Quality teaching in primary school design and technology

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This research will help you think about:

- The meaning of 'quality' in your classrooms
- The relationship between design and make assignments and associated focused practical tasks
- Strategies for reflecting on your own practice

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Abstract

This paper draws its evidence from my Ph.D. research project set in a cluster of schools. The work is on-going and classroom based. Questions about the nature and practice of design and technology throughout the primary phase have been addressed by observer/participant teaching approaches and resultant data analysed through the processes of 'Reflexive Critique' and 'Critical Incident' analysis. The work is now moving towards its concluding phase in which implications for Initial Teacher Education (ITE) courses and In-Service Education and Training (INSET) are emerging.

Introduction

I initiated the research as a reaction to concerns, evidenced from personal contact with qualified teachers and those in training, about the quality of the planning, teaching and assessment of design and technology being undertaken in primary schools. These concerns, were reflected on a national scale in HMI Reports:

> "Work in technology rarely formed part of planned, coherent progressive pattern of experiences through either one or both Key Stages". (HMI 1992: 14)

> "Visits to all schools showed that: in many schools planning for each key stage lacked coherence, with inadequate coverage of the (D&T) Programmes of Study;
>
> the number of schools with satisfactory arrangements for assessment and record keeping (in D&T) remains small". (OFSTED 1993: 2).

The research is based on a series of case studies and my approach is iterative, interactive and dynamic; analysing the professional context and acting within it to test theories about how to realise the educational ideals espoused. The major mode of research activity has been through teaching and a range of data gathering techniques has been used. Figure 1 illustrates the overall structure of the research.

Central to my work is an examination of personal perceptions about the subject, its planning and its teaching methodologies. The exploration has resulted in changes to 'the professional self' which are personally challenging at emotional, as well as cognitive levels. Dadds (1993) expresses this cogently:

> "Studying one's own professional work is no straightforward matter and adopting the reflective mode is not simply a cerebral activity. As we study our teaching, we are studying the images we hold of ourselves as teachers. Where these self images are challenged, questioned and perhaps threatened in the learning process we may experience feelings of instability, anxiety, negativity, even depression". (Dadds 1993: 287)

The focus for my work has been, and continues to be, an examination of aspects of the nature and practice of design and technology education in primary schools in order to identify implications for teacher education; essentially an exploration of teaching. I established the following aims.

To explore personal perceptions about:

1. The nature of design and technology in primary schools – its philosophy and rationale. *The 'what it is' and the 'why it is taught'?*

2. Appropriate planning methodologies that are:

- useful in providing guidance for individual teachers;
- illustrative of what might be put in place at a school level.

The 'how it may be organised'?

