Technology in New York State Education System

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David Hendley looks at the way technology teaching is organised in New York State

There is widespread recognition in the industrial world of the importance of education in technology. The introduction of Technology as a compulsory subject in the National Curriculum in England and Wales was driven by a very clear vision of *why* Technology should be part of the curriculum of all pupils. The Orders for Technology made it clear that technology should not be seen as a 'retread' of craft subjects, but as a 'broad-based introduction to the way the adult world tackles designing and making' (Clarke, 1991). Technology was seen not merely in vocational terms, but as an essential component of the education of all regardless of future careers. It was felt that everyone needed a broad-based understanding of the processes involved in product design and making to increase their ability to be critical and discerning about choice of products and systems. The result was a curriculum which focused upon the processes of planning, designing, making and evaluating in design and technology, rather than prescribing specific content. At the heart of this holistic approach to Technology is pupil acquisition of technological capability in which pupils can be expected to produce solutions to problems which can be tested in use. It is, therefore, far more than practical capability that the National Curriculum is expected to achieve. Design and Technology was seen as the place where the abstract and the practical met and there were high hopes in its ability to end the rigid separation of the academic from the vocational.

The government was also concerned to change the attitudes of both pupils and teachers as well as the general public towards technology and in particular improve the status ascribed to vocational qualifications. Such qualifications should be seen as having equal status with advanced level academic examinations, and increasingly be seen as a legitimate and important route into higher education and better jobs.

It is in this context that I, a teacher educator with responsibility for the training of teachers in Design and Technology, became interested in finding out how the United States approached technology in its schools. I decided to make a study visit to what is, after all, the largest industrial nation in the world to find out their attitudes towards Technology and how they translated into curriculum planning and practice within schools.

In the summer term of 1994 I arrived in New York State (NYS) and spent three weeks visiting schools, observing technology lessons and talking to administrators, teachers and pupils about technology. In this paper I report on this visit and make some observations about the very different attitudes which are held towards technology and how this influences the ways in which NYS approaches education in technology.

The System

The pattern of education throughout the United States is very similar to that of the UK. It is basically divided into two phases:

Elementary school

Secondary school (comprising middle school and high school)

Elementary school is sometimes subdivided into primary and middle school. Primary can be Grades 1 through 6, and middle is Grades 7 to 8 (possibly subject to change). Grade 1 is for 6/7-year-olds. As a consequence students start high school at age 13+ years. Kindergarten is available for children from age five and runs for one year.

High school runs from Grade 9 to 12. In New York State the school day is generally from about 8.15 am to 3.30 pm with one half-hour break for lunch and no morning or afternoon break. Teachers have preparation time almost every day and can take coffee during these periods. They are much more relaxed about leaving their classes for short periods. The curriculum is decided state by state and there is no National curriculum. This is protected in the Constitution. Thus New York State determines the core curriculum for its schools. Within the elementary phase, the compulsory parts of education are:

Music
Art
PE

Also, the State recommends the following should also be taught:

Library
Computer.

These five areas have specialist teachers. The remainder of the curriculum, described below, is taught by the Grade teacher. The Grade teacher usually stays put and the students move to another teacher each year. Occasionally the

teacher will stay with the class as they progress through the grades. The above are considered to be an important part of this phase of education. Students are also taught maths, language and social sciences; very little technology is taught. The students' progress is checked (together with a check on the teaching) through grade tests and Pupil Evaluation Performance Tests (PEPs). These latter occur at the end of Grades 3 and 6. The grade tests occur as follows:

Grades 3 and 6
Maths and Reading

Grade 4
Science (a practical test)

Grade 5
Writing

Grade 6
Social Science (short answer, multiple choice and essay).

In the high school phase, the first two years appear to be fairly general, and much the same subjects are followed, with the addition of a compulsory technology course, which must take up 40 weeks of the two years, usually in 20-week blocks. After this period, students have to complete the following compulsory subjects:

Maths	3 years
English	4 years
Science	3 years
History	4 years

Modern Foreign Language 1 year

Introduction to Occupations, which includes the structure of occupations, finances, etc.

The students then opt for courses which lead them into the career choices or college routes. Some of the courses are technology based. These will be described later.

