# 'Somertech' The Somerset Primary Technology Programme

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Let us tell you how Somerset planned the development of technology in primary schools. The main aims were to heighten teachers' awareness, to help them recognise the inter-relationship of science and technology, to boost their confidence and expertise and stimulate their ability to promote creative innovation in their teaching.

As Advisory Teachers involved with teacher training there was more opportunity to come to terms with this problem, consider it in depth, attend courses having model-making as their theme — together with aspects of control technology. The majority of you will have gained stimulation from these courses and we are indebted to all those trainers of trainers.

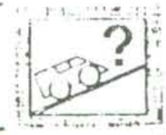
The first trainer we encountered was David Jinks; a budding, enthusiastic professional full of humour but most of all with a way through with bench hooks, junior hacksaws and the — some say — eternal triangles. Isambard Kingdom Brunel seems to have used them as well, although he had not been on a David Jinks course — as far as we know. Our 'encounter' with David, and the message he put across, enthused me and set in motion a series of events.

"God forbid that anybody sets up kits of parts to assemble to plans," he said. We couldn't agree more. We needed to stimulate innovation through original thinking based upon a sound knowledge of skills and techniques. There was a need for accuracy in model-making and relevance in the size of material used to the needs of the children. Dimensions of 8 by 13 mm for wood section did not seem appropriate to for 5 year olds and this age-group had to be the starting point.

**THE PROBLEMS.**
The problems envisaged were as follows (remember, this was in 1984):-

1 To promote technology we needed to make an advance from static models and move towards working models designed and made by children from age 5 years.
2 There was a need for great accuracy in model-making to enable variables to be isolated and, eventually, controlled.
3 Children at that time were being asked to handle tools designed for adults.
4 The curriculum was seen by many to be becoming overloaded. To be accepted in our schools, technology had to be seen to be relevant. There had to be a way of teaching basic skills in a progressive way, which once learnt, could be applied quickly and effectively to problem-solving situations.
5 Safety in the use of tools and the avoidance of toxic adhesives.
6 Cost had to be kept to a minimum; reliability of equipment was vital and effective storage was a major consideration in schools designed by — accountants, or victorian philanthropists?
7 Continuity of learning had to be achieved. Often children needed a test rig to carry out science experiments. At that time, they had to wait six weeks for suitable equipment to be made at the Technology Centre. Was it possible for children to design and make their own equipment?

## TECHNOLOGY



### 'TECHNOLOGY' – The application of science, especially as an aid to investigation through practical problem solving

**3-Dimensional Construction**

Investigations into pulleys – direct drive to drive
- drive to drive with variable pulley size.
  Gearing up/down
  Change of speed.
- drive to drive with twisted belt (180°).
  Change direction of rotation.
- drive to drive with twist belt (90°)
  Change of plane of drive.
  cams.
- rotary to linear transfer of motion.

Investigations into cogs. – drive to drive with 90° change of direction of drive.
- 'specialist' cog-like constructions (waterwheels, etc).

8 Encouragement, confidence, skills and techniques needed to be imparted to 240 primary schools with a teaching force of some 1500 teachers — quickly.

9 The county was large with remote areas

10 The need to stimulate creative design; encourage quality and precision modelling and eventually provide the means for children to 'control' their models.

11 We needed the facility to make models in the cross-curricular context. e.g. for history and environmental projects.

**WHERE TO START?**
From the need to make accurate working models, safely, it was thought that some form of jig system could prove useful.

We are very fortunate in Somerset to have a Science and Technology Department having excellent facilities in the machine shop with technicians to back up requests from primary and secondary schools. Wood was the most appropriate material and was selected on a cost basis.

The next decision concerned the size of the wood section. Here it was thought that the first standard measure to be encountered by children would be the centimetre. Such dimension would also facilitate measurement when they began to be involved with design.

**THE CREATION OF A JIG SYSTEM**

**'The Cutting Jig'.**
Having produced some centimetre square section wood, the next problem was to hold it securely for cutting. It must be emphasised that the whole strategy was based on the use of the Jig-and-tool system by very young children. Thus a channel was provided in a wooden base plate to hold the wood section.