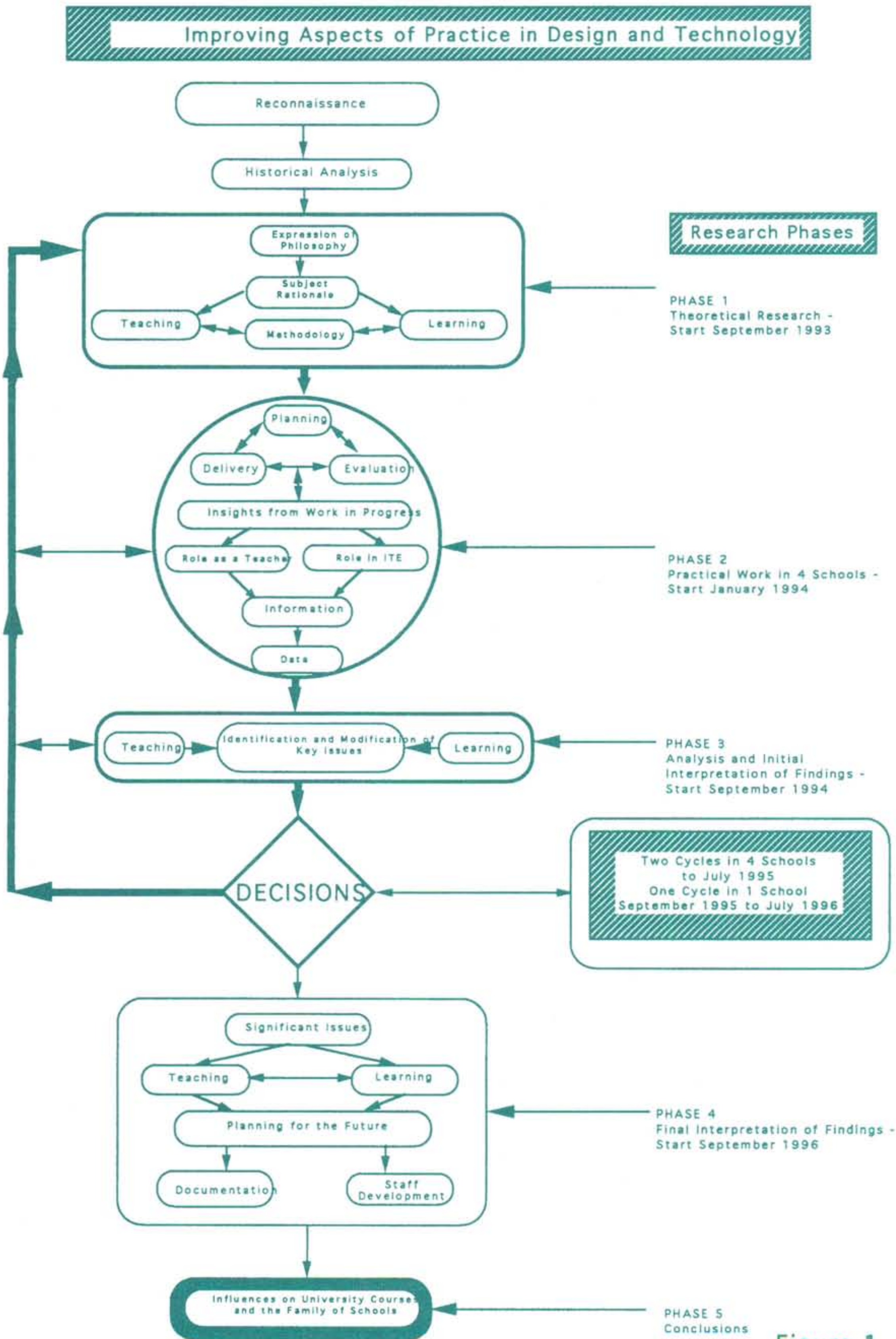
Improving Aspects of Practice in Design and Technology
Reconnaissance
Historical Analysis
Expression of Philosophy
Subject Rationale
Teaching
Methodology
Learning
Research Phases
PHASE 1
Theoretical Research -
Start September 1993
Planning
Delivery
Evaluation
Insights from Work in Progress
Role as a Teacher
Role in ITE
Information
Data
PHASE 2
Practical Work in 4 Schools -
Start January 1994
Teaching
Identification and Modification of Key Issues
Learning
PHASE 3
Analysis and Initial
Interpretation of Findings -
Start September 1994
DECISIONS
Two Cycles in 4 Schools
to July 1995
One Cycle in 1 School
September 1995 to July 1996
Significant Issues
Teaching
Learning
Planning for the Future
Documentation
Staff Development
PHASE 4
Final Interpretation of Findings -
Start September 1996
Influences on University Courses and the Family of Schools
PHASE 5
Conclusions

Figure 1

3. Aspects of teacher performance in terms of the qualities that a teacher displays in the action of teaching?

The 'how it may be accomplished'?

4. Planning and delivery of ITE and INSET courses.

Thoughts on the nature and practice of design and technology in primary schools

The Developing Subject

Whilst the introduction of a National Curriculum that included design and technology can be seen as a watershed in the history of the subject, cognisance must be taken of the numerous attempts to frame a philosophical rationale for it.

The essence of the subject can be traced back to the early years of elementary education and the 'Kindergarten' system (see for example Reay 1884 and Garnett 1884). However, its conception, as we know it in British schools today, can be found in two projects both set up by the Schools Council in 1966. The biases of these projects towards design and craft (The Keele Project) or towards science and technology (Project Technology), were profoundly influential in the secondary sector and remain the bedrock on which perceptions of the subject at the primary level must be built as the work in primary schools resulted from a migration downwards. The ideas have been modified by the culture of primary schools but the fundamental notions have remained the same.

