The Technological Jigsaw

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A concensus is rapidly forming that technology as a cross-curricular activity is becoming an important aspect of all children's education from the earliest years up to the age of eighteen.

In this article I hope to illustrate the ways in which schools within Wolverhampton Local Education Authority have developed approaches to incorporating technology into many different subject areas and the strategies that have been used. Wolverhampton Secondary Technology Team was set up under the auspices of T.R.I.S.T. in September 1986. The team consisted of three seconded teachers whose role was to help and encourage staff from all subject areas to include work of a technological nature in their lessons. At the outset it was decided that it was unwise to spend a great deal of time defining technology in schools but instead, a model of 'Technology For All Across The Curriculum' was developed. We consider that there are four aspects of technology which we should offer to all students throughout their time at school which together combine to form the Technological Area of Experience.

Awareness

At a fairly basic level, all young people should be helped to understand the vocational, social and leisure opportunities which technology affords. They should also be familiar with everyday technological artefacts and have a very simple understanding of their component parts.

At a higher level youngsters should be encouraged to develop a critical awareness of technology, so that they are in a position to make informed decisions about technological developments and are aware of the implications that technology has on our society, for both good and ill. Similarly, all pupils should be aware that technology is not limited to western culture and an awareness of third world technology and alternative technologies is equally important.

Practical Problem Solving Activities

Pupils should be encouraged to gain the attitudes, skills, knowledge and resources to solve problems which will be of use to pupils in the future, rather than an ability to remember the set solutions to a limited number of problems which in any case will very quickly become outdated. In the Japanese electronics industry for example, retraining takes place every three months, such is the speed of technological innovation.

However, it should be noted that problem solving activity can be undertaken at two distinct levels, which develop very different kinds of skill. The approaches developed by a student undertaking a problem, after having been given the resources of skills and knowledge which they will need to solve it, are considerably different from those involved in a more sophisticated approach where children need first to work out what knowledge or skills they will need to use, in order to attempt a solution.

Foundation Work In The Specialist Technologies

Thirdly, all pupils should be given the opportunity to be involved in introductory work in microelectronics, biotechnology, control technology, food technology, information technology, chemical technology and other 'new' technologies, as they develop and become relevant to the needs of children in school.

This will also provide certain pupils who would wish to study some aspects of technology at a more advanced level, with a basic grounding in a number of technological areas.

