Developing capability through application based studies. An evaluation of new teaching material at ‘A’ level

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DEVELOPING CAPABILITY THROUGH APPLICATION BASED STUDIES

An evaluation of new teaching material at 'A' level

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1. Introduction

This paper is a report of an on-going trial of one of the Application Based Studies recently produced by a Joint Trent International Centre for School Technology / University of Lancaster Curriculum Development Project for use in conjunction with 'A' level Design and Technology (D & T) courses. The material is being tried out in four places in Devon, three schools and a Technology Centre, details of which are given in Appendix 1. All Centres are preparing students for the University of Cambridge Local Examinations Syndicate Syllabus 9354: 'A' level Design and Technology (Technology) for examination in 1990.

2. Application Based Studies

2.1 The Idea

The concept of Application Based Study material arose in response to a perceived gap in the learning resources available for 'A' level D & T courses. The GCE Board's joint Common Core statement lists three broad aims for all 'Design and Technology' courses:

(i) to enable students to participate in the process of designing and whilst doing so, exercise responsibility towards identifying and meeting needs in the made world;

(ii) to provide the opportunity for students to exercise initiative, imagination and resourcefulness, to acquire interdisciplinary skills and knowledge in the pursuit of designs;

(iii) to encourage students to develop critical awareness of the made world, and learn how they can be constructively involved in influencing it. (1)

The originators of the material envisage that these aims will be met by a combination of 'design - make - test - evaluate' tasks and the 'study of the designed and made
outputs of others. Application Based Studies have been conceived to meet the latter requirements.' (2)

Each study examines the factors and inter-relationships which have contributed to the design, making, marketing and use of a product or system. The range of factors provides a framework for analysing the chosen product. (Fig 1)

This framework is intended to take the student further than a traditional exercise in product analysis: to a holistic appreciation of the total process involved in fulfilling a need and producing a product that a customer will want to buy. These intentions are expressed as specific aims to the student:

1. To make you aware of the variety of design solutions that can fulfil a particular need.
2. To introduce some mathematical concepts into design work.
3. To develop a body of knowledge about commercial manufacturing techniques.
4. To encourage decisions to be made about cost.
5. To integrate work of a scientific and aesthetic nature.
6. To stimulate innovation.
7. To provide a basis for an understanding of industry, and how it works.
8. To place the design of products in an evolutionary context. (3)

2.2 The Material

Two studies have been developed, one on the foot pump and the other on the personal cassette player. This trial has been of the assignments and material based on the personal cassette player.

The assignments centre on the Bush SC200 personal stereo cassette player (cost approximately £10) although much of the work can be done with any similar model (and not necessarily in working order). The material supplied consisted of a book of 14 Student Assignments (56 pp), a tape of continuous tones and a book of Commentary (36 pp) that extends some of the material in the Student Assignment book, and provides an outline of possible solutions for the assignments. The trial schools were also provided with a number of working cassette players already modified for experimental work. A list and brief description of the assignments is given in Appendix 2.
Fig. 1: The Framework of Application Based Studies
3. Experiences of the Participating Centres

The trial of the material has been monitored up to now by structured discussions with the teachers concerned and, in one place, with some of the students involved.

3.1 Approaches Adopted

The guidance to teachers acknowledges that the material supplied may be too extensive for any one student to do all assignments. It is recommended that the assignments are split between the group and 'report back' sessions held in which individuals explain what they have achieved to the rest of the group.

This poses a number of problems:
- selecting projects means that individual students may lose the overall, coherent view;
- a weak student or student pair may not undertake or present their assignment adequately thus further diminishing the experience of all;
- students will have individual strengths and areas of interest: allowing choice will let individuals work in their strong areas and avoid addressing their weaknesses yet directing students to assignment areas in which they are weak may be disheartening.

However, most of the trial schools started on the material with the intention that all students should have direct experience of all assignments, either individually or by working together in pairs of groups. One, Torquay BGS, split the students into four groups (x 3 students) each of which were allocated three assignments. The last two assignments (nos 13 & 14) were to be done by all groups.

Not all centres succeeded in completing the work for there were other demands on the time available: all schools were involved in preparing entries for the Sainsbury Trust Engineering Scheme, some had already set work on the 'A' level Case Study and there was the inevitable interruption of sessional examinations.

All the staff participating in the trial are keen to use the material again next year, perhaps earlier in the course and as part of a structured and coherent introduction to sixth form work.

