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Improving ICT Entitlement through a Multiple Capability Model
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Author's biographical note
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Abstract
The teaching of information technology (IT) in primary and secondary education has been frequently reported, for example through HMI commentaries on Inspection Findings and Ofsted inspection reports, as one the weakest subjects in schools. One of the principal weaknesses being the dominance of the handling and communicating information strands over the modelling, measuring and controlling strands; the latter being particularly pertinent to information and communication technology (ICT) within the teaching of design and technology.

The main pedagogic problems facing teachers may be that IT capability has been repeatedly defined as a single capability which is described through multiple strands. This paper discusses the pedagogic problems that have arisen through a poorly articulated definition of a single capability. A multiple capability model is proposed as a redefinition of ICT capability to assist subject teachers in improving entitlement.

Key words: curriculum, capability, entitlement, IT, ICT, reengineering

Introduction
This paper is based on the observation that information technology (IT), and more recently information and communication technology (ICT), has been repeatedly described as a single capability in the National Curriculum. In the same period, 10 years, the teaching of IT has been reported as one of the weakest subjects in schools in England and Wales. The main weakness, indicated in Ofsted Inspection Reports and Commentaries on Inspection Findings (for example Goldstein, 1997), is the dominance of the handling and communicating information strands over the control, measuring, monitoring and modelling strands. This is a weakness for all key stages. Whilst there are implications for improvement in the use of IT in all subjects this weakness has particular significance for design and technology (D&T). This is because the strands indicated as weak relate to concepts which are central to the subject, therefore there is a need to evaluate the nature of IT activities in design and technology.

It is not the scope of this paper to suggest the nature of activities to develop the strands of IT within design and technology – there are sufficient sources of guidance available which already do this. For example from:

- The Design and Technology Association (DATA)
- The Technology Enhancement Programme (TEP)
- The National Association of Advisors and Inspectors of Design and Technology (NAAIDT)
- The British Educational Communication and Technology Agency (BECTa)
- The Curriculum Information Technology Support initiative (CITS).

The list above represents a small part of the guidance materials available – often at no cost through the Internet. However, two key questions arise:

- Are these materials being accessed by teachers?
- Are such materials sufficient in enabling design and technology teachers to develop ICT driven modelling, and control activities?
If the answers to these two questions are ‘no’ then the solutions to address any weakness in curriculum provision are simple, namely the implementation of strategies to improve teacher awareness of their existence and the development of more appropriate guidance materials.

If the answers are ‘yes’, then a further question arises, which is, why are these materials not being used to enhance curriculum provision for ICT within design and technology. The answer to this question is somewhat more complicated, and may hinge on several interlinked factors, which include:

- funding and resource implications
- problems with the replication of good practice
- pedagogic problems that have arisen through a poorly articulated definition of a single capability.

The first of these factors, funding and resourcing, is a continued and genuine concern of teachers. However, in this paper, this is merely acknowledged as a constraint. It is the latter two factors which may be the possible causes of an incomplete ICT entitlement in a school’s curriculum provision.

Good practice

The guidance material produced by organisations such as those indicated above, tends to cite examples of good practice on the assumption that it is replicable in all schools. The problem here is that examples of good practice are prone to rejection if they are transplanted without deference to school differences. This is because they offer models, which are inspirational in the originating institution, but are aspirational to the institution attempting replication. If good practice is to be replicable then it will always be controlled by the lowest common denominator, which for ICT is the availability of resources (Hodgson et al, 1994). From observation in schools and through discussion with teachers of design and technology, the resource difference between schools is considerable. Consequently the resourcing to deliver the control and modelling strands is considered to be insufficient in most schools.

Whole school policy for ICT, and an individual design and technology department’s policy within it, must not be limited by resource implications or by trying to aspire to replicating good practice from other institutions. Instead it must take existing systems, reflect on their current efficiency, and reengineer them to become more efficient (Zanker, 2000). A useful document to help with this, which does not centre on the good practice issue, is the Non-Statutory Guidance: Information Technology (NCC, 1990). Unfortunately many schools may have destroyed this guidance as a consequence of two subsequent revisions of the national curriculum. Much of the early national curriculum documentation sent to schools has uses, now, which go beyond their original intention, for example reflective analysis of curriculum provision and its development.

IT (ICT) capability

The underlying philosophy of reengineering is not to throw out the old to make way for the new but to consider what exists and how it may bring about dramatic improvements in performance (Hammer and Stanton, 1995). This philosophy can be applied to a school’s curriculum entitlement for ICT to establish how pupils’ IT capability is demonstrated through competence in a range of activities. These activities should cover various strands of ICT. The weakness of this entitlement is that these strands are, generally, insufficiently covered (op cit); but is this at whole school or individual departmental level? It is not essential that each department addresses each strand. Therefore, to determine whether or not the entitlement in a school is complete it is essential to consider what activities exist, and their location within subjects. This is not easy using a single capability model.

An example of reengineering, seen recently on visits to several schools, was how existing resources could be used to deliver the control strand of ICT. The teachers in each school, in reacting to the National Curriculum 2000 requirement to teach control technology in design and technology, were dusting down their BBC computers, which were viewed as ideal. These machines, nearly 20 years old now, are being considered for the use for which they were originally designed – new computers lack the built-in capability. Unfortunately pupils may react to this negatively by perceiving that ICT in schools is not ‘real-world’ related; an opportunity exists here to link design and technology with the values of conservation and sustainability.

Before proceeding further to look at a multiple capability model for ICT it is essential to look at the National Curriculum literature which describes IT (or ICT) capability.
The 1990 and 1995 versions of the National Curriculum for IT contain statements about, but not definitions of ‘capability’ which imply that multiple capabilities may exist. The 1999 National Curriculum for ICT contains neither definitions of capability or a suggestion of its multiplicity. However, the 1999 attainment target is titled ‘Information and Communication Technology Capability’, with statements of attainment, as levels, of this non-defined capability.