Justifications based on *developing subject knowledge* can be contrasted with those based on the subject's ability to be *personally developmental*. The 'Humanist' view of design and technology is premised on the power of design and technology to engage the individual in activities which develop interpersonal qualities, challenge personal value systems associated with technology and the environment, foster the ability to be judgemental about the consequences and effects of personal actions and improve generic problem solving abilities. Those who advance its ideals in the primary sector often premise their arguments on this assumption. (See for example – Jarvis 1993, Makiya and Rogers 1992 or Tickle 1990.)

This view is, again, not new. Rousseau, over one hundred years earlier than Reay, captured the essence of the interpretation:

> "If instead of keeping a child at his books I keep him busy in a workshop, his hands labour to the benefit of his mind" (Rousseau 1762).

More recent influential work has been that of the APU Design and Technology Project. Set up in 1985 under the direction of Vic Kelly and Richard Kimbell at Goldsmiths College, London, this work (Evaluation and Monitoring Unit, The Assessment of Performance in Design and Technology 1991), like Rousseau, proposed a model of design and technology in which the interaction of mind and hand are central:

> "It is our contention that this inter-relationship between modelling ideas in the mind, and modelling ideas in reality is the cornerstone of capability in design and technology. It is best described as 'thought in action". (21)

Towards a personal rationale

Accepting the above and other influences, whilst at the same time focusing on the activity carried out in schools has led me towards the development of a tentative personal rationale for design and technology education.

> Design and technology education is about children validating the quality of their decision making. The validation mechanism is one in which creative cognitive processes are made manifest and the consequences of judgements tested through discussion, the production of drawings and, ultimately, physical objects. Inherent to the process are the concepts of meeting practical human needs, being constrained by materials and appreciating that potentially all knowledge has relevance to any given designing and making activity.

For me, this statement raised two major implications. The first is associated with guiding the teacher in making decisions about content to be covered, the second associated with the role of teacher in the classroom.

Guiding principles

Through the initial process of the research I explored this rationale and identified a range of principles which I categorised into two sections – those which are **important** within the learning of design and technology but are also significant within other aspects of the curriculum and those which are **unique** to design and technology. I also identified a range of principles which guided me in my teaching.

My role within the research has been to implement these principles through teaching and to scrutinise their veracity.

Important principles

Through design and technology:

Skills

1. Develop creative problem solving abilities through the interaction of hand and mind.

2. Develop motor skills through performance with tools.

Values

3. Cultivate personal qualities – e.g. persistence, determination, respect for others and their views, a personal value system.

4. A respect for the values of craftsmanship.

5. Responsibility for the consequences of decisions.

Knowledge

6. Acquire conceptual knowledge

7. Value knowledge as a tool for the realisation of a design rather than an end in itself.

8. Recognise that the possession procedural knowledge is crucial.

Lifelong outcomes

9. Establish designing as a life skill.

10. Gain insights into the technological world and develop a set of skills to use in maturing views on the advantages and disadvantages of technological developments.

Unique principles

When engaged in design and technology children are:

- Conceptually modelling objects and systems that meet human needs or wants.
- Manifesting the validity of value judgements through the production of products and systems using materials.
- Synthesising procedural and conceptual knowledge and skills from the breadth of the child's experience.

Role of the teacher

To implement these principles requires:

- The teacher not to have 'the answer' but to see their role as facilitating children's learning.
- A classroom that is 'child centred' rather than 'teacher centred'.
- Learning which is action based as distinct from content driven.
- A teaching methodology founded on the recognition that from the child's point of view the realisation of the product is the key feature of the activity but from the teacher's point of view it is the process that leads to the product that is crucial.

Process of the research

The research set out to explore these principles through teaching. The major form of information collection has been from classroom observation and structured taped interviews. Understandings gained via this process are mediated by the participants' experience and are always partial since it is impossible to stand outside one's experiences. It is my view that all research is biased by the predisposition of the parties involved.

The outcomes of my work are not claimed to be generalisable; its effects are ascertained by reflection on changes in personal perceptions about me as a teacher and teacher educator. There is no attempt to establish that my theoretical interpretations are 'true' in any absolute sense. They may nonetheless provide some ideas that others may identify with and wish to explore further.

