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CAPTURING AND COMPARING STUDENTS’ CONCEPTIONS OF TECHNOLOGY: A STUDY OF STUDENTS IN TWO SCHOOLS

By

ANDREW HINE

A Master’s Thesis

Submitted in partial fulfilment of the requirements for the award of

Master of Philosophy of Loughborough University

1st October 1999

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This inquiry explores the premise that the conceptions of technology which students hold are influenced by the corporate vision of technology which is offered to them by their school. A review of the conceptions of technology evident in education and other fields is undertaken to develop a theoretic framework. The framework contains six areas of interest which support the process of focusing from general to specific conceptions of technology. The method of data gathering which is reported allows the conceptions held by a number of individuals to be captured and recorded in a common format such that their conceptions can: be articulated as written statements; plotted to provide a graphical comparison between individuals or groups; or coded to allow comparisons to be made between individuals and groups, using a computer data base.

The study reports the development and piloting of an instrument based research methodology and the subsequent case study investigation of the conceptions of technology held by students in two schools: a Rural Comprehensive School and a City Technology College. Comparisons are explored in each institution between the conceptions of students and the corporate vision of technology in their school. A comparison is also undertaken of the conceptions of technology which were held by each student population.
ACKNOWLEDGEMENTS

I wish to acknowledge the support provided by a number of groups whilst undertaking this research study.

It would not be possible to undertake any ‘school based’ study of this type without the co-operation of the participating schools. I have assured the schools involved that they would not be identified by name, however I still wish to acknowledge my debt to them for providing access to their documentation and not least their staff and students.

Also to the staff of the Inspection, Advice and Training Services of Norfolk County Council for their support in constructing the computer database to search for matching conceptions.

Finally an acknowledgement of the support provided by the staff of the Department of Design and Technology at Loughborough University. In particular Mr E W L Norman (Supervisor) and Prof. P H Roberts (Director of Research) who provided encouragement and advice throughout. For their belief in my research proposal that conceptions of technology could be investigated and reported to a satisfactory conclusion, and their timely and correct challenges whenever I thought it had been.
CHAPTER ONE

Introduction

1.1 Context of study

The development of the broad range of technology teaching in schools is well-documented (eg. McCulloch, Jenkins and Layton 1985, Steers 1990, Eggleston 1996). Before the introduction of National Curriculum Technology courses in technology had been written which reflected the view of technology held by particular schools (by virtue of the views held by members of staff in that establishment) or courses which taught to the syllabus requirements of one of the regional examination boards. Before the late 1970s little opportunity existed for initial teacher training in technology. Technology development in schools reflected the subject backgrounds of the staff who were responsible for its delivery. Most technology teaching could be identified as being from one of a number of ‘traditions’. In the period preceding the introduction of the National Curriculum the following were evident: technology with science; technology with craft and design; technology and society, and following the introduction of microelectronics and computers into schools ‘technology literacy’. This tradition is also well documented, as is the introduction of the Technical and Vocational Education Initiative (TVEI) schemes during the late 1980s (eg. Dale 1990, Lee 1996).

Although making Technology a foundation subject in the National Curriculum (NC) and setting a framework for a standardised
experience, the ‘Orders’ for Technology published in April 1990 provided no concise descriptors of what technology was seen to be. Any articulation of a ‘vision’ of technology would only be possible by interpreting the experience outlined by the Programmes of Study to form an overall view. The non-statutory guidance published to support the implementation of the Orders did provide more explanation of the nature of the new subject. The opening statement in both booklets (Design and Technology and Information Technology) noted:

Technology is a new subject, which requires pupils to apply knowledge and skills to solve practical problems. The statutory Order divides the subject into two profile components:

- design & technology capability
- information technology capability

The reference to capability in both components emphasises that technology is a subject concerned with practical action, drawing on knowledge and understanding from a wide range of subjects. (NCC 1990a p4)

The key aspects of design and technology were seen as:

1) Design and technology is an activity which spans the curriculum, drawing on and linking a range of subjects.

2) Design and technology describes a way of working in which pupils investigate a need or respond to an opportunity to make or modify something.

