Integrating manufacturing industry and design education within a National Curriculum framework

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INTEGRATING MANUFACTURING INDUSTRY, AND DESIGN EDUCATION WITHIN A NATIONAL CURRICULUM FRAMEWORK.

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We are about to attempt to distil what has taken three and a half years to develop, into a fifteen minute case study. It is important therefore to outline our terms of reference before continuing with a detailed account. The overall concept is born out of a belief that design education is the antithesis of the fragmentation currently prevalent at secondary level. The notion of aesthetics and technology being inextricable components of Designing is implicit in our proposals. Therefore we prefer to use the single term Design to embrace those aspects of the National Curriculum which are involved with seeing, thinking and doing.

In November 1984, Martin Rogers the Chief Master of King Edward's School (KES) and Headmaster of the Schools of King Edward VI Foundation, wrote a paper to his governors entitled 'Design Education'. The main aim of the paper was to attempt to redress the imbalance in the King Edward's curriculum, which was at that time too heavily biased toward purely academic subjects, by introducing design into the core curriculum. In particular he had emphasised the notion of Operacy, the ability to get things done, suggesting that it should be placed on a par with Numeracy and Literacy. He had also stressed the need to provide facilities for pupils to enable them to work in areas which spanned the whole creative spectrum.

Such was the response to this paper that advertisements were placed early in 1985 for a Design Fellowship to be based at the school, supported financially by the Smallpeice Trust at Leamington, the DTT and the EITB. Subsequently, Ray Willey took up the appointment in January 1986 with the following brief:

i) produce a Design curriculum for above-average boys and girls to be incorporated into the core and thus be compulsory for all eleven to fourteen year olds;

ii) design a Centre in which such activities could take place;

iii) Head the existing Art and Design department in order to have the necessary authority to implement change;

iv) teach a fifty percent timetable.

Initially items (ii) - (iv) took priority, with item (ii) the most pressing. To specify the building at this stage was akin to being asked to design a container without fully knowing the precise nature of the contents. Thus the brief to the architects specified the need to build-in a certain amount of flexibility to allow for possible change in a rapidly developing subject area. It was also established that the Design Centre should reflect the very nature of the activities within and visually and physically integrate Art, Design and Technology. A number of alternatives were proposed by the architects, but initially nothing truly brought together the different aspects of the subject in a meaningful or cohesive fashion.
PLANOMETRIC VIEW OF KES DESIGN CENTRE.  Fig. 1
In its final conception, arrived at after considerable discussion with the architects, the Design Centre epitomises resource-based learning, each area supporting the activities to be carried out in each of the others. For example, the photographic dark room was not designed to accommodate groups of pupils undertaking photographic examinations: rather it would provide a resource for research and for the communication of ideas.

The importance that we attach to the resource area A is evident from its central location within the building, in an area easily accessible from each of the other rooms. This concept is designed to encourage initiative and responsibility for self-learning. It has been planned with facilities to contain examples of good and bad design, manufacturers' catalogues, video, slide and computer software as well as access to on-line databases. Directly outside the resource area, is an exhibition/seminar area B in which regularly changed displays of pupils' work, manufactured products, travelling exhibitions can be mounted, and up to one hundred people can be seated for seminars.

The ground floor plan is symmetrical: one wing accomodates the lower school design/modelling area C and prototyping workshop D in which the fundamental principles of designing and making are established. These principles will remain the same throughout a pupil's school career but will increase in sophistication as contexts become more involved. In order to accommodate this progression, extended facilities are available in the the upper school wing E & F to support more complex activities.

Facilities common to both wings include a material store and technician's workshop G, (shared by the D&I project engineer), a work in progress store H, a heat treatment bay I, and an external covered area for large scale activities J.

At first floor level a fine art, painting, drawing and wetwork studio K is linked to a photographic facility L, graphics room M and soft modelling/ceramics area N. The staff room O, which houses the computer network server, is strategically placed to provide good visual access of the ground floor. The sixthform room P is above the resource area and will be managed by students from varied disciplines, fine artists mixing with engineers. This provision is regarded essentially as a base, the students using other facilities throughout the building, as and when required. This strategy enables younger pupils to develop an awareness of more advanced activities.

Besides providing a working environment which encourages interdisciplinary activities and the necessary resources to support it, How can the activities of pupils be structured to encourage the necessary attitude shifts to make them more aware of the challenges and rewards of Industry? At KES we believe that motivating experience must be woven into the fabric of the curriculum so that, to an increasing number of pupils, progress into manufacturing industry is perceived as a natural extension of the formal education process. In the early stages of development an opportunity to experiment with these beliefs arose in the form of a live industrial project.

The Avery Project² was started in September 1986 as a unique experiment at the school. Prior to January 1986 there were no structured courses in any aspect of Design or making. Boys were involved in practical activity as light relief from academic rigour and craft was regarded simply as a pastime. Six Lower Sixth boys, five of whom had had no previous experience of Designing, opted to do the Avery project during a voluntary double period (one hour and twenty minutes) on Friday afternoons.
Contacts with the Queen Alexandra College for the blind provided the background information to enable the boys to appreciate the problems associated with blindness. Avery gave access to their own museum and technical support areas so that weighing could be researched. The company also delegated a young engineer to the project to act as advisor and link man.