Two techniques for examining classroom actions

Reflexive critique

My in-school activities produced a wealth of documentary information. Each action, be it a conversation with a child or teacher, some teaching planning or some introspective writing, has contributed. The translation of information gathered from all this was based on Winter's (1989) 'Six Principles for the Conduct of Action Research'. Specifically, Winter starts from the idea that most statements made in action inquiries are 'reflexive', meaning that they are based on complex interpersonally negotiated understandings. Reflexive critique has three phases:

> 1. Accounts are collected such as observation notes, interview transcripts, written statements from participants, or official documents.
>
> 2. The reflexive basis (i.e. their relationship and foundation) of these accounts is made explicit.
>
> 3. Claims about present understandings can then be transformed into questions and a range of possible alternatives suggested where previously particular interpretations have been taken for granted. (Winter 1989: 43)

These questions then provide a means of analysing the relationship between key issues exposed by philosophical analysis and those explored through school based activity. For example, each lesson taught was part of a series structured around 'focused tasks' and 'integrating tasks' (the language I initiated prior to the 1995 Order), the detail of which has been negotiated with the class teacher. When teaching my actions were scrutinised by the class teacher and findings recorded on a questionnaire based on an analysis of the above principles translated into questions. After teaching the lesson is reviewed in a taped interview, again focusing on the principles, but also enabling more open discourse about tangential issues to occur. The results of many such actions establish or challenge the accuracy of the original statements and result in changed perceptions.

Critical incident analysis

I have applied this technique to information gathered using the following sources:

- Teaching and learning questionnaires
- Structured taped interviews
- Introspective notes
- Photographic record.

This record can be viewed as one of 'incidents'. Analysis for impact translates some of these into 'Critical Incidents' (Tripp 1993). That is to say incidents that have altered on my views.

A synthesis from the case study record

What is described here, briefly, are the key features emerging from the detailed analysis of case studies using the above techniques.

Important Principles

My analysis identified the influential nature of the teaching method and the crucial importance of effective planning.

1. *Skills*

   i. There is a need to break down the design process into manageable pieces and teach these so that the children can assimilate them

   ii. The development of cognitive knowledge and motor skills runs in parallel to the acquisition of creative attributes. This form of action has been prevalent throughout my work and I have found it functions as a system for teaching design and technology. The interaction of these dimensions leads to an holistic experience of design and technology. These developments are best facilitated in structured learning situations.

iii. Demonstration is an effective technique for teaching skills to primary age children.

2. *Values*

i. Pupils' ability to work together was developed through their design and technology activity; however, younger children need practice in order to develop this ability. The use of children in a mentoring role is an effective mode of action to facilitate these interpersonal qualities.

ii. The values of craftsmanship were not evidenced as being of significance in the data. There was a questioning of the concept of craftsmanship and what it might mean within the context of the primary classroom. A feature of significance is that when children are highly motivated to achieve successful products they use tools in a safe manner.

iii. There was little evidence from the questionnaires and teacher interviews that children took responsibility for their decisions. There was clear evidence from the photographic record that they did.

3. *Knowledge*

i. Children were acquiring large amounts of conceptual knowledge through the activities.

ii. These was little evidence that *children* saw conceptual knowledge as tool for the realisation of a design rather than an end in itself, but there was clear evidence that children used knowledge effectively when designing and making.

iii. There was little recognition of the importance of procedural knowledge from the children, but there was clear evidence that they used procedural knowledge to progress their designing and making tasks.

iv. Planning and classroom management relied heavily on the children's ability to proceed through the tasks set. Imposing structure on the learning situation was essential to ensure that the children progressed and was powerful in generating creative responses. Structuring both conceptual and procedural learning are equally important.

4. *Lifelong outcomes*

There was virtually no evidence to support or deny the initial ideas expressed here. Lifelong outcomes are an important consideration when examining the philosophical basis for including design and technology in the curriculum. To discover something of value about them requires a longitudinal study of a period outside that being considered for this work. Consequently I decided that it would not be possible to study this effectively as part of this study. However, because I was not able to explore these issues is not to denigrate their importance within the base philosophical rationale for the subject. My belief in the crucial importance of these is held firm.

Unique principles

The data was highly supportive of these; this may well have been because of their fundamental nature. Analysis of the photographic evidence also clearly supported my original contentions.

Teaching principle 1. – The teacher not having 'the answer' but seen as facilitating children's learning.