3) Pupils’ enterprise, and ability to work as members of a team, contribute to their success in design and technology... (ibid p5)
and in Information technology:

1) Information technology is concerned with storing, processing and presenting information by electronic means... (NCC 1990b p5)

It was the range of interpretations of these statutory orders which were held by colleagues of this author in 1990 which provided the motivation for this research inquiry. Within a single institution the range of interpretation created professional conflict concerning:

- curricular models for delivery of the programmes of study and thus timetabling of groups and staff;
- the nature of INSET provision which was to be made available to staff;
- the difficulty of assessing effectiveness of teaching and learning within the Key Stage;
- the provision and management of teaching resources.

This range of interpretation of the NC Orders was not limited to the author's institution, Layton notes:

The problems of implementation with which teachers are wrestling differ according to whether they work in primary or secondary schools and often from school to school. (1991 p1)

Layton continues to provide a detailed articulation of the form of NC Design and Technology; it may be questioned why this work, commissioned by the National Curriculum Council (NCC) the year following publication of the orders was not included in the initial non-statutory guidance.

In considering the courses devised for the delivery of NC Technology in his own institution the author was also concerned that if an ambiguity of understanding existed between members of staff,
then this might also be the case amongst students. At national level interpretations of technology might differ between Local Education Authorities and locally from school to school, but even within any particular institution it might not have been possible to ensure that students understood technology in the same terms as the teachers did. It was not possible to assume the teachers interpretation of technology matched the national outline framed by the Orders. This difference of interpretation of ‘technology’ might also extend to primary phase partner (feeder) schools, parents and local business and community curriculum partners.

In the summer term of 1990 the author undertook an evaluation exercise in his home institution: An evaluation of pupils perceptions of technology and its location in the curriculum of Wayland High School as part of a taught MA(Ed) course. This study was to provide a ‘base line’ for that school, against which curricular provision could be planned and implementation monitored. Amongst the summary of the findings reported back to the author’s colleagues the following key points were noted:

The common perception of technology held even by our first year is that of ‘technology as things’, these are seen as being to do with electronics or electrical equipment. This view has been strengthened by the title ‘technology’ given to the module in the second and third year course in the CDT [Craft Design and Technology] side of the department. This has tended to draw the attention away from HE [Home Economics], and pupils find it difficult to identify technological activity taking place in the work with food.

(Hine 1990 p33)

This position was supported by the comments made by students during interviews:

“When you say technology you automatically think of electronics”. Fourth Year (now Year 10).
"When you say technology I think of using things like electrical things and that". Second Year (now Year 8).

"Taking things apart to see how they work. Technology is something you make". First Year (now Year 7).

"When someone says technology I don’t think of food". Third Year. (now Year 9).

Students also felt that:

..technology contained activities such as designing and improving existing designs. (ibid p33)

Although the Orders have been revised on a number of occasions since their introduction in April 1990 the author still questions an assumption that there is a common conception of technology between: the Department for Education and Employment and the school, the school and the staff, and the staff and the students.

In further developments since the introduction of the NC Technology some schools have been established as centres for technology through the Technology College and Technology Schools Initiative schemes. Studies of American schools have indicated a change of attitude towards technology of students taught in a ‘technology rich’ environment, Householder and Bolin describe the TEC-Lab environment:

The project was funded for two years and allowed for the creation of a technologically-rich environment (TEC-Lab) in a former technology education laboratory. The TEC-Lab incorporated a wide range of technologies, including computers, audio and video equipment, computer numerically controlled (CNC) machine tools, and satellite communication equipment. (1993 p6)

In the evaluation of the project they note:
Participation in the TEC-Lab project, whether in one of the TEC-Lab classes or in one of the comparison classes taught by the TEC-Lab teachers, resulted in positive changes in attitudes towards technology. (ibid p16)

One aim of this study was to explore the extent to which this holds true for the conceptions of students in 'technology rich' schools in England and Wales. The intention was to compare the conception of students in a City Technology College with those of students in another school. For this study agreement was obtained from a Rural Comprehensive School in the same Local Education Authority.

1.2 Chief questions

This inquiry aims to explore the following chief questions:

Are the conceptions of technology which students display dependent on the 'technology' which their school offers?

This is the fundamental question for this enquiry. If the students' conceptions do not reflect that which the school sets out to provide through its curriculum then the 'value which is added' to the student through planned curricular experiences of technology is called into question. Such questioning might explore the effectiveness of 'teaching and learning' within the school; it might explore the consistency of approach across a team of teachers, the suitability of the materials or experiences offered, or acknowledge that students are influenced to a greater extent by experiences from outside school. Although this enquiry is not concerned with exploring the policy of curriculum implementation, an analysis of the consensus or difference between the school's vision and its students' conceptions could form the starting point for further investigation.
What are the conceptions of technology which are evident in education and other fields?