Extensive design and development has resulted in an agreement by the company to produce two to three hundred units which will be assembled in the rehabilitation workshops of the Queen Alexandra College and distributed through college shops nationally. If the product is successful Avery retain the right to mass produce. The team were awarded a commendation in the 1987 Design Council Schools' Design Prize. The radio programme In-touch is awaiting further details to conduct an interview. As a pilot this project has helped considerably in establishing further Industrial projects and has generated great interest amongst pupils, parents and Industrialists alike. The project has spanned two academic years with the responsibility passing from one group to another. This clearly is too long in normal circumstances and we are endeavouring to plan projects to take no more than one Academic year, with the majority being of two terms' duration.

As a result of the success of the Avery project, and the general activity in curriculum development and Industry links taking place at the school, the Gatsby Foundation (a Sainsbury family charitable Trust) became involved and the brief was expanded to include the aim of "encouraging more above average boys and girls to enter engineering". This involvement gave rise to the Design and Industry (D&I) project and a team, comprising Director and Assistant Director, Project Engineer and Secretary was formed to coordinate and administer live industrial projects and support curriculum development in the nine schools of the consortium. The D&I project is significant in that it is to our knowledge the only project which involves both independent and maintained sector schools. The schools and the companies to which they were linked for the pilot stage can be seen in the diagram (fig. 2).

The companies shown in the diagram form part of a stockpile of eighty or more which grew as a result of fundraising activities for the new centre. Negotiations are currently under way to devise appropriate working briefs for schoolchildren, with due regard to the constraints on both sides. It has been found that companies are more than willing to get involved and as long as the conditions are carefully defined will commit both time and resources to Secondary level projects.

Although the aims are similar to those of the Hertfordshire Engineering Education Scheme, also funded by the Gatsby Foundation, the D&I project is fundamentally different in that it is a curricular rather than an extra-mural initiative. In the Hertfordshire scheme, boys and girls are selected at Lower Sixth level and involved in Industry linked design-and-make projects during their free time.

Although it was our initial intention to include live industrial projects at GCSE level from the start, our pilots in the consortium schools have provided a good indication that existing Fourth years have not had sufficient opportunity to gain the social, intellectual and physical skills and 'awarenesses' which constitute the capability required for dealing with the demands of live projects. It is our aim that in the three years of our proposed foundation course, pupils will have developed aptitudes which will enable them to meet the challenges of working with and for external agencies. As an interim step we intend to provide, in collaboration with participating companies, the background resources to support a large scale simulation exercise for fourth year pupils.
KEY TO PILOT PROJECTS

1. Extension to the K Range of rechargeable kitchen appliances.
2. An inexpensive steam wallpaper stripper.
3. A junior school 'workmate.'
4. Design an experiment to provide performance data for a quartz linear heating unit.
5. A security system for jewellery pads at point of sale.
6. A display system which aids jewellery pad retrieval.
8. A new range of bathroom furniture.

Fig. 2
One such exercise has already been produced involving modifications to the design of the "press and breathe" inhalers used by asthma sufferers for bronchial dilation in order to compete with a new breath actuated system. A wide range of resources has been gathered so far including detail drawings of the breath actuated system, copies of journal articles, data bases of prescription trends and consumer evaluations, medical information etc. However, the most important resource is a ready supply of inhalers, and the willing contribution of designers, doctors and even a government minister. The material has been well received by educationalists and industrialists alike and we are currently exploring the possibilities of professional production of contextualising and other supporting videos.

The simulation will be presented as a team activity and although some guidance will be required with the allocation of work and the management of their activities, it is anticipated that the core design curriculum will have prepared them to make a structured and coherent response. Teams will be required to respond to unpredictable change and peripheral issues (introduced to pupils at the start of a session in the form of a "wild card") which need to be resolved in order to meet tight deadlines. This could be a letter or document requiring one or more of the team to stop work, to make a decision based upon new information, to prepare a press release or to modify a manufacturing instruction. We believe that this type of project is not only congruent with the National Curriculum programmes of study but also its structure offers a high level of control, making it a resource with the capability of providing a powerful and memorable learning experience. We are currently negotiating with publishers in order that these and similar packages can reach a wider audience.

Fundamentally the course structure is based around a broad central core of design, with overlaps into art on the one hand and science on the other. The made outcomes resulting from practical activities at King Edward's are in essence no different from those in the vast majority of other schools. The work, whether fine art, plastic or electronics in nature, displays varying degrees of sophistication and registration, contingent upon the capability of the originator. The difference, we believe, is in the context within which practical activity is delivered.

The diagram shows a course plan for years eleven to fourteen and two types of course have been indicated.

One is a cross-curricular course, the outcomes and activities of which are designed to cover the full aesthetic to technological spectrum, the other an interim arrangement allowing each discipline a proportion of the timetable in order for associated skills, competences etc to be learned. It is anticipated that this latter group of courses will be replaced by a series of further cross-curricular elements once the principle has been established with both pupils and staff. Progress in education must be measured if it is to be effective.