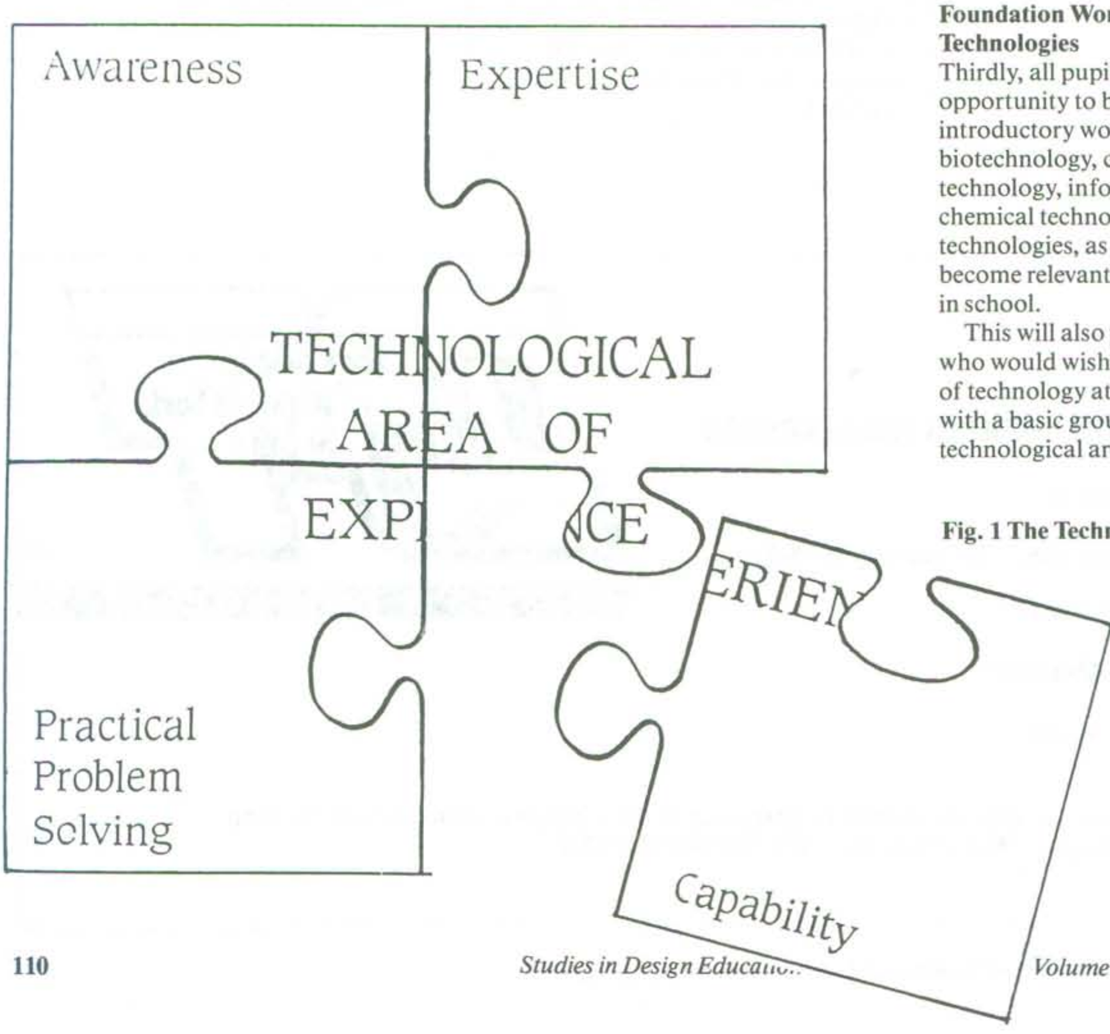

Fig. 1 The Technological Jigsaw

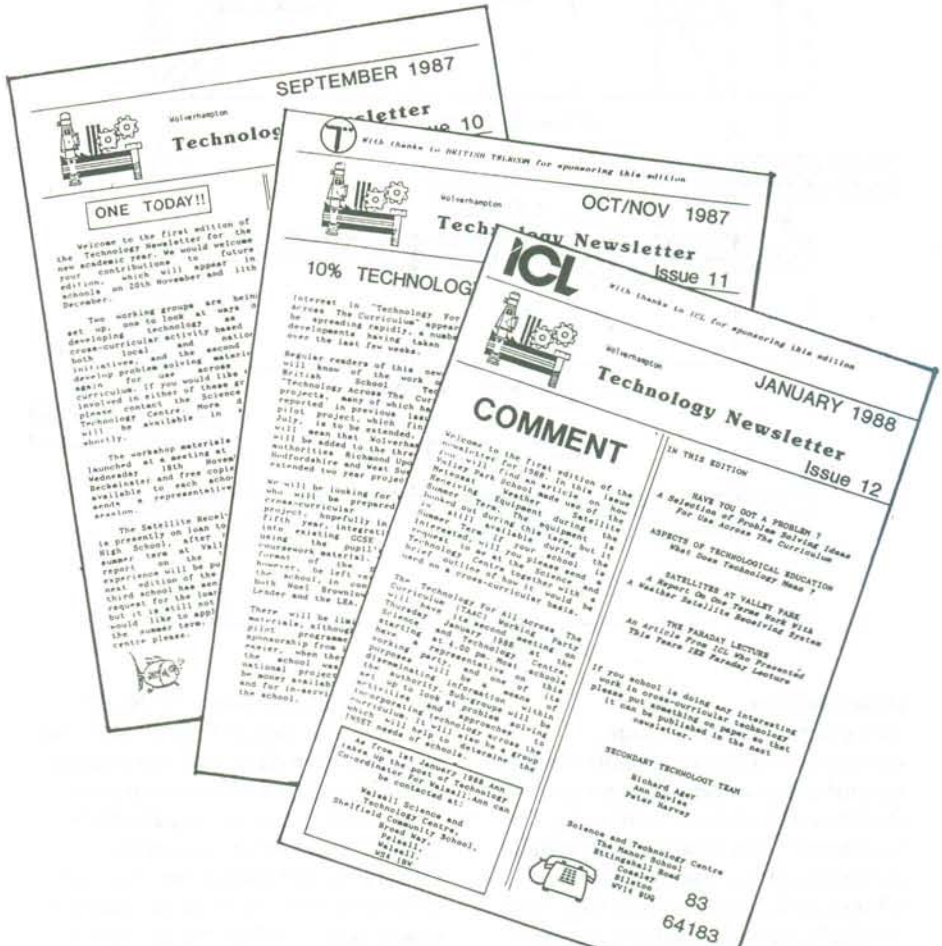

Fig. 2 The Technology Newsletter An Important Method Of Disseminating Information

The Capability to Undertake Technological Tasks

To undertake a technological task requires resources of both skill and knowledge as well as materials. These resources are not to be found in any one area of the traditional curriculum, but throughout it. To undertake such a task therefore requires a cross-curricular approach, with children being able to seek for knowledge and to develop skills with help from teachers of a variety of disciplines.

They must however also be *aware* of the effects of their solution, and should not be content with a solution that merely works. They will undoubtedly have been involved in considerable high level *problem solving activity*, and it is likely that they will have used some knowledge of *specialist technology* in their final product or system. Hence, this fourth aspect, although vital in its own right, provides cohesion for the whole technological experience.

These four aspects can therefore be considered as part of a technological jigsaw. Each piece can make some contribution to the development of technological skills, knowledge and values and throughout their time at school, and in every subject, all youngsters will encounter parts of the jigsaw at levels appropriate to their ability and experience. It is clear therefore that co-ordination is essential to ensure the pieces fit together, and pupils receive a coherent and broad technological education.

The First Steps

In its initial stages, the team concentrated on the first three years of secondary school and devised a number of strategies to encourage all staff to be involved with some technological activity. Firstly, a presentation for staff was offered to schools to instigate discussion. This gave some indication as to why technology should be taught, the curriculum structures that would be necessary for it to be included effectively, and the types of materials which could be used. As we are talking about technology, we felt it was important that we were seen to use it effectively, and the presentation therefore included video inserts of lessons recorded in the borough, and demonstrations of both equipment and software.