Technology in New York State Schools

The New York State definition of technology is 'the systematic approach to solving problems through human and man-made and natural resources' (State Education Department, 1987).

It is interesting to compare this definition with the statement accompanying the new Orders for Design and Technology in the UK: 'Pupils should be taught to develop their designing and making skills with knowledge and understanding in order to design and make products' (SCAA, 1994).

There is no National Curriculum for technology in the USA. There are some states where an industrial arts type curriculum is provided. In these states students work on set projects. In New York State there is a great emphasis on problem solving and the use of a range of resistant materials including ceramics.

In NYS, there is no formal technology taught in the elementary schools. In the high school, technology is a taught element, which has a fairly loose structure of areas to be covered. The Education Department has produced teaching materials for Grades 7 and 8 which cover a wide range of areas in order to '... enable seventh and eighth grade students to understand the concepts that underlie technological systems....the majority of children in these grades will benefit educationally from concrete experiences which will involve a variety of senses' (New York State Education Department, 1987).

The State has produced a ten-module course. These modules are:

Getting to know technology
What resources are needed for technology
How people use technology to solve problems
Systems and subsystems in technology
How technology affects people and the environment
Choosing appropriate resources for technological systems
How resources are processed by technological systems
Controlling technological systems
Technology and society: now and in the future
Using systems to solve problems.

Time spent can be as little as one week per module and there is no upper limit. All the State requires is that these areas are covered during the 40 weeks. At the same time students will engage in 'Home and career skills'. There appear to be no mandatory areas to be covered within these.

All the modules are practically based. The State Education Department believes that '...the use of modern tools and machines is an excellent method of providing children with

the successful, creative experiences that help build the skills and confidence needed to live in an ever-changing environment.' (ibid.). The course is hierarchical in nature and builds on knowledge and skills learnt throughout the course. The basic premise is that technology is an all-pervasive part of life; so, through a study of the resources which are common to all technologies, students are provided with conceptual tools which can be used in problem solving in three aspects of technology:

biologically related technology
information/communication technology
physical technology.

Students further their understanding of technology as they study the ways that humans have combined the resources of technology to create technological systems. Finally, students address additional generic technological concepts such as control, career opportunities and societal implications of technology.

The course is based on the premise of providing links between theoretical concepts and practical applications and that technology is itself an interdisciplinary subject. The course itself also has several 'constants' which reappear throughout. These are:

systems of technology
mathematical concepts
science concepts
societal implications
communication skills
safety and health
psychomotor skills
career-related information
creative problem solving
transfer of learning.

The students are also required to complete a course in home and career skills. Here they learn about home economics etc.

In Grades 9 to 12, students can study some areas of technology or not. Textiles and Home economics are a part of the curriculum in New York State, but there is no link to technology. It is a separate subject area. The emphases of technology are solely around resistant materials and computers. Similarly, business courses are considered to be separate from technology. They do not see a direct connection, other than the identifying a need, costing and research.

There are a number of Technology options including:

construction materials
engineering science
CAD
production
transport.

Teachers did not consider themselves to be well resourced. Each school had a room of computers devoted entirely to CAD, with one machine per student (one wonders what they would need to regard themselves as well equipped!). The workshop areas all have at least ten computers. There is a division of opinion, as in the UK, as to whether to use IBM compatibles or Macintosh. The division appears to be evenly split. Most teachers use Autocad as standard. The New York State technology programme is not a compulsory one. The only requirement is for schools to provide a 40-week course in Grades 7 and 8. If schools adopt the New York scheme, they will have all their lessons set out for them, together with strategies for delivering every lesson.

School Visits

I visited a semi-rural part of New York State with characteristics similar to those within the area in which I work in South West Wales. Over a three-week period I spent time in two elementary schools, two high schools (one rural and one urban of each) and one vocational school which serviced all the high schools in the area. I spoke to administrators (in the NYS administrators have much control over the content of the curriculum), principals, teachers and pupils and visited a number of classrooms to see technology in action.

Although not compulsory, all the school principals I met were in agreement that technology is an essential part of their schools' programmes and make time and money available in order that the subject receives priority. However, none of the schools I visited had adopted the New York State scheme as described above. There seems to be great resistance towards accepting a curriculum determined at government level, and whilst they were all familiar with the scheme and felt it had a lot to offer, had decided it was not for them. Instead the schools had designed their own courses, one of which I describe below.