The majority of children of this age only use non-standard measures such as hands and feet. This problem was overcome with a simple jig pin used within the channel to peg off centimetre dimensions indicated on an adjoining scale. The wood to be cut slides along the channel to rest against the jig pin to provide a pre-set length for cutting.

The next aspect to consider was safety in the use of a cutting tool. Firstly, the cutting tool. A square and vertical cut was needed for accurate modelling. A wide bladed tool — a gents saw — was chosen, rather than a junior hacksaw which might require frequent blade changes and be subject to bending, or blade shatter in inexperienced hands. It had to be a good quality tool operating within a saw guard on the Cutting Jig, and having a separate guard for safe stowage when not in use. The jig was also designed so that the stiffening bar on the top of the blade 'bottomed' on the guard when the cut was completed, thus protecting the furniture.

An additional requirement was a facility to cut mitres, so a detachable, channelled guideblock which locates within the main cutting channel and is locked with the jig pin was provided. At this stage, two further channels were made in the base plate to enable the safe cutting of different sizes of dowelling.

The main jig pin 'measuring' facility provided at this stage was considered to be the first step towards adult competency. We did need to think about progression, so sighting holes were provided in the saw guard which enabled pre-marked wood to be accurately positioned for cutting when intermediate dimensions were called for. The technique of cutting to just leave the line was the objective — the adult skill.Finally, a bench bar was added to the jig so that it could be easily adapted for left, or right hand use.

**'The Assembly Board'.**
Next, the assembly of structures was considered and, although right-angles abound on a table top, so might the proliferation of glue. A simple right-angle Assembly Board was created upon which 2D structures could be put together by rotation. To aid neatness and accuracy the side plates were made slightly deeper than one centimetre to allow small fingers to locate glued triangles in the corner of

## Science and Technology Themes

| | |
|---|---|
| **Transport** | |
| Basic Chassis | – Four wheelers ... vans, cars, lorries, trains, trucks. |
| Box Buggy | – Three wheelers ... road roller.<br>– Two wheelers ... trailers. |
| Power Buggies | – Land yachts, dragsters, racing cars and vehicles.<br>– Sailing boats, power boats, hovercraft, tractors and tanks. |
| **Environmental** | |
| 3-Dimensional Structures | – Buildings (house, school, church, garage, railway station).<br>– Box constructions.<br>– Tower constructions, bridge constructions (beam, cantilever, suspension)<br>– Insulation of buildings, soundproofing, electrical installations.<br>– Electrical circuits for alarm systems, control for working models. |
| Industrial Machines | – Cranes, hoists, lifts, conveyors, drills, wind and water mills. |
| Domestic Machines | – Drill, record player, food mixer, rotary whisk, seed disperser. |
| Leisure & Entertainment | – Fairground roundabouts, toys (helicopter, bird) |
| Robot Constructions | – Devise a task to be carried out - design/make a robot to perform the task. |

## Progression – Phase 1

| Buggy Type | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Box Buggy | 1. Box size and shape.<br>2. Wheel size (diameter).<br>3. Load (mass). | 1. Wheel tread. | |
| | Knowledge of how to construct/fix and use different kinds of wheel, the axle and axle bearer. | | |
| Basic Chassis Buggy | | 1. Wheel size (diameter, tread thickness).<br>2. Load (mass). | 1. Streamlining (card box over standard chassis.<br>2. Time taken over fixed distances e.g. 2m.<br>3. Acceleration/deceleration. |
| | Knowledge of how to build the basic buggy chassis.<br>2-Dimensional rectangular construction, and different wheel types. | | |
| Basic Chassis Buggy + Wind Power | | 1. Wheel size (diameter).<br>2. Mast position/height.<br>3. Sail material.<br>4. Sail size/shape. | 1. Sail position (set of sails).<br>2. Multiple sails. |
| Basic Chassis Buggy + Elastic Power | | 1. Wheel size (diameter).<br>2. Propeller power type and size.<br>length, type, size of band. | |
| | Knowledge of how to build cogs and pulleys, transference of energy and direction of drive. | | |
| Basic Chassis Buggy + Electrical Power | | | 1. Application of electricity (motor, lights, etc.).<br>2. Control of powered vehicle. |
| | Knowledge of gearing, transference of power, circuits and control technology. | | |