3.2 Attraction of the Material

From the outset, the material was seen to be useful and to provide a valuable resource for 'A' level teaching.
One teacher described himself as 'being desperate for new material'. He saw the trial material as both satisfying this need and as 'being more stretching (of students) than I would have been able to prepare'.

Other comments supported the view that the material provided 'a good fit with the syllabus', especially the Common Core, and provided a 'springboard' for the development of specific modules. The 741 amplifier assignment (no 7) and determining the specification (no 1) were felt to be particularly valuable.

The material was also seen as providing a useful structure, specific concrete activities and directions that would be 'particularly helpful to the mid-range student'. This is valuable, too, as an introduction to a different way of working for those students coming to 'A' level technology work from a design and realisation background. The nature of the material encouraged joint teaching (CDT & Science) and could be used to encourage links with other subject areas (eg Economics).

3.3 Effective Aspects

All Centres reported that the product - the personal stereo cassette player - proved to be interesting and motivating to the students and that, in general, the assignments were seen by them to be relevant to their course. However, their enthusiasm for this work was generally less than that shown when working on their own design ideas. The interviews with the students confirmed this.

The teachers reported that the work promoted discussion between students and that splitting them into pairs and teams helped to develop habits of co-operative working. In one Centre a short discussion was held at the end of each lesson which further encouraged group working.

All of the assignments were felt to well prepared, presented at the right level and generally worth doing. The principal exception being assignment 5 (circuit diagram) which is discussed below. Some teachers directed students to specific assignments in order to address individual weaknesses.

The approach of the assignments, emphasising active involvement, was felt to have provided an effective way of acquiring the knowledge and other skills relevant to 'A' level Design and Technology. One student, who admitted to being weak in electronics, would have liked to have used this sort of material at fourth form / GCSE level.
There was less certainty as to whether the broader, holistic aims of the material had been achieved.

3.4 Difficulties

Assignment 5, deducing the amplifier circuit diagram from the printed circuit board, was generally felt to be the weakest assignment. Many students got bogged down here and thus became bored and frustrated. An additional problem was that the IC's could not be found in available data books and so component function and pin identification was not possible. The purpose of this assignment within the overall framework was not clear.

Assignment 6, examining the mechanical system, also caused some difficulty. The principal problems concerned finding a way of measuring the take-up spool torque and the force needed to operate the control buttons. Some teachers felt that additional guidance and/or materials should be supplied to cover this but others thought these difficulties to be 'part of the learning experience'.

Measuring the playback characteristics (assignment 4) also caused some difficulty mainly because the task was unfamiliar but also because the tape proved difficult to use. The individual tones were difficult to find and distinguish; an improvement might be to provide each tone on a separate (short) track.

Overall, the more general assignments were approached less enthusiastically. One teacher, whose students had completed all the assignments, felt that the holistic, integrative aspect of the resource material and the assignments was not really effective. He felt that the students saw the material as being an investigation into the technical aspects of the personal cassette recorder and that they did not find the wider concerns to be relevant at this stage of their course. This, he felt, may have been partly due to the nature of the 'A' level course being followed and he thought that these issues would be picked up later in the Case Study.

Only one other centre made sufficient progress with the material for the students to be able to gain an holistic impression. Here the integration was felt to have been achieved in part, but would have been better managed had there been time for a group presentation and display.

Finally, the question was posed as to how effective the material would prove to be with less mathematical or
technical students: for example, if it was to be used within an AS course.

4. Conclusions

This short trial has generated considerable enthusiasm for the material among all the teachers involved. All see it as being relevant to the course they teach and they intend to use it with their next lower sixth groups. Encouragingly few shortcomings were found in the content of the assignments and only one was thought to be weak and of dubious value. This is a tribute to the attention to detail and care taken in the preparation of the application based studies. However, additional guidance to teachers on ways in which it could be used within different course structures would be helpful.

The material appears to meet many of the specific aims. What is less clear is the extent to which the broader, more general and integrative aims are met and an evolutionary perspective of product design and development achieved. Much may depend here on the attitudes and importance given to these wider issues by the teachers concerned, and on the degree to which this sort of broad perspective has been encouraged lower down in the school.

The introduction and use of this material clearly requires careful planning, with specific deadlines, feedback sessions and displays built into the programme from the start. Further trials of this material are needed with students preparing for other 'A' level and 'AS' level examinations so that a comprehensive picture can be obtained.