A series of workshops were held for multidisciplinary groups of teachers. This enabled staff to experience different activities, such as a role play simulation from the SATIS[1] materials and a simple practical problem solving exercise from the Insight into Industry[2] booklet. It also gave them the opportunity to share ideas with other staff and to browse through materials and look at equipment in order to evaluate it for use in their own school. Feedback from the workshops was encouraging and this led us to arrange a second series.

In these however, teachers were from broadly similar disciplines, and their task was to produce both pupil and teacher materials for a single or double lesson in their own subject. The work however, had to have a technological slant to it, and relate to a topic which they were presently teaching. After trying it out in their own school the materials were then collated and published as 'Technology For All — Workshop Materials'[3] and distributed throughout the authority. This gave teachers some examples of how work of a technological nature could be incorporated into individual subjects.

Because of the cross-curricular nature of technology we felt it would be useful for ideas of this type to be developed by teachers. We therefore held a residential conference at which 21 staff from a variety of subject areas were given the opportunity in small groups to come up with ideas for projects or themes. This material[4] was also published and distributed widely both inside and outside the authority. They were also given the opportunity to listen to educationalists and industrialists views of the developments and to visit a 'high-tech' firm in the area to see the effect which technology could have on employment prospects and conditions.

The residential conference did however also provide us with a group of teachers of varied backgrounds and expertise who in fact have formed the core of the Technology For All Working Party which has been set up in the authority. In its sub groups it is looking at developing more problem solving ideas, producing ideas for themes or projects and looking at the way in which 'Technology Across The Curriculum' can be effectively implemented and managed within secondary schools.