## Progression – Phase 2

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Cuboid Construction + Pulleys | Basic cube (static):-<br>1. A box.<br>2. Buildings/houses:<br>- dimensions:<br>- rigidity, stability, strength.<br>'3D' Constructions with wheels:<br>1. Wheel size (diameter).<br>2. Load (mass). | '3D' Constructions with pulleys:-<br>1. Pulley size.<br>2. Pulley combinations.<br>3. Gearing up and down.<br>4. Direction of rotation. | Pulley developments:-<br>1. Transfer of motion – rotary to linear.<br>2. Linear to rotary.<br>3. Electric pulleys. |
| | Knowledge of how to make '3D' constructions. | | |
| Cuboid Construction + Cogs | Fix and use axles and pulleys. | | Cog developments:-<br>1. Input – output, with changed direction of drive.<br>2. Cog size. |
| | Knowledge of how to make cogs. | | |
| Cuboid Construction + Pulleys and Cogs | Fix and use axles and cogs.<br>Knowledge of gearing. | | Mixed cog and pulley machines:-<br>1. Single input to multiple outputs.<br>2. Transfer direction of drive. |
| | | | Powered machines:-<br>1. Air<br>2. Water<br>3. Electricity |
| | Knowledge of power, gearing, circuits, control, special cogs. | | |

the work more easily. The jig also encouraged the making of a set square by the children for subsequent use in 3D modelling.

**'Cogwheel Assembly Boards'.**
*two further Cogwheel Assembly boards having different radial amplitudes, and central spigot were produced to help the children control the work in progress.

**'Drilling Jig'.**
For slightly older children, some means of drilling holes vertically, and in safety, when under responsible supervision was necessary. Here again, a quality handtool was recommended (but not supplied — Authorities might well purchase in bulk, as we did). Considering cost again, a jig was made which clamped the work to be drilled and provided a bushed guide for a drill operated by a hand drill. Safety was again considered when using 4.7 and 4.8 mm drills in that when fitted fully 'home' in the hand drill, the chuck in operation 'bottomed' on the guide bush thus limiting the depth of penetration of the cutting tool. A bench bar aided the two-child operation of drilling; one child centring and clamping the work while the other performed the drilling operation. Co-operative teamwork.

Needless to say, the creation of this set of jigs involved the skills of our two technicians, john Hale and Gerry Chard, who put up with my outlandish criteria, however, eventually a prototype was produced.

The fun of creating something which works enveloped the Christmas holidays and several models were produced and shown to our Science Advisor, John Brookes. The complexity and accuracy of the models of a crane, an electric car with remote control and a house with removable inside walls to investigate cavity wall insulation met the initial reaction, "That's great but only for fourteen years olds!" The response was, "No! Progressively from the age five."

**TRIALS.**
Trials were agreed, and reported on by schools, and an ESG science course. The response from teachers and children was most encouraging. Some modifications were suggested and incorporated, and further trials carried out.

The vision and foresight, dare I say risktaking, which then ensured to back the project as a teaching aid with considerable financial support has since been shown to have been worthwhile. Many doors were knocked on in the Industry/Education Year to provide some small amount of additional finance.

**THE WORKING PARTY.**
A Working Party was formed of those most closely involved — the Advisors for Science and Technology, my colleagues in the Primary Science Support Team and teachers who had been involved in the trails.

Further modifications were made and a book produced — 'Somertech' — which, in very simple terms, explained the skills and techniques of 'one' way of making models with wood. No plans of models were included; we wanted creative innovation to develop from skills and techniques through problem-solving approaches.

It was, naturally, considered very important to acknowledge the work of David Jinks whose basic ideas has stimulated us to action and this was contained within the book which we sent to him with a kit. We need to support each other and acknowledge other people's work.

