has the last word on what is contained in a course. In the first year of training the trainee should be regarded as a student with industrial connections rather than a worker with educational connections. Technicians should be neither upgraded craftsmen nor failed professionals, but should be specially selected. (Britain)

The Department of Education is planning a pilot project to discover if general education for all youth up to age fifteen improves the life of the less advantaged student by giving him two more years of cultural enrichment. (Holland)

The educators aim to include in technical education the study of the demands of working life for personal behavior and satisfactory professional performance, and the study of the mutual influence between technical activities and society. They try to teach techniques as a means of serving ideals and aspirations. (Britain, Sweden, Belgium)

INTERNATIONAL PROJECTS

The Centre for Educational Development Overseas is preparing audio-visual aids and simple textbooks for the developing countries. (England)

The International Centre for Advanced Technical and Vocational Training is preparing persons from developing countries to administer and maintain industries and projects at home. (Italy)

The Organization for Rehabilitation Through Training has pioneered in providing vocational training programs for Israel. Now it teaches seventy occupations in sixteen countries. Its central institute for training of teachers and technicians is near Geneva. (Switzerland)

The International Labor Organization held a symposium on vocational training in 1962. They recommended training as a means of developing a person's occupational capacities and of enabling him to use his abilities to the greatest advantage. Every country should train to meet manpower needs, to facilitate transfer from one type of training to another, and to allow each individual to reach the highest level of training within his capacity and inclination.

They published a detailed report of their findings.

(Switzerland)

Thirteen-year-old students in twelve countries were given a standardized test in mathematics. Some of the most interesting findings were:

1. The best students achieve whether or not surrounded by poor students.
2. Inquiry-centered approaches to teaching produce higher and less variable scores than more traditional approaches.
3. Where teachers think they are given freedom in the classroom, student achievement is lower.
4. Where opportunities to learn are enriched, scores are higher.
5. Students who had had "new mathematics" achieved higher than those who had not.
6. Students with aspirations for higher education had higher scores than those who did not. (Switzerland, Husen)

ADDITIONAL NOTE

Only those persons in top-level engineering and science are university graduates. The great majority of youth aspire to the subbordinate jobs, where so many more good workmen are needed . These jobs are considered in Europe not only desirable but honorable as life work. Technical education and employment is more popular in all the countries which I visited than it seems to be in the United States. We need a more efficient system of counseling capable young men and women away from the Baccalaureate and into jobs where they are needed and where they can find equal fulfillment of their aspirations in life.

Furthermore, Europe still seems to expect of its workmen efficient use of its resources and careful workmanship of which they can be proud. Depersonalization does not seem to be as prevalent there as it is here.

by the International Vocational Information Research Center of the International Labor Organization

1. Children are staying a longer time in secondary school and having more vocational orientation before starting technical education.
2. There are more positions than there are applicants.
3. Basic technical education is increasingly using workshops prepared for the purpose and extending the time of introductory full-time school.
4. There is more emphasis on theory, non-technical general studies and measuring techniques.
5. Most practical training is on a regular job. Attempts are being made to coordinate work projects with theoretical education.
6. Training of skilled craftsmen is being extended over a larger number of years. Classes are within hours of employment. The median length is three years, ending at age 18 or 19.
7. More examinations are being prepared and supervised by central controlling bodies. For a test in skill a trainee is given a specimen job.
8. There is increased supervision by trade-sponsored semi-public bodies, with more written regulations and detailed syllabuses, but also increased participation of employers' associations in planning and supervising.
9. Each employer pays workmen an allowance depending on their age. Many employers provide the room, equipment and material for teaching workshops.

10. Graduates from apprenticeship have fulfilled all requirements for employment in a craft. Relatively few remain in the craft for which they originally prepare.

11. The system gives employers a broad basis from which to select and train workmen, and a wide margin of variation in practical training. The greatest weakness of the system is in the shortage of qualified teachers.

The report on the curriculum of mathematics is the most detailed for Britain where I made the longest study. For the other countries it is an estimate of the degree of emphasis placed on topics within the scope of mathematics from beginning algebra through calculus--what we teach in MSAC.