School Technology — some examples

The schools offered a course called 'Design and Drawing for Production' in which students learn the various methods of sketching and drawing manually at first in order to teach the various concepts. They are introduced to CAD at a later stage, when they have had plenty of practice in the manual skills and have gained an understanding of the concepts. This removes the necessity of teaching more than one concept at a time. Students do not undertake much model building, but there is a quite a lot of drawing and sketching taught including perspective, isometric and orthographic. Rendering and other methods of adding colour for enhancement are also taught.

In Grade 9, ages 14 and 15, they have an architectural drawing class in which the students design their own ideal house. They produce a floor plan, elevation views, wall sections, lighting and heating schematics. They write up a report on the choices they have made. They also build a scale model of their plan, using card, foam card, wood, etc.

Workshop Facilities and Students

The facilities schools have to support technology is impressive, and far exceeds any provision I have seen in the UK. Workshop machinery is quite extensive although the age of the individual pieces is variable. Students are allowed far greater access to these machines than they are in the UK. For instance, radial arm saws are extensively used by students. They receive individual training on the machines and are not allowed to use them on their own until the teacher is satisfied they are safe to be left. The number of students per class is less than in the UK. On average, in Grades 7 and 8, possibly 15 students, in Grades 9 to 12 around 10–12 students per class. The workshops are also much larger than those in the UK. The amount of tools is sufficient for each student to have a complete set, so there is no need to share. Materials do not appear to be a problem, although all teachers I spoke with say that they do not have enough. Some of the projects the students are involved with are much larger than those attempted in the UK. For instance, most students will build a barn. This is done in sections in the workshop and then transported out to a suitable site for erection. Perhaps, it is worth observing here that most houses in the US are wood-framed and so work of this sort is valuable; also very many Americans do expect to build their own house.

Information Technology

The resources for IT are extensive, although the teachers I spoke to use Autocad as the CAD system. Those who run it on PCs say that Macintosh is not quick enough. However, those who do run it on Macintosh do not complain. Most of the schools I visited are expecting deliveries of more computers to update their present stock. They seem to think that their current computers will remain with them.

The elementary schools also have excellent computer facilities to support the compulsory subject of computers on the curriculum. In these schools 'Technology' meant computers. The children in these schools had computer lessons every day and additional work in subject studies to promote IT across the curriculum. As far as I could tell the elementary schools had opted for the Macintosh because of its user-friendly capability.

BOCES — Board of Co-operative Educational Studies

I also visited a BOCES school. These schools were set up about 20 years ago to act as vocational schools. Initially, they were state funded, but now finance themselves by high schools paying for their students to attend. The way they work is as follows: students in Grades 11 and 12 can spend half of each day at the BOCES, instead of at their high school. The remainder of each day is spent at their 'home school'. What seems to happen is that students who are not academic high flyers or who have discipline problems in the high school are those who attend BOCES.

It is noticeable that the students are all motivated and work well without too much overt supervision. One class I observed stayed on task for one and a half hours and then cleared up at the end of the session without being told. The workshop was swept clean, the tools and equipment were checked back into the cupboards by the students. The teacher did not have to say anything to them. The ethos of all schools I visited was one of working. They do have discipline problems, but the scale is

much reduced. However, we should remember than this is a semi-rural area and it is well known that some areas have real problems!

The courses offered are all vocational: cosmetology and hairdressing, commercial food trades, trade electricity, computer information technology, welding, carpentry, mechanical technology, conservation, auto body repair, auto mechanics, health assisting, building trades (discontinued at present), criminal justice, heating, ventilating and air conditioning/refrigeration, machine trades, mechanical science, plant/ animal science, secretarial information technology, small animal science. However, this facility in the US is a vast scheme with many teachers, many of whom have come from industry and commerce to work with young people. They are all trained teachers.

All courses award a certificate on successful completion of the course. These awards are recognised by employers. All courses include an element of work experience. This is proving very successful now after a hesitant start. Many students are being offered jobs with their work experience firms on completion of their course. Some courses are beginning to get some nationally recognised awards for their students on completion of their course — commercial food trades for example. An interesting feature which is offered is a young mother school. This offers young mothers nursery facilities for their children while they attend school to graduate. In the normal high school this is not possible.