The 1999 National Curriculum for ICT, therefore, may insufficiently help design and technology teachers in planning for the development and assessment of pupils’ ICT capability. Furthermore school co-ordination of ICT provision to meet the full entitlement becomes difficult with a non-defined capability, which can be interpreted differently by individual subjects. However, the guidance about capability accompanying the 1990 and 1995 National Curricula for IT contains useful information which can be applied to the 1999 version.

In the 1990 non-statutory guidance; Information Technology Capability, Section A (paras 1.2–1.3) (op cit), we are informed that:

Pupils who possess IT capability will have:

- knowledge about applications of IT and about IT tools such as word processors, databases, spreadsheets and software for processing sound and images
- the skill to use appropriate IT tools effectively
- an understanding of the new opportunities IT provides
- knowledge of the effects and limitations of IT.

Of particular significance is the reference to capabilities in the preface to the programmes of study for information technology capability in the 1990 subject order for IT.

In the Revised National Curriculum for Information Technology (DFE, 1995, p.1) the characteristics of IT capability are described:

Information technology capability is characterised by an ability to use effectively IT tools and information sources to analyse, process and present information, and to model, measure and control external events. This involves:

- using information sources and tools to solve problems
- using IT tools and information sources, such as computer systems and software packages to support learning in a variety of contexts
- understanding the implications for IT for working life and society.

Pupils should be given opportunities, where appropriate, to develop and apply their IT capability in their study of National Curriculum subjects.

This statement may suggest that, for a pupil to use IT effectively, several cognitive skills may need to be demonstrated to satisfy a single IT capability. For example, analysis of data, communication of information, modelling, and logical-mathematical skills. This is clearly a nonsense because different intelligences are required, as described by Gardner (1983) in his theory of multiple intelligences. Therefore, multiple capabilities are required for the intelligent use of IT resources; yet pupils are assessed on a single capability. For example, if a pupil is good at processing or analysing data, but poor at predicting outcomes through changed parameters (i.e. modelling), then the single capability model cannot accurately assess the pupils’ overall IT capability. Yet, because of resource implications, IT capability in design and technology is often assessed solely on handling and communicating information (e.g. through use of word processors or DTP to ‘type up’ work – i.e. retrospective designing) (source: Ofsted reports).

The change of name from IT to ICT in the 1999 National Curriculum is, in fact, of little relevance to curriculum entitlement since IT has always included communication as one of the strands of IT capability. However, the relationship between communication skills, information handling skills and ICT (and incidentally IT) has been described by Zanker (op cit) as having implications for the assertion that multiple capabilities may need to be considered. There is, nevertheless, the potential for confusion with communication skills, as a life skill, which often means something entirely different.
This confusion is implicitly recognised in the National Curriculum Handbooks (DfEE/QCA 1999) under the heading ‘Promoting Skills Across the National Curriculum’. In these handbooks six key skills areas and five thinking skills areas are described without reference to each other. Each describes capabilities which are a close fit to multiple intelligence theory. The key skills areas are communication, information technology, application of number, working with others, improving own learning and performance, and problem solving. The thinking skills areas are information processing, reasoning, enquiry, creative thinking and evaluation skills.

Some observations arise from scrutinising the descriptions of these skills, these are that:

- the communication key skill definition makes no reference to the use of technology as a means of assisting communication
- the information technology definition includes the ICT abbreviation but makes no reference to communication
- the information processing thinking skills definition makes no reference to either communication or information technology key skills.

The potential dangers of putting the C into IT, and of defining skills areas separately are:

- the emergence of two fields of study, namely information technology and communication technology
- communication skills becoming the domain of languages or performing arts and information processing skills the domain of design and technology or science.

Strands of IT
IT capability and its educational progression were described in the Revised National Curriculum for IT (op cit) though the strands of:

- opportunities (including applications and effects) (all key stages)
- communicating and handling information (all key stages)
- controlling and modelling (Key Stage 1)
- controlling, monitoring and modelling (Key Stage 2)
- controlling, measuring and modelling (Key Stages 3 and 4).

These strands are used to describe the matters to be taught through the programmes of study. The 1999 National Curriculum programmes of study for ICT do not use this nomenclature. However, the attainment target for ICT capability makes reference to the same strands of the 1995 version in the statements describing the attainment levels. Therefore, it is essential that the teaching requirements, through the programmes of study, reflect the strands of ICT.

By taking the key words in the strands, a series of statements can be constructed, each describing, not a characteristic of a single capability, but a capability itself. For example, one capability of using ICT resources, which pupils should develop or demonstrate, is the ability to identify appropriate opportunities to apply or learn the skills, knowledge and understanding needed to communicate information.

The highlighted phrase in the previous sentence could be replaced by each of the phrases in the list below to describe further ICT capabilities:

- to handle information
- to control events
- to create models of real or imaginary situations
- to monitor events
- to take measurements from events.

Further capabilities exist, for example relating to the ethical issues of the use of ICT resources, or to the wider use of ICT resources in industry and commerce.

Summary
Having redefined a single ICT capability as a multiple capability model individual subjects become better placed to consider the separate capabilities within their own subjects. For example, in design and technology,
whilst all capabilities may be relevant, some will have greater relevance than others. Indeed many IT activities, quite rightly, will involve several capabilities. This is the strength of a multiple capability model because it allows those responsible for monitoring a whole school ICT provision to identify overall deficiency in their pupils’ ICT entitlement. The starting point for this may be the analysis of existing curriculum materials, for all subjects, not just design and technology, in terms of a multiple capability model.

References
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