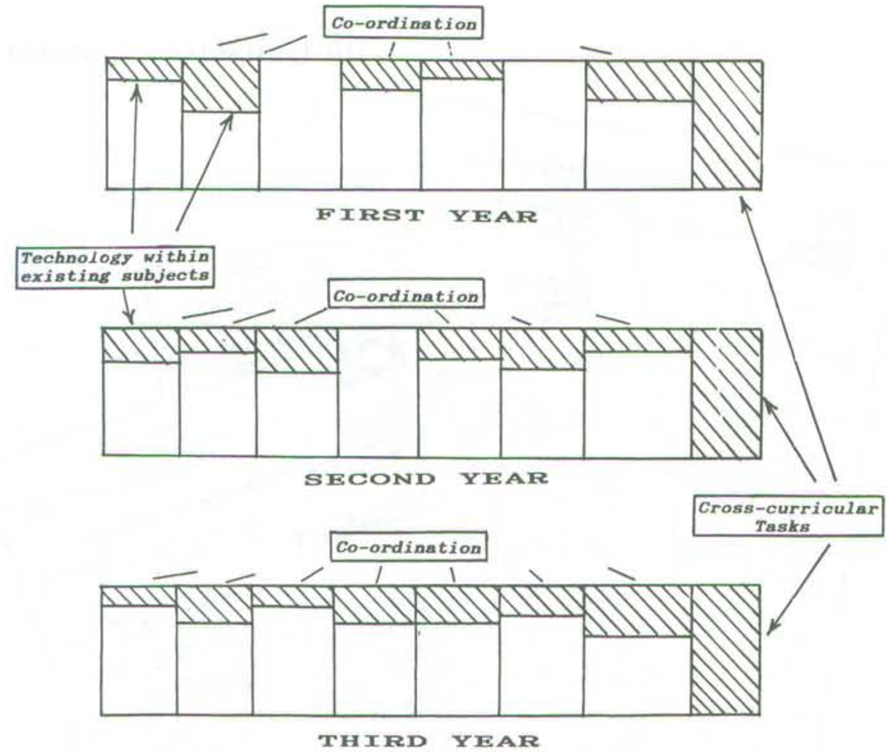

Fig. 3 Model Illustrating A Possible Way Of Incorporating Technology Into The First Three Years of Secondary Education

Dissemination
At the outset, it was felt that all secondary and special schools should be kept informed of developments and we therefore distribute a 'Technology Newsletter'[5] as a means of publicising initiatives taking place in individual schools, and hence trying to eliminate the duplication of development work. To this end, we also try to keep schools within the authority up to date on work which is being done at a national level.

Insert Within Schools
Another important aspect of the work of the team is in-service training of staff within their own school. Putting equipment into school is of little use unless the staff using it have been made aware of its possibilities. It is also reasonable to expect staff to become proficient in the use of equipment and be able to answer all the children's questions after a couple of INSET sessions. However, if they are in a room with their own class, and two members of the team run the lessons for a few weeks, they can be involved with the lesson and get some ideas of the difficulties and queries that may arise. One member of the team can take the lesson, and the other one has time to work with the class teacher. Once the expertise within an institution has built up to a reasonable level further INSET can be organised by the staff in the school themselves.

This approach has been used in schools where Microelectronics For All[6] and Lego Technic II[7] are being introduced into the curriculum. In an effort to increase the range of problems which were available, teachers were encouraged to link Lego models with the Mfa boards, so that children were able to see more relevant uses of the electronics. In several schools where the Lego work was undertaken in CDT departments and the Mfa equipment was used in science departments, this integration of the material into practical problem solving activities was a useful way of initiating links between the two departments. Several schools have also seen the advantage of a more modular approach to the use of Mfa, and this is being taken account of in the new Mfa materials which are currently under trial.

