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Developing design and technology capability - rhetoric or reality?

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Abstract

This paper examines teachers' perceptions of technological capability and the factors which influence and constrain the effective planning and delivery of learning programmes in secondary schools. The predisposing issue central to the research has been the apparent mismatch between the stated intentions of teachers and their practice.

The research, which is described, employs a range of methodologies allowing a measure of triangulation, validation and reliability. Focused activities with groups of teachers, structured interviews and the analysis of curriculum planning materials provide three modes of response. By employing this complementary sequence of investigative strategies it has been possible to gather qualitative data which provides an insight into the curriculum planning processes employed by teachers. The methodology has enabled the pre-defined learning outcomes of teachers to be tested against an examination and analysis of the teaching, learning and assessment strategies which they employ to bring about their stated objectives.

Finally the paper proposes conclusions about the factors which motivate and influence teachers in the curriculum planning process. This paper argues that factors other than the learning needs of pupils unduly influence the selection and prioritisation of content, teaching methodologies and assessment strategies.

Introduction - establishing a context for the research

The National Curriculum of England and Wales has advocated in its approach to technology education (DES, 1990) that the central focus should be on 'capability' achieved through the attainment of satisfactory performance in 'designing' and 'making'. The vehicle through which these capabilities were to be developed was deliberately left vague resulting in little prescription in terms of specific technological content or proposed design methodologies. The review of the National Curriculum carried out by Sir Ron Dearing (DfEE, 1995) made some attempt to define and clarify the skills, knowledge and understanding which should be taught within technology. Nevertheless, there is still no universal consensus for the selection of curriculum content or teaching methodologies within technology.

As a consequence of this lack of specificity the interpretation by teachers of the standing orders (and the perceived demands of the syllabi of public examinations) becomes

enormously significant. It is the intention of this study to determine what teachers feel are the essential components of technological capability and to examine the ways in which they plan and deliver learning programmes which develop that capability in learners.

Research methodology

This piece of small scale qualitative research is designed to investigate:

- a) what specialist design and technology teachers working in secondary schools believe the components of technological capability to be;
- b) how teachers of design and technology perform the task of teaching children to become technologically capable;
- c) the relationship between the educational objectives described by the teachers and the curriculum content and delivery models that they select and implement to achieve those objectives.

The justifications for the adoption of the model employed in this research are similar

to those outlined in Bennett *et al* (1984) and also by Shield (1996) and makes the assumption that expert teachers reflect their values and experience in their professional practice.

The respondents in the study were fifteen experienced technology teachers from fifteen secondary schools in the Merseyside region. The respondents were selected on subjective criteria (e.g. advice from 'experts' in the field) and their willingness to engage in curriculum investigation which it is felt indicated a confidence in their own capability. Other considerations included the wish to employ a sample of schools from a number of Local Education Authorities.

The method of sampling is analogous to that described by Delamont (1992) as 'opportunity' sampling which places less emphasis on a representative sample but which requires an acknowledgement in the data analysis of the effect that the sampling method may have had on conclusions.

Three principal tools of investigation were employed in the research, the first of which was focus group activities in which teachers were encouraged and facilitated to explore, debate and document what they perceive to be the essential components of technological capability.

Respondents were asked to examine their principal educational goals and to reflect upon the skills, knowledge, concepts and attitudes which they feel combine to bring about 'technological capability'. Through this process it became possible to identify the learning which teachers believe is central to technology and to establish the combination of skills, knowledge and attitudes which they consider are important in their teaching.

Reflexivity is an important facet in this and the two subsequent phases of research.

What I mean by reflexivity is the attempt to render explicit the process by which the data and findings were produced. (Wilson, *et al*, 1986).

In common with all such ethnographic studies the work required the continuous monitoring and reflection upon the role of the researcher in order to avoid any misinterpretation of what was observed. Equally important has been the need to make explicit the process by which the data and findings were produced.

The second method of gathering data involved the examination of the curriculum planning documents produced by the respondents. This phase of the research activity provides an opportunity to examine how the educational objectives of the respondents are translated into a curriculum model. This strategy provides an opportunity for some triangulation within the research methodology. Through the employment of this 'method triangulation' (Wilson *et al*, 1986) data produced by different methods may be used to provide a basis for triangulation.

Structured interviews with a representative sample of respondents provided the third and final investigative tool. This phase of activity enabled an examination - in greater depth - of teachers' interpretations of the components of technological capability. The structured interviews were also employed to gauge the impact that these interpretations and other influences have on curriculum planning and delivery.

The thematic content analysis of the taped and transcribed interviews provided the basis for a comparative analysis of the data generated from three different sources from the same group of respondents. This provides a measure of reliability and validity in the work. However, in common with most ethnographic studies, reflexivity and triangulation are the principal tools employed to ensure a level of validity of the analysis (Wilson *et al*, 1986).