Of the courses offered, the most interesting to me were the electrical trades and mechanical technology courses. Both courses are of two years' duration and have a requirement that students pass the first year before they progress to the second. The electrical trades course covers areas such as house wiring, industrial wiring, alarm installation, telephone installation, computer-based costing, computer programming in BASIC and computer control. The course leads straight into degree programmes in electrical and industrial electronics.

The mechanical technology course covers areas such as technical drawing through to manufacture of designs, using injection moulding, vacuum forming, etc. The students design and make the moulds for their projects and then use them to make their products. The course also offers CAM facilities. The system used is not the most modern, but one that provides a good progression for students from their CAD work. Basically, the students produce a simplified program of the shape of the workpiece, which the machine would translate into G and M codes. The students save their work on tape, and this is then checked by the teacher, before the tape is taken to the CNC milling machine and the programme executed. The teacher is reluctant to introduce linked CAD/CAM at present. He does not see the need for this as it may confuse the students. They have a better feel for what is happening with his methods. The course leads directly into apprenticeships and degree courses in mechanical design as well as providing recognised qualifications for jobs.

Conclusion

The New York State scheme for technology does provide a different structure and purpose for technology in its schools compared with that of England and Wales. The New York State system also puts a much greater emphasis on the importance of technology in that its status as a subject is much greater than in the UK. However, it is only compulsory in Grades 7 and 8. Students appear to put together their own timetable based on their interests, which will include free time, and select their own major areas of study. They can also pick up other courses which can complement these major ones. There appears to be a gender division after Grade 8 in that not many girls take technology. In the schools I visited I found approximately five girls taking courses in some form of technology, usually the CAD-based ones.

The students are educated to be self-reliant, and so the work which is set them is generally completed without too much insistence from the teacher.

The BOCES in particular seem to produce highly motivated students who use their time in these institutes very well. The work experience elements of the courses here are somewhat different in that students are encouraged by the companies who take them on to return for a full-time job when they leave school.

It would seem that the differences between New York State and England and Wales are many and can be summed up as follows:

- There is a very different perception of the type of technology which should be taught

in schools, England and Wales emphasising the process of designing and making products, NYS emphasising problem-solving skills, how technology affects society and vocational training

- In England and Wales technology is seen as something for all children, an important component of a balanced, broad education intrinsically relevant to all regardless of academic ability or vocational leanings. It has a much narrower target audience in mind in NYS with an emphasis on vocational skills and training
- As a result of the non-compulsory nature of technology except in Grades 7 and 8, very few girls opt for technology, whilst here all girls from 5–16 (14 in Wales) have to study technology as part of the National Curriculum requirement
- The decision of the UK to focus on the processes has meant that the updating of vocational courses has lagged behind. There is a tendency for the same craft skills to be taught through a design and technology framework, whilst in NYS the latest advances in computer control, electronics and mechanical technology have been introduced.

As we move towards the end of the millennium it is natural to speculate on what kind of education will be most relevant for our children, most of whose lives will be spent in the 21st century. Most people seem to agree that technology is an important part of education for the future. However agreement over the form it should take or the opportunities it should provide and the purposes it is intended to meet is, as we have seen in this brief comparison with NYS, far from settled.

I would like to thank all the teachers and students in New York State who made me so welcome and treated my questions with patience and understanding.

References

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DATA's Guidance Materials for Design & Technology

Key Stage 3

In March this year, DATA published two packs of guidance materials to support the new Order for Design & Technology. Some 22 conferences were held across the country, to introduce teachers to the new Order and to DATA's support material.

Two Units of Work from the KS3 pack are reproduced here, so that readers can get a flavour of what is available. They were created by a writing team of Ali Farrell, Eileen Small, Mark Hudson and Barry Payne and have been widely praised for their breadth of coverage and their practical approach. The pack contains the following:

20 page booklet
32 Units of Work
A Units of Work Framework
A Pupils' Planning Sheet
An A3 Planning checklist
An A4 Level Descriptions card

Packs are still available at £7.50 each (£13.50 to non-members). Contact DATA to place your order.