Implementation In The Lower School
In the lower school each subject is probably already involved in one or more of the four aspects of technology. However, the individual components need to be identified and then co-ordinated to ensure that all children are experiencing a wide range of technological activity. This co-

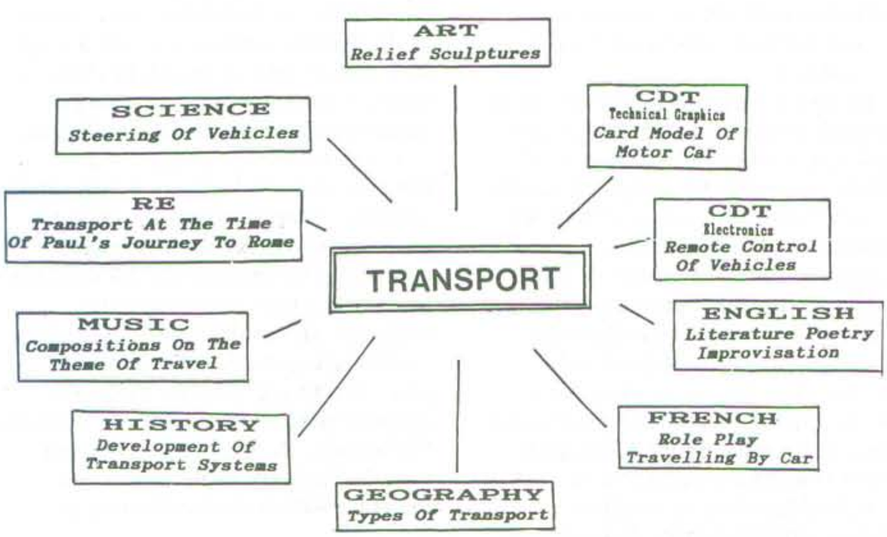

Fig. 4 A Diagram Illustrating A Project Approach To Transport

ordination can be done through a use of either technological themes or projects.

Themes

A thematic approach would involve a group of pupils within the school studying a technological topic in a number, or ideally, most of their subject areas. The main benefit of this is that it breaks down the artificial divisions of knowledge both as far as the pupils and, perhaps more importantly, the staff are concerned. At Heath Park High School, the subject 'Transport' was chosen as a unifying technological theme for a group of 12 and 13 year olds during the Spring Term 1987. Ten subject areas were involved and this necessitated a considerable amount of both planning before, and co-ordination during the project. Brief details of the contribution which each department made are included in Table 1.[8]

Table 1 Contributions which individual subjects made to the technological theme Transport

English: Language and communication skills were covered through the theme. Literature and poetry used included 'The Railway Children', 'The Night Mail' and 'The Train'. Letters written to the Severn Valley Railway and drama activities included improvisations on the theme of machines which were recorded on video tape.

French: Vocabulary relating specifically to transport was introduced, and role play was used for practising conversations at the petrol station or garage. Travelling by car was selected as a topic, and investigations were undertaken as to the difference that would be noticed e.g. the motorway system, signs used on the road, the rule of the road and grades of petrol available.

History: Transport was studied in three groupings, these being Pre-industrial Revolution, Industrial Revolution and Post Industrial Revolution. The three groups had to look at the types of transport available, and to discuss the reasons for the development of new forms of transport. An important aspect of the work was that of pupils learning how to find the appropriate information. Each group then presented their findings to the rest of the class.

Geography: Pupils undertook individual projects looking at a variety of types of transport. These included railway, airline and motorway networks, bridges, tunnels, ships, aircraft, containerisation of road transport and road safety within Wolverhampton.

Religious Studies: The spread of Christianity through the Roman Empire was made very difficult through lack of transport. The pupils examined the way in which Paul and the apostles travelled, and a study was made of the very hazardous and exciting journey that Paul made, as a prisoner, to Rome.

Science: Problem solving activities were undertaken to see how objects could be transported both horizontally and vertically. Technical Lego was used to produce rigid four wheeled vehicles, steerable vehicles and powered trollies using gears.