In the tabulation H is a high degree of emphasis, M is medium and L is low. The degree was determined by my perusal of text books and syllabuses to determine the number of countries which included each topic.

In Britain the code names the type of course, listing all the types which include each topic.

O is the ordinary upper secondary course which all pupils are expected to take.

A is the advanced upper secondary course taken by those aspiring to the highest levels of technical education.

G is the general basic engineering mathematics taken in technical college by all who did not complete it in secondary school.

T is the specialized technical mathematics for technicians and technologists.

ALGEBRA	Ten Countries	Courses in England
Arithmetic Review		
Add, subtract, multiply, divide	H	OGT
Natural and real numbers	M	O
Decimals	H	OGT
Percentage	M	OGT
Fractions	M	OGT
Algebraic Expressions		
Signed numbers	H	OG
Symbols	H	OGT
Add, subtract, multiply, divide	H	OGT
Properties of Numbers		
Commutation, association, distribution	M	O
Axioms	L	O
Counting systems	L	O
Algebraic properties	H	OG
Absolute value	M	OA
Set Theory		
Elements, subsets	L	O
Union, intersection	L	O
Mensuration		
Formulas	L	OGT
Areas and volumes	H	OGT
Approximation	L	OGT
Scientific notation	L	OGT
Functions		
Relations	H	OG
Mapping	H	O
Graphs		
Cartesian system	M	OGT
Data	L	OGT
Linear equations	H	OGT
Quadratic equations	L	OAGT
Maxima and minima	L	G
Equation solving		
One variable	H	OGT
Two variables	H	OAGT
Three variables	H	AT
Quadratics	H	A
Higher degree	M	A
Graphing	M	GT
Determinants	L	A
Relations of roots	H	AT

Products and Factors		
Products	H	OGT
Common factor	H	OGT
Difference of squares	M	OGT
Trinomials	M	OGT
Grouping	L	G
Exponents and Radicals		
Positive exponents	H	OAGT
Negative exponents	M	OAGT
Fractional exponents	M	OAGT
Radicals	M	AG
Rationalizing	L	A
Exponential functions	H	A
Logarithms		
Bases	M	A
Base 10	H	OAGT
Processes	H	AGT
Tables	H	AGT
Logarithmic graphs	L	A
Slide rule	H	OGT
Inequalities		
Notation	M	OA
Graphs	M	OA
Solutions	L	OA
Imaginary Numbers		
i notation	H	A
Complex numbers	H	A
Theory of Equations		
Binomial	L	A
General	L	A
Quadratic	L	A
Sequences		
Arithmetic Series	L	A
Geometric Series	L	A
Permutations	L	OA
Combinations	L	OA
Proportion		
Ratio	L	OT
Fourth proportion	L	OT
Variation	L	OGT
Probability and Statistics		
Probability	L	A
Statistics	L	A

GEOMETRY

Graphics		
Coordinate System	H	O
Vectors	H	O
Transformations		
Translation and Rotation	M	OA
Symmetry and Reflection	M	OA
Projection	M	OA
Lines and Planes		
Relations of lines and planes	L	T
Relations of planes and planes, angles	L	T
Logic		
Postulates	L	
Propositions	L	OA
Deductive method	L	OA
Geometric proof	L	O
Angles		
Classification	H	OGT
Parallels and perpendiculars	M	O
Measure relations	M	OGT
Polygons		
Properties	H	G
Quadrilaterals	H	G
Triangles: congruent, similar	M	GT
Areas	H	OGT
Pythagorean Theorem	H	OG
Circles		
Properties	H	OGT
Related lines	H	O
Measure relations	H	OGT
Sectors and Segments	M	GT
Loci		
Conditions	L	O
Intersections, Concurrence	L	O
Construction		
Angles and triangles	M	
Perpendiculars and parallels	M	
Solid Geometry		
Lines and Planes in space	L	
Revolutions	L	
Sections and surfaces	L	