Focus groups

For the purposes of this work the respondents were brought together and asked to consider a single question - what are the components of technological competence? To assist teachers in the formulation of a response to the question they were encouraged to think of technological competence as the fusion of

skills, concepts, knowledge and attitudes - the possession of which result in a child being technologically capable.

The teachers were allocated to small groups of four or five at random. Each focus group was assigned a facilitator who recorded the outcomes of the discussion and fed back the results of the individual group efforts to the wider group. This plenary session allowed for a sharing of responses, further clarification of views and some discussion of the elements of capability recorded by each of the focus groups.

The compilation of the responses from the teachers are set out below. A number of similar 'components of technological capability' were recorded by more than one focus group. In all, the teachers collectively identified 22 components of technological competence which have been arranged under three headings. A number of the components listed by the teachers appear under more than one heading. This reflects the difficulty in determining the specific nature of a skill or personal attribute.

Personal qualities and attitudes

work independently, organise-time, resources, materials, ideas, themselves, think effectively, possess design values, take responsibility, work collaboratively, plan ahead, be decisive, recognise quality, have critical opinions, possess design attitudes.

Strategic skills

respond to stimulus,organise- time, resources, materials, ideas, themselves, think effectively, employ new ideas, techniques, skills, technologies, apply knowledge, skills and concepts, model, gather information, apply and appreciate graphical thinking skills, analyse problems/information, compromise, optimise, plan ahead, employ appropriate 'design' vocabulary, have critical opinions, possess design attitudes.

Practical skills

recognise quality, presentation skills-oral, graphical, model, apply and appreciate graphical thinking skills, apply knowledge,

skills and concepts, employ new ideas, techniques, skills, technologies.

Structured interviews

For the purposes of this phase of the research five teachers were questioned employing an interview-administered questionnaire. The questionnaire asked the respondents to describe:

- i) how they selected the content of their curriculum and the considerations which influenced that choice;
- ii) how they selected the teaching, learning and assessment methodologies they employ;
- iii) the processes they employed to plan, document and evaluate their curriculum.

The teachers were asked to describe the part that pupils' expectations played in determining the content and style of teaching adopted for a curriculum unit.

"... we take into account when we are choosing ... particularly a job we are doing - obviously they want to take something home that ... so we always think well ... would they really want to do that?"

"we feel that if you don't get their interest, their enthusiasm then it can be really hard"

"The children are used to the direction - we try to challenge - but it is difficult."

When teachers adopted a thematic starting point to their planning there was much to suggest that the outcomes were pre-defined and influenced by their perception of what would be acceptable to their pupils.

"Well we start with a theme - say structures or build a vehicle where mechanisms are central. We start with a theme and work around that ..."

The respondents were asked to reflect upon the place of progression in their curriculum planning.

"When I was doing this at Key Stage 4 - I made almost no reference at all to what they had done at Key Stage 3 ... because this is Graphic Products I am having to assume that whatever they have done in

their graphic input will be at a fairly minimum level."

"OK. Well if it is the lower school I assume no knowledge. At year 7 you can't make assumptions about what they may - or may not - have done before. So we assume that they know nothing."

"Well we operate a carousel here and the children do everything - food, fabrics and by the time you see them they will have forgotten most of it ..."

"...the children might use the miller in making their next job so we might look at what skills they have used and what skills they will need for their next job".

The teachers were asked to describe the ways in which they selected the teaching methodologies to be employed in the delivery of a curriculum unit.

"I suppose you just go into auto-pilot. You think I have done this so often before you don't even think how it is going to be tackled."

"... we share ideas. He might say I did this and it was great and I might do a sheet and pass it on - oh yeah we always do that."

"your starting point is something that you have done before that you know is going to work"

"My delivery style is very open and free. And in so much as it is not talk and chalk but I sit like this with my feet on a stool to kind of give a relaxed feel."

The teachers were asked to describe the ways in which the National Curriculum influenced teaching content and teaching and learning methodologies. The responses to this questioning varied significantly.

"it was always that the National Curriculum hadn't got to dictate ..."

"we look at what is expected of us ... in the delivery of the National Curriculum - what the National Curriculum demands - what they have got to do at that particular stage."

Conclusions

The examination of the data generated by the various complimentary strands of the small scale research has provided sufficient evidence to support the following conclusions:

- i) that practising teachers are able to confidently and spontaneously define the knowledge, skills, concepts and personal attributes which enable learners to become technologically capable;
- ii) that there is a significant level of agreement between experienced teachers with regard to the definition of the essential components of technological capability;
- iii) that practising teachers rely on past practice and experience rather than promote the development of the essential components of technological capability which they have earlier identified.