It was imperative to encourage participation so ideas for 'Work Briefs' and 'Design Challenges' were included. Similarly, a structured approach to learning; the need for 'progression' was essential, so formed part of the book. Much thought was given to 'Control Technology' but at the time it was thought that the cross-phase problem of continuity would cause difficulties in the secondary sector unless a staged introduction was agreed.

**Reference:**
Some ideas for 'Work Briefs' and 'Design Challenges' plus some considerations regarding 'Progression' are contained at the end of this document.

Since then, every primary school in Somerset has been provided with a kit and the book, and has had one member of staff attended a course on the use of 'Somertech'. We have further the idea of 'class sets' to provide individual jigs as

well as kits, and invested considerable capitation on tools to produce equipment and back-up consumable materials.

**COMMENTS.**
It is important to acknowledge that many individuals, institutions and authorities have come up with excellent equipment to serve our needs as teachers. Our way is only one of many approaches so we tend to provide our teachers with the opportunity to see as many ideas as possible. It is for them to decide what works best for their children. However, it must be said that those who have approached technology teaching from the create-from-scratch viewpoint as opposed to using construction kits from educational supplies have one great advantage. At the end of the day, the children can take their models home. They do not have to be dismantled for the next lesson or for another class of children.

Of course, there are many materials other than wood which we should be working on — straw, metal and plastics etc. From the start, our courses have always included familiarisation, structured play and the skills and techniques of using many marketed construction kits. A thorough knowledge of their potential can contribute enormously to progressive learning and subsequently invite designs which link these source materials to advantage.

What has been the result, so far, of this overall strategy which started in 1984?

Many people were apprehensive about the 'word' technology.

When it was suggested that in three days time they would have made quite complex models similar to those displayed, reacted, "No way!" But they did succeed and you will have found the same. They were delighted. More importantly, they were able to impart it to their children.

We see evidence of this heightened awareness and development of expertise in science and technology at our annual 'Science Fairs'. Each year the Primary Science Support Team set design challenges for infant, lower and top junior children and judge the events. The first year, 10 schools and 100 children attended a single fair. Last year, 106 schools and 3500 children attended eleven fairs across the country. This year, inspite of the many commitments which teachers have, the attendance has been maintained. However, we have moved into a new phase. Groups of schools are now organising their own fairs; holding them over a longer period and extending them to the evening so that parents can attend — a good communication link. Finally, the centrally organised fairs are being held in secondary schools which serves to encourage inter-phase liaison.

**SOME UNFORSEEN BENEFITS.**
There have been some spin-offs from all of this which had not been envisaged when we started. Special schools have become very much involved. They have found that many of their children who, among other things may have problems with manipulative skills can enjoy success through the use of the jig system. The older children have used the skills and techniques to create 'mockups' of eventual full sized projects. Technology, or applied science — whatever you wish to call it, is certainly giving a sparkle of success to these children.

Some two years ago, through the local DESTECH branch, Heads of Science and technology from secondary schools asked to be shown what was going on in their linking primary schools regarding technology. Twenty-five members were somewhat 'surprised' to see the extent and quality of work being produced. They were also, may I add, somewhat concerned when faced with control technology models made by girls and boys aged 9 years. This sort of work, apparently, was not usually introduced until much later. In some quarters this led to the consideration of the more flexible and open style of teaching in primary schools and possible implications for the first two years of secondary education. Subsequently, 'Somertech' was adopted in some of these schools and a Further Education College. It has also raised the awareness of secondary teachers of the teaching skills in primary education.

**THE HELP LINE — and possible food for thought?**
Yet another consideration is that many authorities like to share ideas but often the factors which influence their actions are cost, distribution and distance together with advertising; not quite such a problem. The other important point is that education authorities are there to promote education, not commercial management. However, Educational Suppliers can provide these services — at a cost.