The sense in which I explored the concept of 'facilitation' was that of the teacher creating a learning environment that was structured to allow children to progress in their learning activities. This may require giving answers or didactic inputs but these forms of teacher action need to be balanced with the generation of an inquiring classroom climate in which the children ask questions of themselves as well as of the teacher. The teacher should not impose 'the

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Design and make a transportable meal — food tasting. Year 5/6 children

easy for the teacher to lose focus and forget to ask the all important question of – 'activity and experience to achieve what?' The concept of child-centred learning identified was where the needs of the child were acknowledged and provided for by careful analysis of the intended learning in relation to a child's ability to take possession of the knowledge and skills embedded within it. The role of the teacher as illuminated by Bruner (1960) is to set up a learning environment appropriate to the child's level of understanding and I would see my activity within this concept of child-centeredness.

answer' but must have explanations which help the children towards 'an answer'. The data demonstrated that a focused task/integrating task approach facilitates this.

Teaching principle 2 – A classroom which is child centred rather than 'teacher centred'.

Traditionally 'child-centred' or 'progressive' education stresses 'learning' rather than 'teaching' and focuses on the child's perceptions of reality rather than the adult interpretation of the world. However, in starting with a consideration of the activity and experience that the child engages in it is

My perception of self as a teacher, as clarified through the process of the activity, places me as a progressive educationalist in terms of a focus on activity based learning. However, I also see consideration of the knowledge component in a 'traditional' sense as important. Dearden (1976) sums up my stance here very effectively:

"As well as having a sensitive and sympathetic insight into the world of childhood experience, a teacher also needs determination and a will directed towards the future". (59)

Teaching principle 3 – Learning which is action based as distinct from content driven.

It Works! Year 1 children working on circuits to put into their vehicle

Design and technology is intrinsically an action based subject. Engagement with designing and making requires children to be active cognitively and physically. However, actions need to be to some purpose and concern some content, therefore there is a contradiction in this statement. Content based learning is required, but this is not the antithesis of action based learning. Within focused tasks, which could be seen as content driven, children were involved in active learning, but this was often to cover content required to address successfully integrating tasks, which could be seen a action based. The statement should be rephrased as:

"Learning which is action based to achieve competence with desired content and familiarity with process skills".

Teaching principle 4 – Teaching methodology founded on the recognition that from the child's point of view the realisation of the product is the key feature of the activity but from the teacher's point of view it is the process that leads to the product that is crucial.

The data illustrates the importance of design process. This principle was applied effectively when I was teaching within the research. There was also clear evidence that children were excited by the process, proud of their products and worked hard to produce them (*See photos for examples*).

Nevertheless, there was a high degree of uncertainty whether other teachers see design and technology in this way. When discussing teacher knowledge one of the teachers worked with commented that:

"This (the lack of effective planning) is not just because teachers haven't got the knowledge or the skill but that they see design and technology in terms of an end product rather than a process".

I see this as a cause for concern.

Issues from the critical incident record

These were features associated with the concept of the subject that lay outside of the initial principles I developed.

1. In group based situations teacher input needs to be balanced across all of the activities being carried out by the children including those in other curriculum areas. There is a need to consider the order in which groups participate in design and technology if a rotating group pattern of organisation is used.

Previous experience of INSET in design and technology had highlighted that teachers often commented on the difficulty of undertaking work in this subject alongside that in other curriculum areas. They stated that design and technology took far too much teacher time. I found that without careful consideration of the teacher role in the progression of sessions that this was