The components of capability listed by the respondents are similar to those identified by Kimbell (1991) and Saxton and Miller (1996). As both of these studies employed a larger sample of respondents there is some justification for the assumption that the findings of this research are reliable and generalisable (in terms of defining capability) to a larger population.

It is evident that the respondents value strategic skills of design in their pupils. They also value drive, determination and self motivation. Nevertheless, the study provides compelling evidence to suggest that little thought is given by the teachers to the promotion of these skills and qualities when planning their curriculum. In practice there is much to suggest that the workpiece, the three dimensional artefact, the 'job', becomes the central focus of work in the classroom or workshop.

What the research has highlighted is that teachers have no clear model of the inter-relationship between technological capability and the co-processes which bring capability about. The evidence gathered also suggests that there is no meaningful attempt made to structure and resource learning activities in a way which fully enables children to practise

and develop technological capability in its broadest sense.

Our research suggests that many of the concepts that lie close to the heart of design are not understood or shared by our colleagues. (Saxton and Miller, 1996)

The delivery models adopted by all of the teacher respondents were similar. The approach involves a short period of 'designing' where pupils have to make limited decisions with regard to form or construction detail. This is followed by several sessions of practical activities during which time an artefact, system, food or graphic product is made. During this second phase of activity teaching is limited largely to short practical demonstrations. The suggestion here is that it is the completion of a practical outcome which is of central importance during the planning and delivery of a series of lessons.

"OK. Well - the children are used to the way we work and can be left ... they know by now what is expected and they just do ..."

"I kind of think about how much I can give the kids in any one time and give them the time to produce what I am asking them to produce."

This final observation is insightful as the teacher appears to be suggesting that the teaching of strategic skills and technological concepts interferes with the 'real' work of producing a practical outcome.

Linked with this observation is the very evident desire on the part of the teachers to gain the approval of the learners for the content of a curriculum unit and the teaching methods which they employ in the classroom or workshop. Although further research would be required to substantiate these observations there is some evidence to suggest that approaches which place limited demands on learners and which consequently avoid rigorous approaches to teaching were preferred by the respondents.

This view is supported by the curriculum materials which indicate a constrained and directed approach to curriculum planning

where the outcomes of the educational activities are pre-determined. In each of the examples provided, the practical outcome of the activity is defined in precise terms - 'design and make a mechanical toy', 'design and make an electronic toy for a young child', 'design and make a healthy drink which could be sold at morning break'.

This observation is reinforced by the limited materials which are provided for learners to work with. By specifying at the outset the materials and manufacturing processes which are to be employed in providing the solution to a design task the opportunity for design is limited. Such an approach restricts the involvement of the learner in the process to constrained decision making or closely directed problem solving.

Consideration of strategic skills in design are limited to a simple reference to the 'design process' or 'designing - researching for a specific need'. In some examples an indication is provided of the linear process which the children will employ in providing a response to a task. 'Analysis of data and research, planning design ideas for a healthy drink, realisation, evaluation'. By limiting the creative involvement of children to the employment of a linear and mechanistic 'design process' teachers run the risk of failing to fully exploit the potential of their subject to develop and nurture the skills, knowledge and personal qualities which they say are central to their subject.

Pupils are too often forced to design to a formulae called 'The Design Process'. This redundant model is still seen by many as the only legitimate design tool. (Downie *et al*, 1997)

In general terms the practical skills and knowledge elements detailed in the curriculum planning documentation were much more comprehensive and clearly defined than the design skills. It is also noteworthy that many of the skills listed in the curriculum planning sheets under 'design skills' were practical in nature - 'rough freehand drawing, use card to make prototype'. It is clear from the analysis of the planning materials that teachers experience

difficulty in developing schemes of work which focus on the development of technological capability in the terms that they used in the focus group activities. With the focus of the learning activities so squarely on the practical outcome the evidence suggests that teachers provide little opportunity for children to fully engage in creative processes.

'Imagining and 'imaging', in mutually responsive accord, constitute the means by which new concepts are apprehended, refined and realised. It may be said with certainty that they are among the most essential disciplines of design education. (Thistlewood, 1990)

It was very evident that teachers found it difficult to describe how they choose to deliver a curriculum unit. It was also evident that the teachers tended towards a delivery model which provided little formal input other than to demonstrate practical techniques. Little evidence is provided at any stage of the research to suggest a rigorous approach to the teaching of creative skills.

In conclusion, the study has revealed a significant mismatch between the stated educational objectives of teachers of design and technology and the curriculum which they devise to promote technological capability. The study has produced evidence to support the conclusion that this mismatch has resulted in a distortion of the design and technology curriculum which promotes the development of practical skills and technological knowledge at the expense of strategic skills in design. The teachers provide no educational justification for such an emphasis in the selection of curriculum content other than that this has become their established practice.

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