Once proven as a useful tool for teachers in Somerset, making 'Somertech' available to other authorities was an immediate consideration. Advertising could be achieved through the various

## Work Briefs and Design Challenges

| 'The Buggy' | |
|---|---|
| 1. | Can you design and build a buggy, powered by any means you wish, that can climb at least 50cm up a 30° slope? |
| 2. | Can you design and build a buggy which can be powered by "wind"? (a vacuum cleaner can be used to provide a source of wind). |
| 3. | Can you design and build a buggy that will travel the longest possible distance after rolling 1 metre down a 30° slope? |
| 4. | Can you build a buggy that will roll along the floor, after rolling 1 metre down a 30° slope? Now improve your buggy to travel at least 1 metre further along the floor. |
| 5. | Can you design and build a buggy to be powered by an elastic band? What is the greatest distance it can be made to travel? |

'Associations' but delivery to schools across the country was impossible. Local counties were a possibility if a central delivery point could be agreed. The primary Science Support Team have, in the past, presented workshops to some authorities and to a degree this can still be done. The only effective way to make the idea available to schools has been to use an Educational Supplier and market nationally. They provide an excellent service, unfortunately, the mark-up for any such service to all of us attempting to help each other, in our eyes, is considerable. As in the normal market place, you pay for the name as well as the service. It is accepted that the fixed overheads of these companies is considerable; is there a way in which we could all help each other to reduce costs to schools?

The implementation of the National Curriculum both in 'Science' and 'Design and Technology' will need the injection of considerable capitation in our schools. It is gratifying that the vision of colleagues in Somerset has recently resulted in a formal agreement with an American manufacturer of educational equipment to market 'Somertech' throughout North America, Canada, South America and Mexico. It is hoped that this, at least, should eventually help to defray the cost of research, development and machinery which the project incurred, to the benefit of all those who wish to use it. Incidentally, its market price to schools will be 50% less than in this country.

## CONCLUSIONS.

'Somertech' is just one example of how one authority set about the business of starting to achieve success in the field of Technology — or should I say Applied Science? It matters not. What does matter is that lots of people are coming up with good ideas to help the children — our prime concern as teachers.

Model-making is an essential part of the National Curriculum and should involve strong elements of design and innovation within Science and Design Technology both in their own right and in the cross-curricular mode. We cannot teach science devoid of its application.

It is the end of the beginning; there is much to be done in the future. The participation in this exciting work has also raised the awareness among secondary colleagues of the stimulating and quality work going on in primary schools, thus helping to break down the traditional barriers of the past. This inter-phase liaison must be of benefit if continuity and progress are to be achieved across the phases.

## PRIMARY TECHNOLOGY PROGRAMME

### KEY QUESTIONS

1 'Design Technology' and 'Science' have been separated and given different emphasis in the National Curriculum. How can we ensure that the strong inter-related balance previously being strived for is maintained?

2 There appears to be some confusion in primary schools in identifying the three 'apparent' technologies. The first is 'Science Technology' — fairly well established; the second is 'Art, Design and Technology' — which, in part, seems to embrace the design and model-making aspect of Science Technology and have similar aims and objectives, and thirdly, arising from Computers in Education, 'Information Technology'.

What strategies are being employed to clarify this problem for small schools attempting to prepare their School Curriculum Plan?

3 It is difficult to provide a nationwide distribution of educational products developed by authorities. The services of Educational Suppliers are excellent but, naturally, the cost of the product reflects their high overheads and reasonable profit margins. The final price tends to emanate from competitive market forces, rather than from the original desire of the 'producer' to help colleagues.

Is there a way in which we can help each other and keep charges to a minimum.

# Work Briefs and Design Challenges

| 'Box Construction' | |
|---|---|
| 1. | Can you design and construct a '3-D box' to house an input – output machine which ... (There are many variations on 'a theme') ... slows down the drive; increases the speed of the drive; changes the rotational direction of the drive; changes the angle of the drive?<br>There are many follow up challenges ... can you reduce it even more; increase the speed of drive even more? |
| 2. | Can you design and build a 3-D box to house a machine which does some work and is powered by wind, water (or dry sand), electricity, or by hand? |
| 3. | Can you design and construct a 3-D box to house a machine which can be used to transport a 100g mass across a 1 metre gap? |
| 4. | Can you design and construct a 3-D box to house a machine which can be used to run a fairground ride? |
| 5. | Can you design and construct a bridge which can lift, or swing to let tall ships pass underneath? |