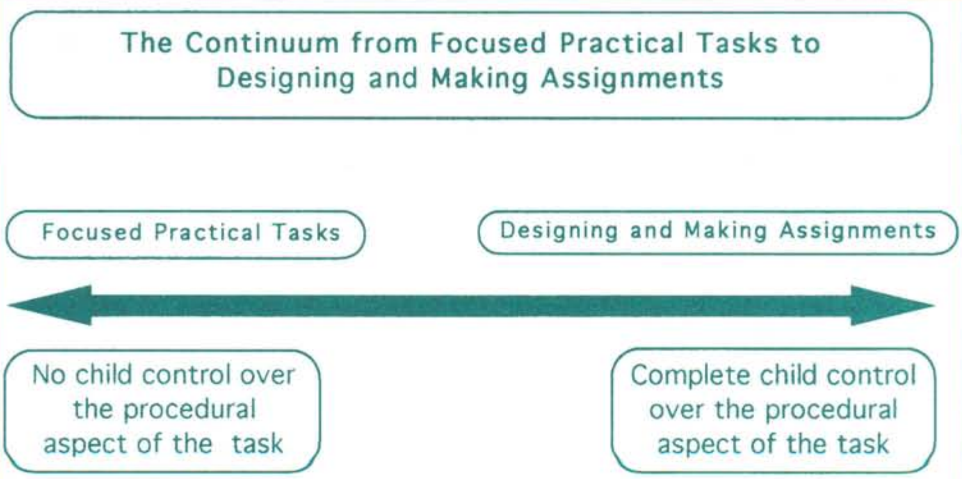

Figure 2

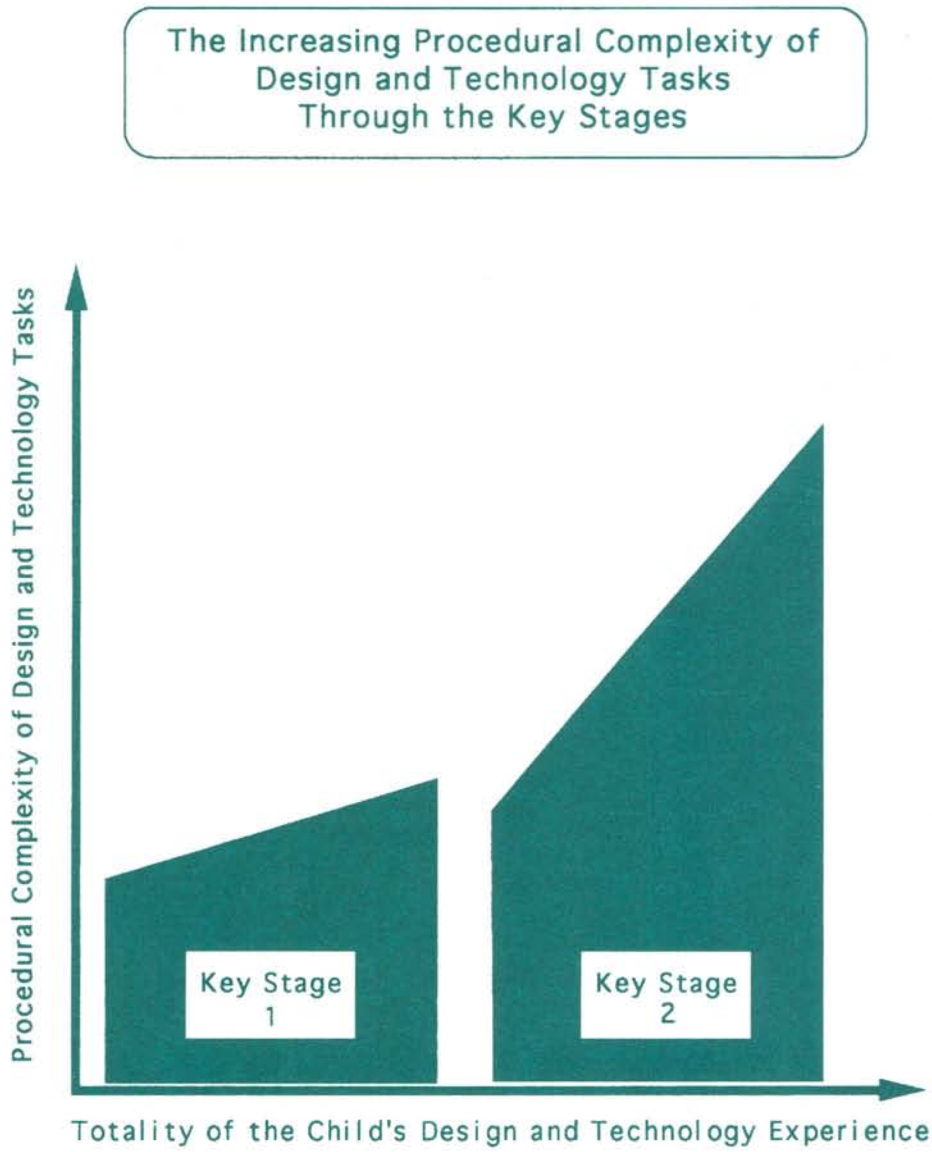

Figure3

true unless the demands were thought through. Balancing the workload was dependent on my ability to analyse the pupil-teacher interactions and set up inputs and continuing work in relation to each other. It was then possible to focus on individual curriculum areas. In rotating group situations the order groups tackled the activities was significant as later groups had the benefit of seeing previous group's work. In addition there was often the advantage of informal peer teaching. These simple expedients reduced markedly the 'crocodile' syndrome.