Music: First there was a discussion about different types of travel and the image that each one portrayed e.g. motorbikes — young/trendy; Orient express — luxury/mystery. Pupils, in groups, then wrote the lyrics which had to have the theme of travel. The music was then composed this being either melody and accompaniment or just rhythmic accompaniment. Finally pupils recorded their composition using a multi-track recorder, learning such techniques as balancing tracks, use of a microphone and the use of 'echo', 'phaser' and stereo chorus.

Art: Pupils produced a series of relief sculptures in clay. Each group researched into a particular form of transport and produced a full size drawing of their particular design. The designs were transferred to the slabs of clay and the sculptures produced by a combination of modelling and carving. After firing the sculptures were finished with a combination of gold and bronze spray paints.

CDT Technical Graphics: A simple car shape composed of entirely straight lines was used as a means of teaching elevation and plan drawings. From these, isometric projects were developed followed by developments, which were used to make a simple card model of the car.

CDT Electronics: The transport theme was used to introduce the basic ideas of control technology. The pupils were working towards the construction of some form of remotely controlled vehicle. The pupils also constructed their own hand held, wired controllers. The final stages enabled pupils to build their own vehicles (usually from Technical Lego) and control then via their own controller. Quicker groups also investigated simple computer control using the mfa boards.

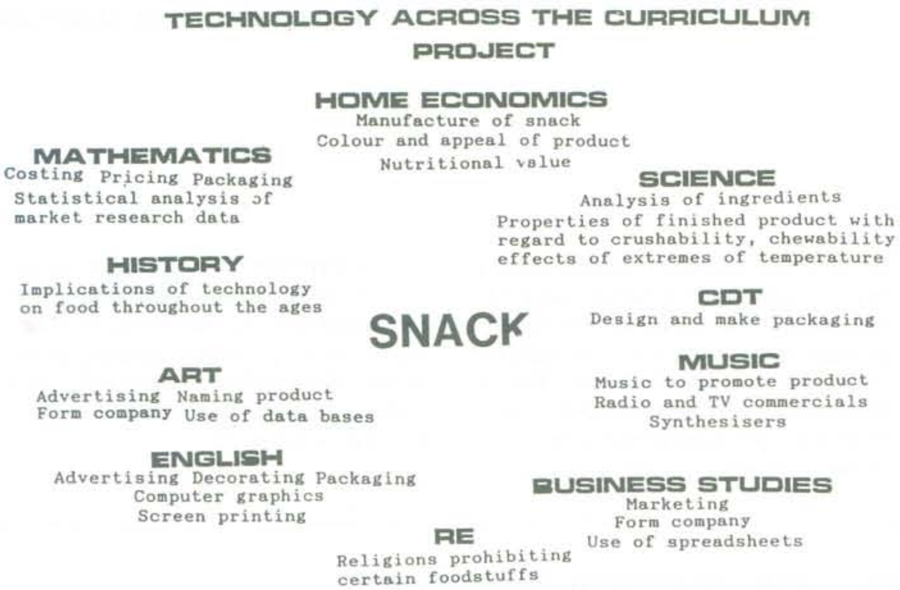

Fig. 5 A Diagram Illustrating The Wide Range of Activities Arising Out Of The Snack Project

Tasks
Wednesfield High School investigated a task or project approach, by getting children to devise a new healthier snack bar and looking at its nutritional value, costing, marketing and packaging. The idea was formulated within the Home Economics department, but other areas of the curriculum willingly became involved. On completion of the project, it was clear that the work could have been extended into many other curriculum areas, and suggestions of ways in which this could be done are included in Figure 5.

Difficulties can arise in developing technological capability whilst solving real and relevant problems within the constraints of a normal 35/40 period a week timetable. A number of schools are therefore looking to putting aside blocks of time for particular year groups, together with a team of staff from a variety of disciplines, to allow children to spend from a full day, up to a week on a particular technological task.

Implementation In The Upper School
In the Upper School there are a number of ways in which Technology For All could be implemented. Firstly, it could be incorporated into individual subjects, and again themes or tasks could provide the coherence and continuity. One notable example of this type of work is the Waldegrave High School 'Tourist Tape' project[9], which was part of the British School Technology Trust 'TAC' development, where some of the departments used work that was undertaken for the project as relevant and interesting coursework for GCSE examinations. In this case therefore it did not involve an increased workload for the students.