Trigonometry and Analyttic Geometry

Trigonometric Functions		
Circle of radius 1	H	OAGT
Sin, cosin, tangent	H	OAGT
Six functions	M	A
Four quadrants	H	A
Graphs	H	AGT
Tables, logarithms	M	T
Identities		
Rules	H	AGT
Sums	H	GT
Products	H	GT
Oblique triangles	H	T
Equations of a Line		
Slope, parallel, perpendicular	H	OA
Forms of the Equation	L	AT
Introduction to Conic sections		
Parabila, circle, ellipse	H	OA
Change of Origin	H	A
Parabolas		
General equation	H	A
Different axes	H	A
Tangent and normal	H	A
Other intersections	M	A
Circles		
General equation	H	A
Different axes	M	A
Tangent and normal	H	A
Intersections	M	A
Sphere	L	A
Ellipse		
General equation	H	A
Foci	H	A
Tangent and normal	M	A
Intersections	M	A
Ellipsoid	L	A
Hyperbola		
General Equation	H	A
Parametric equation	L	A
Asymptotes	H	A
Vector Analysis		
Add, subtract	L	A
Multiply by scalar	L	A
Three-dimension	L	A

CALCULUS

Function		
Basic concept	H	A
Rate of change, velocity	H	A
Slope of tangent, limit, $\Delta x \rightarrow 0$	H	A
Differentiation		
Constant	H	A
Sum and difference	H	A
Product and quotient	H	A
Trigonometric	H	A
Higher derivatives	H	A
Graphs	M	A
Logarithmic functions	H	A
Function of a function	H	A
Inverse functions	M	A
Implicit functions	M	A
Integration		
Standard	H	A
Variable and constant: sum, product	M	A
Change of variable	M	A
Trigonometric functions	M	A
Applications		
Area under a curve, development of curve	H	A
Volume	L	A
Geometric figures	L	A
Mechanics	L	A
Solid of revolution	L	A
Differential Equasions		
First order	L	A
Second order	L	A
Application to mechanics	L	A

REPORT

on a European Curriculum Study in Mathematics made by W. D. halls and Doreen Humphreys of the Oxford University Department of Education for the Council for Cooperation, set up by the Council of Europe. It is the result of a questionnaire sent to sixteen national Boards of Education. They were asked for a report on the detailed list of topics in mathematics required for the final examination in secondary school of the student completing the highest level of mathematics.

A long list of topics was sent out. Some of them were often required and some never. From the responses there emerged a common core of mathematics required by all the countries and a surprising lack of consensus about all the other topics.

Another observation resulting from the analysis is: "It would seem that the attainment of general objectives is almost more a question of method--the way in which the content of the syllabus is taught--rather than the syllabus itself." (page 15)

The following is the list of the common core topics with the degree of emphasis imposed in each country: high, medium or low. Each number indicates the number of positive answers to each degree. The total is sixteen in each case except where the information on an answer was insufficient. (See next page.)

Other conclusions of this study are that mathematics occupies 18.5% of the time devoted to all subjects, and that of the time spent on mathematics, 6.4% of it is on Euclidean geometry.

The trend for the future is toward the inclusion of modern mathematics, set theory and vectors, and of probability theory and statistics.

COMMON CORE TOPICS	DEGREE OF EMPHASIS		
	High	Medium	Low
Polynomials	7	9	0
Rational Functions and their Graphs	6	9	1
Relations between roots of second degree	7	9	0
Algebraic Equations	8	6	2
Mensuration of pyramid, cone, sphere volume and surface	6	7	3
Sine and cosine rule for triangles	8	5	3
Analytic geometry of line and circle	9	6	1
Focus and directrix of parabola, ellipse, hyperbola	12	4	0
Analytic geometry of parabola	6	9	1
Ellipse and hyperbola; principle axes; Rectangular hyperbola: assymptotes	5	9	2
Differentiation and derivatives	6	8	2
Identities	6	8	1
Inequalities: modification, second degree	6	7	2
Theory of numbers	0	9	4
Limit F(n) $n \to \infty$	1	7	5
Limit F(x) $x \to a$	1	8	6
Continuity	0	6	7
Arithmetic, geometric series	5	8	1
Maxima, minima, inflexions	5	9	1
Simultaneous equations (3 linear, 1 linear) second degree	4	10	1
Definition and properties of definite integral	1	9	3

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