2. The concept of 'quality' in design and technology activity needs to be addressed. This must account for individual differences within children.

This is a difficult concept. The constituent components of quality in children's design and technology; good use of conceptual knowledge, including that of materials; effective procedural processes used for progressing the work; skilled performance with tools; development of personal qualities; how are children gaining insights into our technological word; how well they are developing designing as a life skill are, of course, dimensions of quality design and technology. Of crucial importance when considering quality in children's products must be the age of the child. Adult visions of technological products produced for the consumer market must not be confused with child conceptions of products. A very slim and much overlooked document produced by the National Curriculum Council (National Curriculum Council 1993) has many effective suggestions in all of these areas.

3. Differentiation by outcome is the easiest way of managing individual differences and recording differentiated learning is as important in design and technology as in other subjects.

This statement begs some questions. Is differentiation by outcome the most effective form of differentiation for the child? What is the effect on the child who has performed poorly in relation to others? How does this effect their self-esteem? Again the data has no answers, but raising issues is an important function of my research.

Conclusions and making meaning

This section explores implications extrapolated from my research.

Planning and Evaluating

The National Curriculum requires teachers to construct activities, or in the language of the 1995 Order – 'focused practical tasks' (FPTs), 'designing and making assignments' (DMAs) and products investigations and evaluations (PIEs), (Department for Education, (DFE) 1995) that are of appropriate complexity for the age, ability and experience of the child. The concept that lies behind the terms FPT and DMA are familiar to primary teachers and the structure, if not vocabulary, has been used to teach this subject for many years. FPTs are the vehicle by which subject matter is taught. DMAs are the test of effective learning of the subject matter; but more than this, they are where children's creative attributes in making value judgements, utilising the learning directed by the teacher through FPTs, PIEs, previous DMAs and all of their other learning come to the fore. DMAs are the essence of design and technology teaching. The major function of PIEs in the primary school should be as a kind of FPT facilitating learning that contributes towards a DMA whilst at the same time also fulfilling the function of developing understanding of the made world.

Teachers have always thought about the component parts of an activity and planned them in relation to one another. I found that this 'deconstruction' approach, often used in other subjects, is also the key to effective planning in design and technology. DMAs need to be deconstructed so that the necessary procedural and conceptual knowledge children require to both initiate and maintain their activities is taught. My research experience shows that when I was unsuccessful it was because my short-term learning intentions were unclear and the management of the learning environment unstructured. To provide a child-centred environment requires *more* and *better* teacher organisation rather than *less*. Creative responses in design and technology do not occur within unstructured situations but within a formal structure of well-taught procedural and conceptual knowledge. The role of the teacher is to provide greater access to conceptual knowledge and furnish learning environments in which children, progressively, have greater control over the procedural aspects of their work.

There is, in the majority of primary classrooms, a reliance on an organisational pattern of rotating groups and this, laid alongside the requirement to establish a balance across all subjects, obligates the teacher to carry out a very elaborate juggling act. Introducing design and technology into this setting has been problematic. In order to achieve success the crucial factor is the planning of activities in relation to one another. The teacher needs to make professional decisions about the amount of teacher input required to introduce and sustain all the activities and