The cross curricular courses have been designed to provide the student with a structured and coherent progression from simple contexts, with clearly expressed intended outcomes in the first year, through to the complexity of real 'live' projects, usually confounded by communication difficulties, working with others, resource shortages and logistics problems. It would be short-sighted not to accommodate experience of this inevitable transfer from harmony to cacophony, and we believe that one way of achieving this is for the pupils to participate in the following or similar activities. The examples are taken from the core curriculum and have been mapped against the Attainment Targets and Programmes of Study specified by the National Curriculum.
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*Fig. 3*

Denotes a holiday unless otherwise stated.
Modelling. The important key aim of this unit is to help the pupils to realise that modelling methods need to be selected with great care if they are to help the observer to understand an artifact, system or event. The course is run over a six week period in the winter term of the first year. It covers four aspects of modelling: an application of observational drawing, graphical modelling using flow charts, pie charts etc., esquisse (sketch modelling using card, clay, foam etc), and engineering systems-modelling using kits like Alpha boards and 'syringe and tube' modelling of a simple pneumatics application. On the fifth week, by which time all of the pupils will have completed each of the modelling exercises, an activity is arranged which allows them to use what they have learned in a more learner-directed application. Throughout this course, a series of home assignments will be completed by the pupils, each one addressing a different aspect of modelling, specifically mathematical, conceptual, progress, process, and logic.

At the start of the second year, all of the pupils are involved in the cross-discipline 'Teams of three' project. In common with the starting points favoured by the APU\(^3\), the pupils are "fast forwarded" into the context of this project by a video. Each of the team members is responsible for a different aspect of the design and production: one for artwork and aesthetic design, another for product design and manufacture and the third for the design and production of the simple printed circuit board involved. Again, this sounds no different from many of the teamwork projects undertaken in schools. The difference however can be seen in the flow chart. The pupils who are working on a specific task, for example the electrical component, do so in a room away from their other team colleagues, only meeting up with them at specified times throughout the project. This means that the success or failure of the project is contingent upon good communications during the meetings. Secondly, when a successful prototype has been made by the team, rather than repeat the process, longhand as it were, for each member of the team, appropriate technology, photocopiers, existing artwork and vacuum-forming moulds are used to demonstrate batch production techniques.

The simulation exercise undertaken in the second year was inspired by the work of Prof. John Arnold as described by Papanek\(^4\). Essentially the rationale is that if student designers take part in design exercises involving the needs of mythical creatures, their work cannot be readily influenced by their own preconceptions. The exercise puts the pupils into the role of members of design teams whose function is to prepare for the integration on earth of Intelligent life forms whose experience to date has been two-dimensional. During the project, team members will be 'in role' responding to whatever input the teacher and the resources provide. Responding to "discontinuous change"\(^5\) is perceived as a major component of robust capability and is consequently encouraged by a number of the elements within the proposed curriculum.

For evaluating the work of the pupils and recording their achievements at all levels, we felt that profiling would be the most effective method and this belief was supported by the recently published RANSIC Report.\(^5\) In the Design department at King Edward's, report generation is computer assisted in the following way. When a course element is written, it is set against specific objectives which are mapped against National Curriculum attainment targets. A range of descriptors, explaining to what extent the pupil met the criteria implicit in the objectives, is also included with the curriculum materials. At the end of each course unit a profile sheet is produced with the help of a computer into which the descriptor bank, pupil lists etc have been fed. The profile sheet contains the following information:
a brief explanation of the activity in which the pupil has been involved;

ii) a list of the objectives, the reasons for having involved the pupils in the activity;

iii) a qualitative statement explaining to the reader the degree to which the pupil met those objectives.

As with any project which seeks to co-ordinate disparate groups and activities, there have been a number of difficulties. The main one is undoubtedly caused by the delay in completion of our own Design Centre. The Contractors started in October 1987 and at the time of writing have still three or four weeks’ work left to do. Until we have adequate facilities and the benefit of the core behind us we are considerably hampered in our own development. It is not planned to introduce A/S Level exams until September 1990 and A level the year after; thus the majority of live projects being run at KES are being done (and will continue to be for at least twelve months) in Voluntary periods and/or Extra studies. In addition we are still regarded as the soft option in the school and there are considerable attitudinal changes to be achieved before we can profess to have made our mark. We have however had some effect on the system in that from a standing start (there being no Exams at all in previous years) we have sixty boys opting to do GCSE this September. I am sure that this is an indication of things to come and that the Department will continue to expand.

As far as the D&I project is concerned the main priority is to complete the curriculum development in order to begin teaching it as part of the core in September. The following year will be spent evaluating and modifying our proposals in the light of our growing experience and supporting the consortium schools during their own project work. In addition further project development will be taking place including the specification and gathering of back-up resources. Eventually the resource facility will be being added to by all the consortium schools and hopefully will be published in one form or another.

Finally, dependent on successful completion of the first stage it is hoped to make the package available for dissemination to other parts of the country.

REFERENCES:


