# The role of published materials in curriculum development and implementation for secondary school design and technology in England and Wales

ABSTRACT. This paper discusses the ways in which teachers exploited a set of curriculum materials published as a vehicle for curriculum innovation, and the relationship between chosen modes of exploitation and teachers' own perceptions of how the materials had 'added value' to their teaching. The materials in question were developed by the Nuffield Design and Technology Project ('the Project') to offer a pedagogy appropriate to the statutory curriculum for secondary school design and technology education in England and Wales (DFE/WO 1995). The Project had sought both to inform the statutory curriculum, and respond to its requirements. An earlier case study (Givens 1997) laid the foundations for the survey that is reported here. This paper focuses on the teaching of pupils aged 11-14. It finds that while most teachers made at least some use of all the various components of the publications, they were selective. While the Study Guide, which carries out a meta-cognitive dialogue with pupils, was generally underused, those teachers who did use it perceived greater value added by the materials as a whole to the quality of pupils' work, their effectiveness in design and technology and their autonomy.

**Key words: t**echnology education, design and technology education, curriculum innovation through publication, meta-cognition, study guides, students' guides, pupils' guides

# MEETING THE CHALLENGE OF NATIONAL CURRICULUM DESIGN AND TECHNOLOGY THROUGH CURRICULUM DEVELOPMENT AND PUBLICATION: THE NUFFIELD DESIGN AND TECHNOLOGY PROJECT

Design and technology was introduced as a new subject into the National Curriculum of England and Wales in 1990 (DES/WO 1990). A central feature of the subject is that it required pupils to design and make products. Designing and making engages students with thinking about the made world and how they might intervene to change it. The educational value of this work does not depend on the worth of the products that pupils design and make; the activity itself is held to be highly significant because " the process of trying to create change requires pupils to engage in a challenging, enriching empowering activity" (Kimbell, Stables & Green, 1996, p. 29).

The Nuffield Design and Technology Project was initiated in 1990 as schools were required for the first time to teach design and technology. It soon became clear to the Project that many teachers were finding it extremely difficult to meet these new requirements. This was echoed by the findings of Her Majesties Inspectors of Schools; the annual report for design & technology in 1990-1991 (DES 1992) makes sorry reading and shows a decline in pupils ability to design and make since the introduction of the National Curriculum, particularly in the 11 - 14 age range. The Project took a three-pronged approach to address this by:

i) promoting and contributing to a radical revision of the Statutory Orders to make them accessible to teachers.

ii) establishing a clear pedagogy that teachers could use to teach effectively.

iii) developing curriculum materials that utilised the effective pedagogy and provided the detail that was lacking in the Orders, in a way that gave teachers ownership of the curriculum they had to teach.

## *A Nuffield influence on the revision of the Statutory Orders*

The Project worked closely with Government Departments and officials, in particular with the review team led by HMI Vic Green that was set up to provide the first proposals for revision of the Orders in 1992 (DfE/WO 1992) and then with Mick Walker and Neil McLean, design and technology Subject Officers with the Schools Curriculum and Assessment Authority. The Project convinced those responsible for revising the design and technology curriculum that much of the pedagogy developed by the Project could be adopted nationally. This pedagogy consisted of three types of activities as follows:

**Resource Tasks** – short practical activities to make pupils think and help them learn the knowledge and skill they need to design and make really well.

**Case Studies** – true stories about design and technology in the world outside school. Pupils learn the way firms and business design and manufacture goods and how goods are marketed and sold. They also learn about the impact that products have on the people who use them and the places where they are made.

**Capability Tasks** – designing and making a product that works. These build on learning experiences from Resource Tasks and Case Studies.

The tasks have roots in the Task-Action-Capability model of technology education proposed by Black & Harrison (1985).

The Project argued that all three types of learning activity were necessary. Resource Tasks and Case Studies put pupils on the road to success, demonstrated through meeting the challenges set by Capability Tasks. A diet of Resource Tasks and Case Studies alone would not require the pupils to be capable. A diet of

Capability Tasks alone would not give pupils the resources with which to be capable. By teaching through a mixed diet of these activities teachers could ensure that their pupils are able to respond positively and effectively to the challenges of designing and making. The Project saw the basis of curriculum planning for design and technology as identifying a sequence of Capability Tasks for pupils aged 11 – 14 years which provided, breadth, balance, coherence and progression.

The pedagogy proposed by the Project closely matched the teaching methods recommended in the Revised Orders of 1995. Resource tasks can be used as focused practical tasks (FPTs) and for investigation, disassembly and evaluation activities (IDEAs). Capability tasks can be used for designing and making assignments (DMAs). Case study work was not formally adopted in the 1995 Revised Order for design and technology and this was a disappointment to the Project, which argued that this limited pupils' experience of design and technology. Case study work enables pupils to consider large technologies e.g. communication systems, intermediate technology, technologies of the past, and the development and impact of influential technologies e.g. printing. Although elements of the programme of study might usefully be taught through case study work this was not required by the Orders. However the Project took some satisfaction in the inclusion of case study tasks as a recommended teaching method in the technology curriculum for Scotland (The Scottish Office Education Department 1993).

## *Developing appropriate materials*

The Project had the task of producing materials that would enable teachers to use the pedagogy it proposed. It developed two task files - a **Resource Task File** (Barlex et al. 1995a) that contained a wide range of focused practical tasks and investigation, disassembly and evaluation activities and a **Capability Task File** (Barlex. et al. 1995b) that contained a wide range of designing and making assignments. The Resource

Tasks were presented as copy-able originals that could be given to pupils as instruction sheets. Each Capability Task described a designing and making assignment in detail including a listing of the Resource Tasks and Case Studies that could be used to provide the knowledge, understanding and skill likely to be needed to be successful in tackling the task. To support pupils in tackling both Resource Tasks and Capability Tasks the Project produced two books – the **Student's Book** (Barlex et al. 1995c) and the **Study Guide** (Barlex. et al. 1995d). The Student's Book described in detail the substance of the programme of study. It must be emphasised that this was not a standard text-book in the sense that pupils were expected to start at the beginning and work through to the end. It was designed to be dipped into when needed; the need being provided by both Resource Tasks and Capability Tasks. Each Resource Task refers to the pages in the Student's Book that can provide support for that task, encouraging pupils to be independent learners, and each page in the Student's book refers to the Resource Tasks that allow pupils to apply the information on that page. In Capability Task work when pupils are making design decisions they are expected to find and use those parts of the book that might be relevant, initially with teacher guidance but ultimately under their own volition. In addition to 35 Case Studies the Study Guide contained guidance to the pupil on:

- the nature of this new subject called design and technology,
- the purposes of Resource Tasks, Case Studies and Capability Tasks,
- what it meant to 'get better at design and technology',
- how to 'get better at design and technology',
- how to use other subjects in design and technology
- how to assess your own progress.

The Project hoped that this book would talk directly to the pupil and help towards establishing the autonomous behaviour required to develop and demonstrate capability in design and technology. The Project had a clear view as to the meta-cognition it wanted to develop in pupils and it attempted to do this in

the first part of the Study Guide using a highly illustrative, almost comic book style. There are precedents for the success of this approach (Curtis 1975) which have been discussed in the context of science education (Barlex and Carré 1985). Reviewing the Study Guide, McCormick (1996, p99) commented:

> '…the material comes clean with the students: in telling them about what it means to learn through, for example, Capability Tasks , by posing questions "What's in it for you" (Study Guide, p17) or practical advice about not losing work so as not to lose marks (Study Guide p54). More impressive still is the whole idea of the students taking responsibility for their learning….. manifest in a section in the Study Guide on "Styles of Learning" and in one on "Resourcing your work", …..these exhibit the best ideas on metacognition translated into a language and techniques students can use'.

To enable teachers to use the materials effectively the Project produced a **Teacher's Guide** (Barlex. et al. 1995e).

The materials were designed to enable teachers to use them to construct and teach a curriculum of which they felt ownership. The Project envisaged teachers using the materials in different ways depending on the state of their current curriculum. For a department with a well established curriculum that already met most of the statutory requirements, this might entail using a few of the Resource Tasks to supplement existing focused practical tasks and one or two Capability Tasks to replace those designing and making assignments that were less successful. For a department whose curriculum needed radical revision the materials provided an off the shelf scheme that could be adopted and adapted according to the facilities, staffing and pupils in the school. Clearly there are positions of intermediate use. For example, a school with well established designing and making assignments but weak focused practical tasks could use Nuffield

Resource Tasks to support those assignments. The way that Resource Tasks were used was entirely at the discretion of the teacher, who could decide which tasks pupils did, when, how long they should take, which parts if any should be missed out, and how they were organised (ranging from all pupils doing the same task at the same time to a free choice from a range of options). The Capability Tasks were designed to be customised. They can be used as presented, adapted in small ways or the Capability Task structure can be used as a framework for designing and making assignments already undertaken by a school or for new tasks written by a school; the latter two modes of use aid teachers in making best use of other Nuffield materials (e.g. Resource Tasks) in support of in-house design and make assignments. The two pupils' texts can be used to support the teaching and learning irrespective of how Capability and Resource Tasks are used.

### *In service training*

Developing and publishing the materials was only a first step in enabling teachers to use them effectively. The materials were a complex set of teaching and learning resources and it was possible for them to be used inappropriately or ineffectually. The Project held the view that in order to fully exploit Nuffield resources, teachers needed to understand the 'Nuffield approach' to design and technology, as described by DATA (1997, p1): ' The key idea (is that of) teaching through sequences of tasks designed for specific learning purposes'.

In an attempt to promote effective use, the Project initially provided 'twilight' in-service training sessions which aimed to familiarise teachers with the Nuffield approach to design and technology and the structure of the materials, and to address a concern identified by McCormick (1996, p98-99): 'about how teachers came to understand and develop the sophistication that is built into the materials'. Only those teachers who

attended INSET were given the INSET Guide (Barlex 1994), which also introduced the 'Nuffield approach' and provided a photocopy-able sample of the materials sufficient for six months of pupils' work. Over the two year period between the completion of most of the materials and the publication of the revised Orders, over 1500 secondary school teachers attended INSET. There are precedents for making training a prerequisite to the purchase of materials: the 'Man: A Course of Study' programme (Jenkins, 1980) is an example.

### *On-going support*

Once the materials were published and launched through a series of regional events it was clear that many purchasers would benefit from support in their effective use. The Project appointed eight part time Area Field Officers to provide this support (one or two days per week); they came from a variety of educational institutions and included teacher educators, teachers and local education authority advisers. They had the tasks of helping individual schools make the best use of the Nuffield materials that they had purchased and of recording examples of good or improving practice. The work of schools using the Nuffield approach and materials was written up in a termly newsletter 'Update'. This kept users in touch with developments in the Project and gave the Project a voice on important national developments – key skills (Barlex 1998a), the Robinson Report on creativity (DfEE 1999; Barlex 1998b) and the most recent revision of the design and technology Orders (QCA 1999, Barlex 1999) for example.

### *Market penetration*

Since publication in 1995 of the materials for pupils aged 11 - 14 year, the sales have been considerable. The Student's Book has sold some 50,000 copies, the Study Guide over 20,000 copies. The sales of the

Task Files (only one copy of each being required per school) suggest that over 2000 of the 6099 secondary schools in England and Wales have used and/or are using Nuffield tasks.

## LITERATURE

This study focuses on teachers who were addressing two linked invitations to change their practice: one, a statutory curriculum that prescribed new content, broad types of learning activity and assessment for a subject; the other a set of published curriculum materials that embodied a particular pedagogical approach as well as detailing knowledge, skills, pupil activities and study skills. To the extent that this study concerns the diffusion of curriculum innovation, it is useful to note that the diffusion of Nuffield Design and Technology depended in part upon teachers' acceptance of the National Curriculum as well as their acceptance of the Nuffield materials and approach.

While much of the literature on change predates the National Curriculum, it offers some analyses that remain relevant. In many respects the National Curriculum appears to be a working example of what Bennis, Benne and Chin (1969) called the 'Power-coercive strategy' in that it became a statutory obligation for all state schools to teach this new subject irrespective of teachers' preparedness, relevant skills and experience, or professional opinions. The effectiveness of power-coercive strategies in achieving curriculum change has been seriously questioned (Blenkin, Edwards & Kelly 1992 p152). The National Curriculum also has some features of Schon's (1971) 'centre-periphery' model of change, the success of which requires that an innovation be fully developed and detailed prior to diffusion; this was clearly not entirely true for the National Curriculum for design and technology. Indeed, one of the purposes of the Project was to offer development and detail to those teachers who sought it.

There is evidence that teachers have found changing their practice to meet the requirements of the Orders very demanding (OFSTED 1998). This is not surprising when one considers the views of MacDonald and Walker (1976) which partly support Havelock's (1971) position that new messages which 'appeal to pre-existing values ….. will get far', but add the rider that other factors, such as 'release from a boring occupation, …career qualifications' (p.44-45) can lend motivation. There is little evidence that these potentially motivating factors were widespread in this case. Indeed, there are accounts of teachers deliberately rejecting the statutory requirements and adopting a position more in keeping with values based in their early professional development Paechter (1995) or with a 'craft paradigm' (Mittell & Penny 1997).

The Project saw the National Curriculum as an invitation to develop materials that in turn would invite teachers to adopt but also, importantly, adapt them to the particular requirements of their pupils. In developing materials over the period 1991-96 the Project sought to respect teachers' agency in their creation of learning opportunities and learners' agency in responding to them, while recognising the National Curriculum as a statutory prescription against which both teachers and learners would be assessed.

Bennis, Benne and Chin (1969) identified a group of 'empirical-rational' strategies for innovation, which appeal to the user's perception of the validity of the innovation and have implicit within them the need to justify the innovation to the potential practitioner. MacDonald and Walker (1976) allude to the ancestors of the Nuffield Design and Technology Project in England and Wales as typical 'empirical-rational' strategies for change:

> ‘The attempt to change the curriculum by publication of materials which have been written to embody particular ideas and values is a common one. “Materials production” forms a basic activity for most Schools Council and Nuffield curriculum projects’. (p.102)

Although backed by considerable resources, there is a question over the extent of diffusion achieved by these projects. Kelly (1989), reflecting on the outcome of the Humanities Curriculum Project, asserts that

> ‘if an innovation is to have a chance of ‘taking’ in a school, it will be necessary for more to be done than the mere provision of resources and in-service support’ (p.131)

It is a feature of the Nuffield design and technology materials that they embody particular teaching and learning methods, which constitute the ‘Nuffield Approach’ to the teaching of design and technology. History suggests that new curriculum content is easier to bring into use than are new methods. MacDonald & Walker (1976) cite Becher’s (1971) description of projects in which

> ‘materials intended to exploit discovery methods were used didactically, and (those) intended to ‘encourage active pupil participation’ were used ‘for passive rote learning’. (p.99)

While it might be tempting for a curriculum project to ‘teacher-proof’ its materials, there are both practical and professional indications against this. Becher (1971) points out that it is difficult to produce materials that are impervious to teachers’ individual skills and attitudes, while Kelly (1989) suggests that the notion of teacher-proofing implies a view of teachers as technicians rather than professionals. The view taken by the Project was more in keeping with Bloomer (1997):

> ‘Teachers are not merely points in some conduit linking centralised prescriptions to learners’ desks. They are not technicians, faithfully acting out the detail of prescribed blueprints. Rather, they ‘act upon’ prescriptions in order to create learning opportunities’. (p. 137)

Thus, the materials developed by the Project offered an ‘off the shelf’ solution to those teachers who sought this, but designed them so as to maximise opportunities for adaptation to local circumstances.

## METHODOLOGY

The survey was informed by a previous case study (Givens 1997) and by Area Field Officers’ observations and conversations with teachers regarding how the materials were being used. Both sources revealed that some teachers were using the materials in ways that the Project had not anticipated, and were also perceiving that use of the materials had resulted in gains that the Project had not expected. Hence the survey was designed not only to gather feedback on the extent to which the materials were fulfilling the Projects’ intentions, but also on uses of, and gains from, the materials that the Project had not intended or expected. This decision was influenced by the sophistication that two teachers had demonstrated in taking ownership of the materials (Givens 1997) . The Area Field Officer team was used as a focus group to evaluate the survey as it developed. As a result, the survey asked three types of question:

i) about the respondents and their schools (e.g. ‘how many years experience of teaching D&T do you have?’)

ii) about how much the materials added value to various aspects of a teacher’s work (e.g. ‘quality of pupil’s modelling’) on the following scale:

1= Lots of added value, 2= Some added value, 3= No added value

iii) about the extent to which teachers used different components of the materials in particular ways (e.g. The Resource Task structure used as a framework for in-house focused practical tasks), on the following scale:

1= Considerable use, 2= Some use, 3= No use.

The question offered as an example above was the result of Area Field Officers' input to the survey: they had observed that some teachers, rather than use the Resource Tasks exactly as intended, had adopted the Resource Task structure for learning materials that they had themselves written. It is important to clarify the term 'added value' in this context. This part of the survey was NOT concerned with added value just as

'the boost that it gives to a child's previous level of attainment'

(McPherson 1993 p44)

or as

'quantitative measures of the educational progress pupils make while at school'

(Thomas, S. & Goldstein, H. (1995) p17)

In contrast to the above, what the survey did seek was a user's subjective judgement of

'what difference the materials had made'

(Field notes, Area Field Officer meeting, 12/09/97)

Put simply, the authors took the view that when teachers believed that their perceived needs had been met, then value had been added. This could be manifest through teachers or pupils finding an aspect of their D&T work easier, or finding that they carried it out to a higher standard, or that they felt able to do something within D&T that formerly they had not felt capable of. Each question, therefore, invited respondents to make a judgement about added value in a particular aspect of their work, e.g. the quality of their pupils' modelling work, their own confidence as a D&T teacher, the proportion of their pupils who complete their projects.

Questions about added value and about use of the materials were asked twice, once for 11-14 age range and again for 14-16 age range. This paper reports only on the former.

## THE SAMPLE

It was considered important to draw the sample from schools that had made a commitment to Nuffield design and technology materials; accordingly, the initial selection comprised schools that had spent £1,000 or more on the Project's publications. Of these, each Area Field Officer identified schools in their Area with which they had been in contact ('known schools'), and those with which they had not (' not-known schools'). The project sought permission from Head-teachers to invite their design and technology staff to participate. Permissions were received from the head-teachers of 62 'known' schools (to send surveys to a total of 250 teachers) and 102 'not known' schools (to send surveys to a total of 429 teachers). Surveys were individually addressed to all of these teachers, on the assumption that the response rate from 'not known' schools would be lower than that from 'known' schools.

The overall response rate (TABLE I) by teachers was 33%. The sample was, by and large, opportunistic, but it is interesting to compare it with other data about the national picture.

TABLE I

Response rate

| | surveys sent | | surveys completed | | response rate | |
|---|---|---|---|---|---|---|
| | schools | teachers | schools | teachers | schools | teachers |
| total | 164 | 679 | 105 | 223 | 64.0% | 32.8% |

The data that follow are offered in order to paint a picture of our sample, to indicate its representativeness, and for further comparative purposes.

### *Distribution of school types (3)*

Local Education Authority (LEA)- funded schools are the category best represented in our sample; Grant-Maintained Schools (which have been absorbed back into LEA structures since these data were gathered) are over-represented, and independent schools appear to be very underrepresented (Table II). We say appear, because there are two factors that may reduce the relevance of independent schools to our survey

1. They are not legally obliged to teach design and technology; some do not teach it at all, others offer only those facets of design and technology that are traditionally associated with one or other sex (e.g. food, textiles for girls, control technology for boys).
2. While 37% of secondary schools are independent, they serve far less than 37% of secondary pupils, because many independent schools have small numbers of secondary aged pupils on roll. While national statistics do not distinguish between primary and secondary pupils in the independent sector, they do show ( DfEE 1998b, p26) that in January 1997 there were 554,124 pupils in independent schools, compared to 3,041,621 pupils in state secondary schools. Thus, if there were no primary aged pupils in the independent sector, it would still account for only 15.4 % of pupils; in reality, as many schools in the independent sector statistics do include pupils in the 3-11 age range, the sector must account for less than 15% of secondary aged pupils.

TABLE II:

Number of teachers responding, and number of schools represented in response, by school type.

| School type | Total | | **LEA (**incl. VA, VC and special) | | | **GMS** | | | **Independent** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | schools | teach-ers | schools | schools | teach-ers | schools | schools | teach-ers | schools | schools |
| | n | n | n | % | n | n | % | n | n | % |
| sample | 105 | 151 | 69 | 65.7% | 57 | 27 | 25.7% | 15 | 9 | 8.6% |
| DfEE (1998) | 6099 | - | 3117 | 51.1% | - | 679 | 11.1% | - | 2303 | 37.8% |

Chi square=48.153, df=2, Significance <0.001

The distribution of school types in this survey sample is significantly different to the national distribution.

Teachers responded from a large part of England and Wales (bounded by and including Cornwall, Kent, Norfolk, Lincolnshire, Newcastle, Lancashire, Flint, and Carmarthenshire). There were responses from 7 London Boroughs (13 teachers), from 12 Metropolitan Districts in England (35 teachers), from 33 non-Metropolitan Counties in England (including Unitary Authorities) (165 teachers) and from 5 Education Authorities in Wales (12 teachers).

This suggests a sample that is varied and offers comprehensive coverage (geographical, and of type of school); it is not, however, statistically representative.

*FIGURE 1 ABOUT HERE*

## *Teaching experience*

Compared with the DATA survey (22%) (DATA 1994), our sample shows double the representation of teachers with less than ten years experience (47.5%)(Table III). Joining the profession more recently implies training more recently, and may imply different attitudes to curricular change; the latter suggestion, however, is speculative.

TABLE III:

Years of teaching experience

| years | **1-4 yrs** | **5-9 yrs** | **10-19 yrs** | **20-29 yrs** | **30+ yrs** | **unclear** | **total** |
|---|---|---|---|---|---|---|---|
| sample: teachers | 42 | 64 | 48 | 57 | 12 | 0 | 223 |
| sample: percent | 18.8% | 28.7% | 21.5% | 25.6% | 5.4% | 0.0% | 100% |
| DATA (1994): percent | 11% | 11% | 39% | 32% | 7% | 2% | 100% |

Chi-squared= 97.4, df=4, $p<0.001$.

The chi-squared test indicates a highly significant difference between the Nuffield and DATA distributions of years of teaching design and technology.

## *Distribution of teachers by sex*

There is very little difference between the ratio of male to female teachers (46:54) responding to our survey (Table IV), and shown in DfEE statistics (50:50) (DfEE, 1997) and that difference is not statistically significant.

TABLE IV:

Sex: comparing the survey with DfEE (1997) *Secondary Schools Curriculum and Staffing Survey*

| | **female** | **male** | **total** |
|---|---|---|---|
| sample: teachers | 121 | 102 | 223 |
| sample: percent | 54.3% | 45.7% | 100.00% |
| DfEE 1997 * | 49.6% | 50.4% | 100% |

* total of teachers of 'D&T', 'Other Technology' and 'Home Economics'.

Chi square (between survey and DfEE data) =1.453, df=1, significance=0.228.

## *Initial training*

Comparisons regarding training are hampered in this case by the decision of some DATA (1994) respondents to declare more than one area of training. The total DATA responses (2472) therefore exceed the number of teachers taking part (1527).

Comparing the responses to this survey with those to the DATA survey shows that several training subjects feature less in this sample than in the DATA sample, i.e. Engineering (less than 1%, compared with 6%); Design/Craft (3% compared with 8%); Art/ design (5% compared with 10%). Two subjects appear more

frequently in this sample than in the DATA sample, i.e. Technology/D&T (38% compared with 17%) and Home Economics (40% compared with 22%).

Some differences may be explained by the time that elapsed between the DATA and Nuffield surveys, in that retirements from, and new recruits to D&T teaching would increase the proportion of more recently trained teachers, i.e. those trained in 'technology/D&T'.

The above can offer only the most tentative conclusions about our sample, as we are not comparing 'like with like'; the Nuffield survey sought the subject in which respondents trained to teach, whereas the DATA survey sought respondents' Higher Education subjects. A teacher with an Engineering degree and a D&T PGCE (4) might reply, e.g.
'Engineering' *(for their degree subject)* AND 'D&T' *(for their PGCE)* to the DATA survey, while replying only 'D&T' *(for their PGCE)* to the Nuffield survey.

RESULTS

## *Patterns of teaching 11-14, and implications for coherence and progression*

Responses to the questionnaire revealed the following pattern of teaching

TABLE V

Teaching Patterns, 11-14 years

| | n | % |
|---|---|---|
| Generalists<br>(teach 3 or 4 focus areas) | 6 | 3.0% |
| Semi-generalists: stereotypical<br>(teach Resistant Materials + Systems & Control, or Food + Textiles) | 75 | 37.1% |
| Semi-generalists: non-stereotypical<br>(teach Food + Resistant Materials, or Textiles + Resistant Materials) | 5 | 2.5% |
| Specialists<br>(teach in only one focus area) | 116 | 57.4% |
| Total | 202 | 100.0% |

The breadth of design and technology in the curriculum for England and Wales creates problems for those seeking to provide a curriculum experience that is coherent and progressive. To accommodate the breadth of the subject in a school where the teachers can teach only one or two of the four contributing focus areas (food, textiles, resistant materials, systems & control), a school may have to timetable classes so that children move from one specialist teacher to another as they progress through the course. This is sometimes called the ‘circus’ or ‘carousel’ approach. An alternative approach recommended by DATA (1998) involves

parallel time-tabling so that a class has two teachers throughout a year. The DATA model does require that each teacher can teach two focus areas – often resistant materials plus systems & control or food plus textiles. In both the circus and DATA approaches there is a risk that different teachers may give pupils contradictory messages about the nature of design and technology by transmitting different expectations or understandings of important features of the design and technology curriculum (such as the nature of a design brief or a product specification). Also the coherent development of procedural skills in designing (so that pupils skills broaden and deepen as they move through the curriculum and that pupils can call upon them in whatever specialist area they are working) becomes difficult if pupils are moving from teacher to teacher. Both approaches require good communication between the teachers teaching a particular class, including joint planning to ensure coherence and progression. It is noteworthy that over half the teachers in the survey (57.4%) taught in only one focus area and are almost certainly teaching as part of a circus approach. A further 39.6% teach only two focus areas; some of these are also likely to be operating in a circus system. An key feature of the Nuffield approach is that it can be used to establish an orthodoxy across a department – common means of planning the curriculum by sequencing Capability Tasks, common pedagogy and common resources leading to a shared understanding between teachers.

McBrien (1996) gives a teacher's evaluation:

> 'The Nuffield Design and Technology INSET Guide and the related introductory session on the Nuffield approach had enabled the whole… team to develop an appreciation of the approach and the supporting materials'. (p.74)

In the revised Nuffield materials (Barlex 2000) this has been developed further, by suggesting a programme of design strategy Resource Tasks that can be taught concurrently in all Focus Areas so that all involved are aware of the design strategies that pupils have been taught, and are able to encourage their effective use.

## *Gender stereotyping*

The distribution of male and female teachers across the Focus Areas raises the issue of stereotypical gender role models. For example, 96.7% of those teaching Food Technology were female; 88.2% of those teaching both Food Technology and Textile Technology were female; 82% of those teaching Resistant Materials were male; 87.8% of those teaching both Resistant Materials Technology and Systems & Control were male. In terms of widening the appeal of particular facets of design and technology to groups of pupils who have typically not engaged with these facets, this represents a problem; it has been reported on many occasions that the teacher can be a significant role model (Mayfield 1997 p132, Murdoch 1997 p137). If, in the majority of cases, only female teachers are seen to teach food and textiles while only male teachers are seen to teach resistant materials or systems & control then this mitigates against pupils' making counter-stereotypical choices.

## *To what extent were the materials used?*

Respondents were asked how much they used different components of the published materials on the following scale:

1=considerable use, 2=some use, 3= no use.

Alternative 'modes of use' were recorded for two components: as well as using Resource Task and/or Capability Tasks per se, teachers could answer that they had used either Task structure as a framework for Tasks that had been written within their school ('in-house'). These modes were not mutually exclusive. A teacher might, for example, use some Resource Tasks directly as Focused Practical Tasks (FPT), in addition to using the Resource Task structure as a framework to give coherence to FPTs that were designed in-house.

TABLE VI

Frequencies: use of components of the materials, including alternative modes

| | Considerable use | | some use | | no use | | total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Student's Book as a teacher's and pupil's resource | 67 | 35.8% | 93 | 49.7% | 27 | 14.4% | 187 | 100% |
| Resource Tasks as Focused Practical Tasks | 47 | 24.7% | 117 | 61.6% | 26 | 13.7% | 190 | 100% |
| Capability Task structure as a framework for in-house Design and Make Assignment | 42 | 23.9% | 86 | 48.9% | 48 | 27.3% | 176 | 100% |
| Capability Tasks as Design & Make Assignments | 40 | 22.2% | 99 | 55.0% | 41 | 22.8% | 180 | 100% |
| Resource Task structure as a framework for in-house Focused Practical Task | 39 | 22.0% | 102 | 57.6% | 36 | 20.3% | 177 | 100% |
| Teacher's Guide | 30 | 17.4% | 105 | 61.0% | 37 | 21.5% | 172 | 100% |
| Study Guide Pt 1 as teacher's and pupil's resource | 20 | 11.6% | 100 | 58.1% | 52 | 30.2% | 172 | 100% |
| Study Guide Pt 2 as teacher's and pupil's resource | 12 | 7.2% | 107 | 64.5% | 47 | 28.3% | 166 | 100% |

The majority of teachers had made considerable *or* some use of all the components in Table VI including the alternative modes; this suggests that most teachers were prepared to try out all of the materials, and found something useful in each component. The Student's Book, and Resource Tasks used as Focused Practical Tasks, were the most used of the materials, there being less than fifteen percent of teachers who reported no use in each case. The two parts of the Study Guide were the least used, approximately thirty percent of teachers reporting no use. Task structures were used nearly as much in providing frameworks to structure teachers' own in-house tasks as were the Nuffield Tasks themselves; this suggests a willingness on teacher's behalf to adapt materials to local needs and opportunities.

Separating 'considerable use' from 'some use' adds more detail to our picture of uptake. Over a third of teachers reported considerable use of the Student's Book, this being followed by each of the Tasks and Task structures which gained considerable use by between a fifth and a quarter of teachers. Only seventeen percent reported considerable use of the Teacher's Guide, this dropping to twelve and seven percent respectively for Part1 and Part 2 of the Study Guide.

All of these resources could be used on a selective, piecemeal basis without requiring teachers to radically change the content or style of their work; equally, any or all could be adopted in their entirety and be instrumental in a radical change of practice.

### *Added value?*

The survey sought feedback on what teachers perceived themselves to have gained from using the materials. One set of questions asked teachers to rate the value that the materials had added to various aspects of their teaching on the following scale:

1=lots of added value, 2=some added value, 3=no added value.

For purposes of analysis, three new broad categories of added value were obtained by taking aggregates of selected original questions, as follows:

The quality category: the aggregate of quality of pupils' designing, quality of pupils' modelling, quality of pupils' making

The professional satisfaction category: the aggregate of teacher enjoyment, confidence as a design and technology teacher, teachers' expectations of pupils

The effectiveness category: the aggregate of reduction in the time that pupils spend queuing for your attention, proportion of your pupils who complete their projects

The extent of pupils' autonomy was retained as a discrete category, taking data from a single question.

It may be useful to clarify that what is being aggregated here is not the aspects of the subject themselves but the added value that teachers perceived that they had gained in those aspects. There are precedents for this: as Goldstein (1979) p 219 points out, there is a consensus that the Retail Price Index is useful, although it is based on a collection of separate indicators. Similarly, within education the aggregation of values that have been allocated to differing items is commonplace in assessment: for example, formal qualifications in D&T have been graded by aggregating the scores that pupils achieved in discreet tasks that each assessed one or two aspects of the subject (e.g. an unseen examination for technical knowledge, practical coursework for design skills and manufacturing skills, a 'seen' design examination for design skills).

As a filter to isolate those teachers who had gained the most from the materials, a threshold was set for 'Substantial' added value in each category:

Quality category substantial <=5, minimum score =3, maximum score =9,

Professional satisfaction category substantial <=5, minimum score =3, maximum score =9,

Effectiveness category substantial <=3, minimum score =2, maximum score =6,

Pupil autonomy question substantial =1, minimum score =1, maximum score =3.

Thus 'substantial' requires that a 'considerable added value' answer must be recorded to at least one question in a category. Note that the threshold varies between categories because they aggregated different numbers of questions.

TABLE VII

Added value

| | 'Substantial' added value | | 'Lower' added value | |
|---|---|---|---|---|
| Added value category | n | % | n | % |
| Quality | 37 | 21.1% | 138 | 78.9% |
| Professional satisfaction | 46 | 25.8% | 132 | 74.2% |
| Effectiveness | 24 | 13.5% | 154 | 86.5% |
| Pupil autonomy | 21 | 11.5% | 161 | 88.5% |

Between twenty and twenty-five percent of teachers' scores indicated substantial added value in the 'quality' and 'professional satisfaction' categories while little over ten percent of scores indicated substantial gain in 'effectiveness' or 'extent of pupils' autonomy'.

Was added value associated with greater use of the materials? The scores for extent of use of the six components of the materials plus the two alternative modes of use were aggregated. Spearman is the appropriate bivariate correlation for non-interval data; the standard test of statistical significance was used. The Spearman correlation of aggregate use with quality added value was 0.41, with professional satisfaction

added value was 0.40, with effectiveness added value was 0.35 and with pupil autonomy added value was 0.28. All were significant at the 0.01 level. The higher a teacher's aggregate score for use of all the components, the higher their score for perceived added value was likely to be. These tests were repeated for individual answers to the 8 added value questions that contribute to the quality, effectiveness and professional satisfaction quality categories; the correlation of each discrete added value question with each of the components, including the alternative modes, was greater than 0.2 and significant at the 0.01 level. As would be hoped, greater use of the materials was therefore associated with greater perceived added value from the materials.

### *Was there a relationship between the categories of added value perceived by teachers and the modes in which they used the materials?*

The underlying question of interest to the authors was: where teachers perceived the materials to have added value to their work in a particular respect, had they used the materials differently from those teachers who did not perceive value to have been added in that respect?

Spearman bivariate tests were used to investigate correlation between teachers' reported added value in each of the broad categories and their reported use of the materials (Table VIII).

TABLE VIII

Correlations between reported added value and reported use of materials

| | Quality of pupils' work | Professional satisfaction | Pupils' effectiveness | Pupils' autonomy |
|---|---|---|---|---|
| Resource Tasks as Focused Practical Tasks | **.275*** | **.263*** | **.276*** | *.124* |
| Capability Task as Design and Make Assignments | **.293*** | **.340*** | **.256*** | .157* |
| Student's Book as a teacher's and pupil's resource | **.301*** | **.238*** | .143 | .123 |
| Study Guide Part 1 as a teacher's and pupil's resource | **.237*** | .178* | **.204*** | **.266*** |
| Study Guide Part 2 as a teacher's and pupil's resource | **.221*** | .176* | .182* | .171* |
| Capability Task structure as a framework for in-house Design and Make Assignments | **.295*** | **.337*** | **.285*** | **.212*** |
| Resource Task structure as a framework for in-house Focused Practical Tasks | **.211*** | **.311*** | **.256*** | .165* |
| Teacher's Guide | **.249*** | **.324*** | **.282*** | .191* |

* significant at the .05 level; **bold type** indicates a positive correlation >= 0.2

Values of n were in the range 149-170.

Reported use of most of the materials in most modes correlated positively with reported added value; in other words for most components, the more that a teacher reported using that component, the more they were likely to report gaining added value from them. Correlation was not dependent upon teachers using all or a majority of the components.

One alternative mode, namely the Capability Task structure used as a framework for in-house Design and Make Assignments, correlated with all four added value categories. In other words, teachers who had adapted a Nuffield Task structure to activities that had been developed in-house were more likely to report higher added value across the board.

Five other components/modes (Resource Tasks as focused Practical Tasks [FPTs] AND the Resource Task structure as a framework for in-house FPTs; Capability Tasks as Design and Make Assignments [DMAs]; Part 1 of the Study Guide; the Teacher's Guide) correlated to three types of added value.

Every one of the components /modes correlated to added value in terms of quality of pupils modelling/making/designing; while this was the only added value category that correlated to all components, it is particularly important because it relates to a core purpose of design and technology education.

Two components/ modes (Capability Task structure, already discussed, and Part 1 of the Study Guide) correlated to added value in terms of pupil autonomy. This implies that pupils autonomy accrues both from

teachers taking ‘ownership’ of the materials (e.g. by adapting task structures) and from the pedagogy of the subject being made explicit to the pupils.

### *What magnitude of use was associated with added value?*

The Spearman tests (above) supplied correlations between reported added value and reported use of the materials. To investigate magnitude of use of the materials in the context of added value, frequencies of ‘considerable’, ‘some’ and ‘no use’ answers by teachers reporting ‘substantial’ added value in each category were compared with frequencies of those answers by teachers reporting ‘lower’ added value in each added value category.

In six instances, the percentage of teachers making ‘considerable use’ of a particular component was at least three times higher amoung those who had reported ‘substantial’ added value than amoung those who had reported ‘lower’added value (Table IX).

TABLE IX

| | | 'considerable' use of Study Guide Pt 1 % | 'considerable' use of Study Guide Pt 2 % | 'consider able' use of Teacher's Guide % |
|---|---|---|---|---|
| Added value category | score | | | |
| Quality | <= 5 | 27.6% | - | - |
| | >= 6 | 8.7% | - | - |
| Professional satisfaction | <= 5 | - | - | 35.0% |
| | >= 6 | - | - | 11.2% |
| Effectiveness | <=4 | 31.6% | 26.3% | 45.0% |
| | >= 5 | 9.5% | 4.6% | 13.9% |
| Pupil autonomy | =1 | 33.3% | - | - |
| | =2 | 9.7% | - | - |

These instances concerned:

- 'considerable' use of Part 1 of the Study Guide,

  and 'substantial' added value in terms of 'quality, 'effectiveness' and 'pupil autonomy'
- 'considerable' use of Part 2 of the Study Guide,

  and 'substantial' added value in terms of 'effectiveness'
- 'considerable' use of the Teacher's Guide,

and ‘substantial’ added value in terms of ‘professional satisfaction’ and ‘effectiveness’

## DISCUSSION AND CONCLUSIONS

### *Specialist teaching at Key Stage 3*

In the 11-14 age range, there is a lot of specialisation of teaching, to the extent that many teachers work only in one of the Focus Areas, i.e. only in food or only in resistant materials. Design and technology seeks to teach a set of generic design skills in such away that they become transferable, so that for example pupils who learn a particular design skill (e.g. developing specifications) when they are working with textiles are able to access and use the skill appropriately when working at some later time with systems & control. If this is to take place, it remains important that teachers, curriculum developers and curriculum publishers present generic skills in such a way that transferability is optimised. The literature on transfer of knowledge and skills (Hennessy & McCormick (1994), Levinson et al (1997) McCormick (1999)) suggests that this is not easy.

### *On or off the shelf ?*

All those surveyed came from schools that had made a considerable financial commitment to the materials, but uptake was nevertheless variable. Most widely used were the Student’s Book and the Resource Tasks; it may be relevant that both were easy for teachers to use selectively without necessarily changing their practice. Least used were the two parts of the Study Guide. Part 2, the Case Studies, was not explicitly required by the National Curriculum; we can only speculate about the reasons for Part 1, the pupil’s guide, being underused: it may be that a profession that has its roots in the demonstration of practical craft skills (Paechter 1995, Mittell & Penny 1997) is not ready for a text that speaks directly to learners about the subject.

## *Use of the tasks*

The pattern of use of the materials poses interesting questions. First, task structures were used nearly as much as the tasks themselves, but as frameworks for schools' own in-house materials. Further, use of the Capability Task structure in this way was associated with added value in all categories (quality of pupils' work, professional satisfaction, pupils' effectiveness and pupils' autonomy). The task structures embody the pedagogy behind the materials ('the Nuffield Approach') through, for example, detailing activities (Resource Tasks and Case Studies) that will prepare pupils for a Capability Task and indicating value considerations and links to other subjects. When teachers adopted the Task structures but not necessarily their content, were they, in fact, adopting the pedagogy and applying it to their pre-selected content? If so this would have implications for curriculum innovation. Becher (1971) relates how teachers adopted the content offered by a curriculum innovation but retained their existing (didactic) teaching methods. Our findings appear to show some teachers responding to accessible structures in the opposite way, i.e. adopting the pedagogy from a curriculum innovation while retaining content from their established practice.

## *Use of the Study Guide*

While Part 1 of the Study was used less than most of the materials, its use, where reported, correlated with added value in respect of quality of pupils work, pupils' effectiveness in design and technology and the extent of pupils' autonomy. The use of Part 1 appears to have been three times higher among teachers reporting substantial added value than among those reporting lower added value. This suggests that 'coming clean with the students' (McCormick 1996) is one significant means by which the Study Guide added value to the work of the albeit small number of teachers who made considerable use of it. This offers a paradox: why did only a limited number of teachers recognise the potential of materials that set out to empower pupils as designers and makers? Is it the case that meta-cognitive materials, presented in an accessible way

to pupils, can make a contribution to the diffusion of curriculum innovation provided that teachers are prepared to let pupils use them?

Part 2 of the Study Guide (containing Case Studies) was the least used component of all. Its use, where reported, correlated with added value in respect of quality of pupils designing, modelling and making. The use of Part 2 appears to have been five times higher among teachers reporting substantial added value in this respect than among those reporting lower added value. While it will not surprise design professionals that the act of studying existing designs is linked to the quality of novice designers' own practice, the low usage of this component of the materials suggests that such an appreciation is not widespread among the design and technology teachers in this survey. Alternatively, it may be the case that the absence of such work from the Statutory Orders simply condemns it to a very low priority.

### *Use of the Teacher's Guide*

Use of the Teacher's Guide was three times higher among teachers reporting substantial added value in two categories (as compared with four, in the case of the Study Guide Part 1) than among those reporting lower added value. Although it should be no surprise that a Teacher's Guide assisted teachers to exploit curriculum materials, this was one of the least used components. Clearly, for both the Study and Teacher's Guides, provision alone was not enough: the key challenge must be to increase the proportion of pupils and teachers respectively who engage with such materials. The findings raise the question: 'do materials that present the pedagogy to pupils have more effect than those that present it to the teacher?' In either case the observations of Banks and McCormick (1995) are pertinent:

> ‘promoting change is difficult… and without extensive in-service training the materials themselves must carry much of the training burden’. (p.186).

Finally, it is important to note that, although it didn’t have the biggest impact on perceived added value, the Student’s Book was the most widely used component. This serves to remind us that there remains much still to be learned about how teachers choose and use curriculum materials.

NOTES

1. A Statutory Order is a legal requirement formulated by Act of Parliament. In respect of Education, Statutory Orders govern what shall be included in the curriculum and taught in maintained schools, i.e. schools that are funded by the state.

2. The Nuffield Foundation is a charitable foundation; in the field of education it funds research and the development of curriculum materials for publication.

3. At the time of the survey, state schools were either funded through Local Education Authorities (LEAs) or directly by the Government (Grant Maintained Schools). Voluntary Aided (VA) and Voluntary Controlled (VC) Schools are also funded by the state but there is Church involvement in their operation. Independent (‘private’ or sometimes ‘public’) schools are privately funded, and are not required to follow the national curriculum.

4. Postgraduate Certificate in Education.

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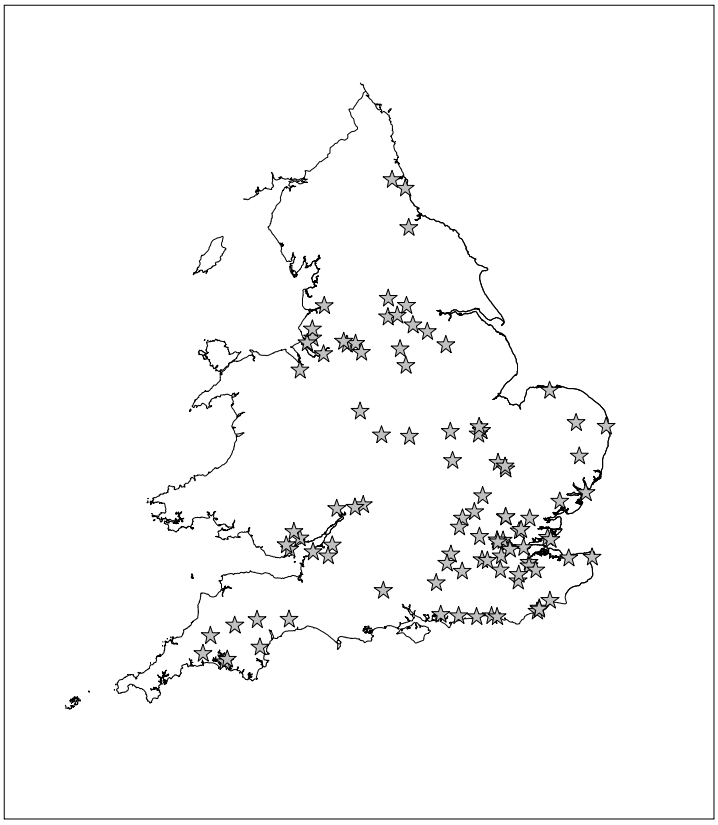
Fig. 1:



CAPTION

Fig. 1 Geographical spread of schools represented in the survey

# The role of published materials in curriculum development and implementation for secondary school design and technology in England and Wales

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