The material definitely appears to fill a gap in the resources available for Design and Technology teaching at 'A' level. It is hoped that further application based study material sort will become available soon for use in 'A' level and other courses.

References

(1) GCE Examination Boards of England, Wales and Northern Ireland, Common Cores at Advanced Level, 1987; p 1.

(2) P M Threlfall and P H Riley; 'An application-based approach to the teaching of design and technology'; Electronic Systems News; Summer 1989; p 6 & 7.
Appendix 1: Participating Schools

Honiton Community College (Comprehensive, 740 mixed)

<table>
<thead>
<tr>
<th>Nr of students</th>
<th>9 (pairs +3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sixth form students drawn from Ottery St. Mary, Sidmouth and Honiton.</td>
<td></td>
</tr>
<tr>
<td>Timetable time</td>
<td>2 x half days per week</td>
</tr>
</tbody>
</table>
| Staff | Mr T Smith (CDT) *
| | Mr J Perkins (Science) |

Plymouth School Technology Centre

<table>
<thead>
<tr>
<th>Nr of students</th>
<th>5, some assignments done singly, some in pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students drawn from a number of Plymouth schools</td>
<td></td>
</tr>
<tr>
<td>Timetable time</td>
<td>2 x half days per week</td>
</tr>
<tr>
<td>Staff</td>
<td>Mr D Barnwell *</td>
</tr>
</tbody>
</table>

Okehampton Community College (Comprehensive, 1080 mixed)

<table>
<thead>
<tr>
<th>Nr of students</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timetable time</td>
<td>1 hr per week x 4 weeks</td>
</tr>
</tbody>
</table>
| Staff | Mr R Thomas (CDT) *
| | Mr J Hepworth (Science) * |

Torquay Boys Grammar School (780)

<table>
<thead>
<tr>
<th>Nr of students</th>
<th>12, 4 x groups of 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timetable time</td>
<td>2 x 1 hr for 4 weeks</td>
</tr>
</tbody>
</table>
| Staff | Mr A Croyde (CDT) *
| | Mr J Grainger (Science) |

* Interviewed during June
## Appendix 2: Summary of Assignments

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Nature of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The Need</td>
<td>Writing a specification for a cheap personal cassette player.</td>
</tr>
<tr>
<td>2 Evolution</td>
<td>Preparing a 15 min talk on the development of the domestic tape recorder from 1950.</td>
</tr>
<tr>
<td>3 Competition</td>
<td>Identifying the features of different makes and models, unique selling points, etc., and explaining how they are implemented.</td>
</tr>
<tr>
<td>4 Science &amp; Mathematics</td>
<td>Examining the playback characteristics of the tape head using a pre-recorded tape of fixed frequency signals. Distortion, and graphs of frequency vs. gain.</td>
</tr>
<tr>
<td>5 Science &amp; Mathematics</td>
<td>Deducing the amplifier circuit diagram from the printed circuit board layout.</td>
</tr>
<tr>
<td>6 Devices</td>
<td>Examining the mechanical system, making a mock-up of button interlocking mechanism, investigating tape speed variation vs. supply voltage.</td>
</tr>
<tr>
<td>7 Devices</td>
<td>Building a loudspeaker amplifier (400mW) based on 741 op. amp. and BFX 85/88.</td>
</tr>
<tr>
<td>8 Economics</td>
<td>Identifying the cost/volume relationship in commercial manufacture.</td>
</tr>
<tr>
<td>9 Production</td>
<td>Identifying ways in which different models have been simplified to reduce production costs.</td>
</tr>
<tr>
<td>10 Legal</td>
<td>Examining the arguments for and against a levy on tapes to protect copyright holders.</td>
</tr>
<tr>
<td>11 Legal</td>
<td>Examining the effect of patent protection on commercial development: cassette and video tape development compared.</td>
</tr>
<tr>
<td>12 Materials</td>
<td>Magnetic characteristics of the tape head: susceptibility, remanence, coercive force, hysteresis.</td>
</tr>
<tr>
<td>13 Aesthetics</td>
<td>Design of packaging for 'point of sale' display.</td>
</tr>
<tr>
<td>14 Aesthetics</td>
<td>Redesign of product for use by people with limited use of their hands.</td>
</tr>
</tbody>
</table>