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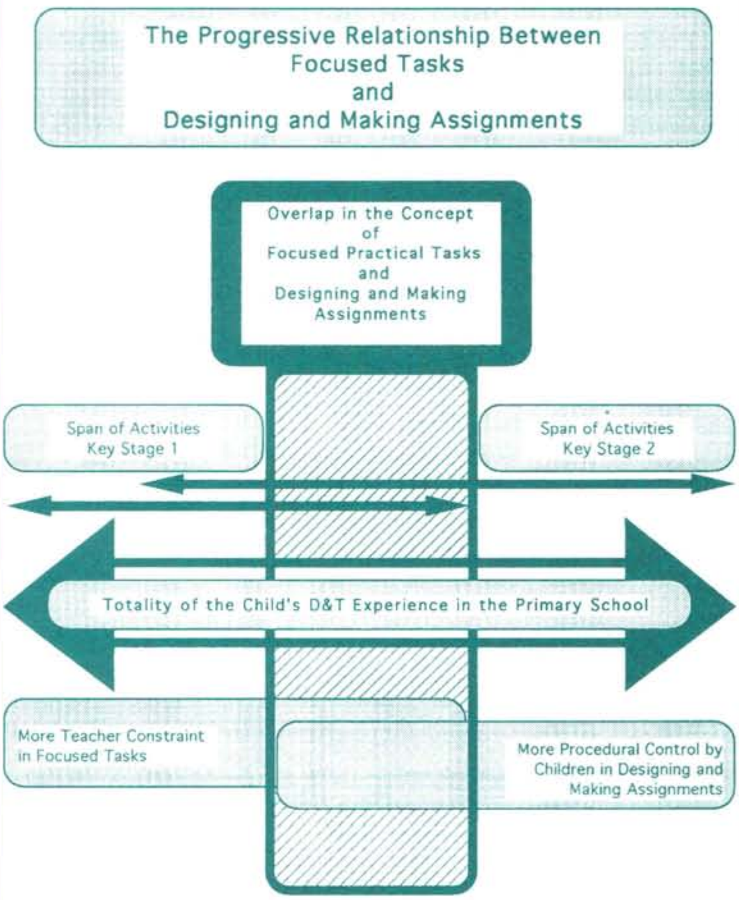

Figure 4

decide where the focus of their teaching effort will be at any particular point in the progression of the session. Design and technology learning can be maintained independent of direct teacher action. To do this effectively is often dependent on the resources – both the nature of the physical resources the children are designing and making with and the learning resources provided to facilitate children's procedural progression. Many aspects of design and technology – research, planning, evaluating and even making if adequate resources are available – can be effectively managed using class-based methods.

Having valued the National Curriculum approach as a system of planning I would now like to question the relationship between FPTs and DMAs. It is my contention that they are not distinct and that their concept changes as children progress through the key stages. FPTs and DMAs have a relationship that can be described by a continuum. The concept identified within the 1995 Order is one where activities that are very narrow, in which children have very little control over the procedural aspects of their work are FPTs which lie at one end of the continuum, and activities in which children have greater control over the procedural aspects are DMAs which lie at the other – Figure 2 captures this idea. Any design and technology activity can be placed on this scale. Most activities would not be a point but cover a span because, except for the simplest of tasks, there will be some degree of pupil decision about how to proceed and this is balanced against teacher control.

My research has shown that within each key stage of the primary sector there is an advance in the degree of control that children have over procedural matters – Figure 3 captures this idea. If this is the case more globally it questions the notion of the DMA as being consistent from key stage to key stage. What might constitute a DMA at Key Stage 1 – an activity that might be placed towards the centre on the continuum in Figure 2 might well be seen as a FPT within Key Stage 2. The notion of a DMA must be key stage related with the range of work expanding from key stage to key stage – Figure 4 illustrates how this idea works.

Implications for INSET and ITE

This phase of the work is in the very early stages of development. However, a number of implications are emerging.

Students undergoing initial courses and teachers involved in INSET should recognise the following:

- Design and technology is not a new concept in the education of young children, its history is long. Throughout its genesis its justification has been the subject of debate and the argument continues.

- The importance of imposing a clear structure on the teaching and learning process and the definition of knowledge and skills to be taught in order to allow creative responses by children. This being best achieved by deconstructing designing and making assignments into focused practical tasks that are differentiated for the age, ability and experience of the children.

- That the relationship between focused practical tasks and designing and making assignments is not one of distinction. Highly teacher controlled FPTs, and DMAs in which children have control over the procedural aspects of the work provide the extreme poles of a continuum. There is a need to recognise that the location of a DMA on this continuum varies through key stages.

- The significance, in group based situations, of planning teaching/learning activities *in relation to one another*. Teachers need to make decisions about when to class teach in order to utilise teacher and class time effectively. The key feature here being the professional judgement that an individual teacher makes decisions about the focus of their teaching effort.

- The constituents of 'quality' design and technology for particular age groups. How this must have a 'child flavour' and that adult perception of quality resulting from our use of technological products developed by industry must not be allowed to cloud our vision of children's products.

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