A second alternative investigated would be to put an a modular 'Technology Across The Curriculum' course suitable for all abilities, and covering as broad a range of technological activities as possible. Modules could include such things as Bio-technology, Media Studies, Control Technology, Works Experience and Satellite Technology, and all could include the four aspects of technology. A group of schools in Solihull LEA are developing a course along these lines.[10] This model would also allow for a second group of modules to be available for those students for whom more specialisation in technology would be appropriate, and they would obtain a GCSE dual award.

A further model exists where technology modules exist within subject areas. Thus the geography department may offer a module on weather and weather satellites, the science department one on biotechnology, the CDT department one on computer aided design, the history department on the effects of inventions through the ages and so on. These individual modules could then be asessed both for a technology qualification, and for the subject in which it was being taught.

Shropshire LEA are developing a Mode III course which concentrates on assessing the technological skills, processes and value judgements which need to be addressed when undertaking a technological task.[11]

It would appear that some sort of Modular Technological Framework set up by an examining board from which schools could select a series of modules, or alternatively write one or two of their own would be a worthwhile development over the next few years. It is

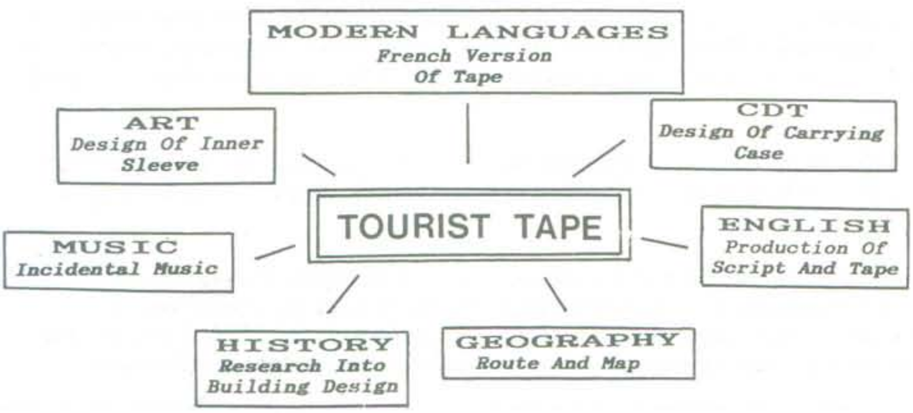

Fig. 6
A Diagram Illustrating A Cross-curricular Approach To The Teaching Of Technology Through A Project In Upper School

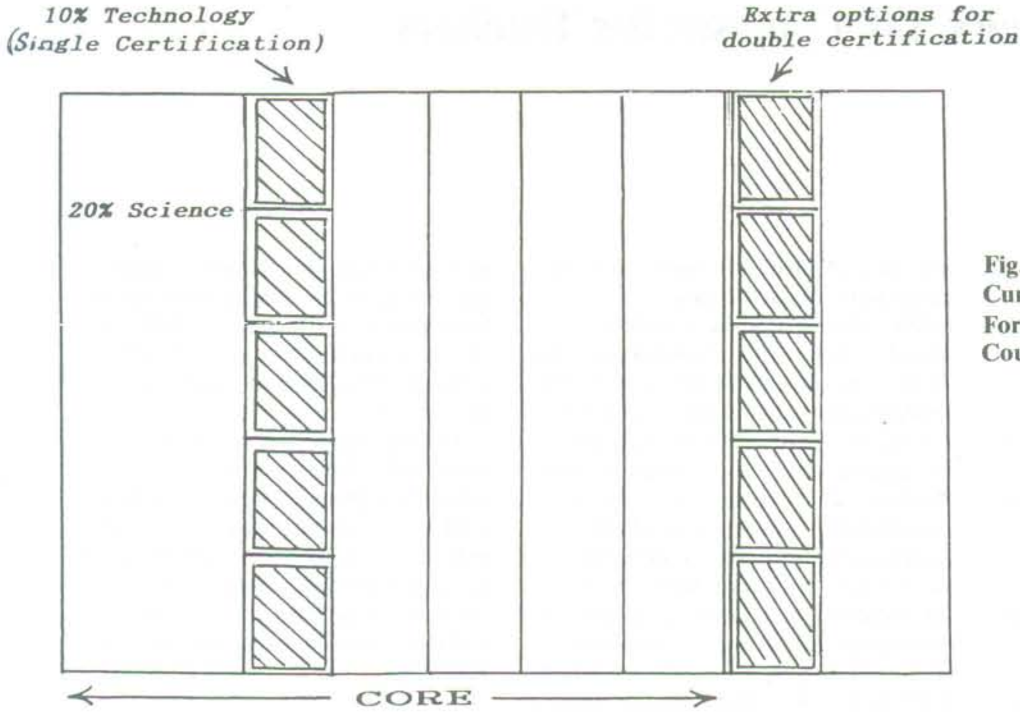

Fig. 7 Model Of The Upper School Curriculum Including 10% 'Technology For All' Using A Modular Technology Course

important to reflect however that a course of this type should not and must not preclude the inclusion of technological activities within other areas of the curriculum as well.

British School Technology Trust Technology For All Across The Curriculum

A number of schools within the authority will be involved in the British School Technology Trust 'Technology For All Across The Curriculum' two year project, which is just about to start.[12] The aim will be for schools to investigate ways of making technology an integral part of their work across the curriculum. This will involve technology for discrete subject enrichment, collaborative links between subjects, projects on their own without allegiance to a particular subject or examination as well as subject courses in aspects of Technology leading to recognised public examinations.

The Future

The next few years are likely to see rapid developments in technology as a cross-curricular activity. Because of the very nature of technology in our modern society, work on technology across the curriculum in schools will continually evolve. We would therefore be ill-advised to wait until we have al the answers, but instead should make every effort to ensure that all children in schools today are exposed to the whole range of activities in the technological jigsaw.

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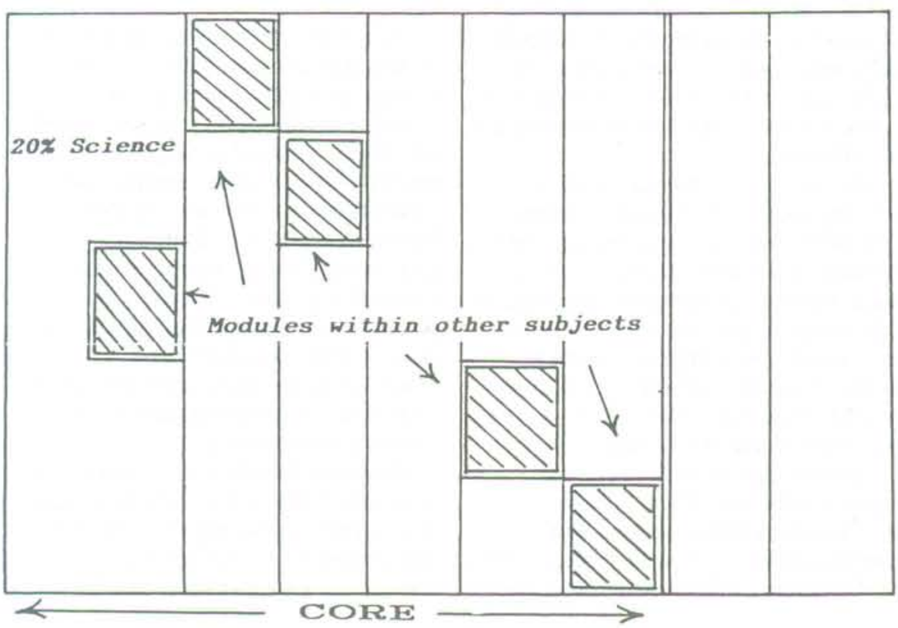

Fig.8 Model Of The Upper School Curriculum Including 10% "Technology For All" Using A Modular Technology Course Within Existing Subject Areas