The author's MA(Ed) study suggested that a range of conceptions of technology could be constructed; as part of the pilot work for that study the technology teaching staff at Bedale High School constructed a spectrum of views of technology which may be identified within the school situation. In considering the influence of school in developing students' conceptions of technology this study will also be concerned to examine influences from outside school. A review of published conceptions will provide a framework against which the conceptions held by students can be placed. This range of published conceptions gathered from the review will provide an indication of the range across which any investigational method to determine students' conceptions will have to operate.

What overviews of technology education are displayed by policy statement, subject content and curriculum organisation in: a City Technology College and a Rural Comprehensive School?

The intention of this aspect of the investigation is to establish the published view which is available to the students in each of the schools. In the context of this study it is assumed that it is feasible for 'the school' to hold a corporate vision of technology to which staff and students aspire. This assumption will be considered further as the methodology is developed and justified.

Can the conceptions of students in these schools be captured?

This inquiry is open to complications in two aspects, both of which arise from the lack of attention to language. This results firstly in
arise from the lack of attention to language. This results firstly in confusion of terminology between perceptions, conceptions and attitudes; and secondly in a lack of discriminatory words to describe different parts or segments of technology. Confusion concerning perceptions, conceptions and attitudes is evident in previous studies which have been undertaken in this field. A particular concern for this inquiry will be the construction or articulation of a conception of technology. This is linked to the development of a reliable methodology which enables the researcher to verify that both student and researcher hold a shared understanding of the meaning of the student's articulated statement. The methodology should provide qualitative data which will enable a measure of validity to be made whilst also providing quantitative data on which to base comparative investigation of a school and its students or the population of one school with that of another.

What conceptions of technology do the students hold? Do the conceptions reflect the published view of the school which they attend? If they do not coincide how do they differ?

This stage of the inquiry will require an analysis of data to provide details of the range of differing conceptions and the frequency with which each of these views is held. This can then be compared with the corporate position of the school. The issue here is to determine the extent to which students hold common conceptions, and then to determine the extent to which students may have been influenced by the curriculum of the school. Any influence of the school curriculum would be associated with a narrow band of frequently occurring conceptions which matched the corporate vision of the school.
What does a comparison of the conceptions held by the two groups suggest?

A comparison of the two student groups may provide some amplification of the issues evident in the analysis of the data from each institution. Is the technology education curriculum (or teaching and learning) of one institution more evident in the conceptions of its students than that provided by the other? Is the curriculum content of either institution producing an influence on students’ conceptions of technology which is apparently greater than the influence from outside school?

1.3 Concerning the use of language

The use of language presents difficulties in undertaking this investigation. There are three types of study distinguishable in this field by the titles ‘perceptions of’, ‘conceptions of’, and ‘attitudes towards’ technology. Firstly, the consistent use and careful distinction of perceptions and conceptions of technology is considered. Many other studies have apparently made no distinction between these notions. In some cases these notions may also be explored as attitudes towards technology. Whilst the titles of other research enquiries state that perceptions and/or conceptions have been explored, the published reports suggest that no effective distinction has been made.

However, in the context of this study, a clear distinction is made between these two notions. A student’s perception is understood by the author to be evanescent in nature. These perceptions of technology (once reflected on) form the conception of technology which the student holds. This study is concerned with those conceptions. Students will be asked to articulate their understanding
of technology and it will be argued that this recall and articulation is an indication that the description given is a conception.

This author would suggest that in order to obtain a student's perception of technology, a study would be required to capture the perception simultaneously with the student being exposed to the technology stimulus. This capture would have to occur without allowing the student any opportunity to reflect or assimilate that experience with other experiences identified as being linked with technology.

Having outlined the distinction between perceptions and conceptions, the distinction between conceptions and attitudes needs to be clarified. However, attitudes and conceptions are related. In this study attitude is taken as a ‘settled mode of thinking’; thus this study may explore certain attitudes which students hold to aspects of technology, so as to frame or allow students to articulate their conception.

The further difficulty concerns ‘naming’ aspects of technology. Many authors note conceptions which are based or framed by a number of aspects or activities concerning technology yet only two words are in common usage to articulate these abstract aspects, namely ‘technology’ and ‘technological’. It is interesting to compare this with descriptions of the physical phenomenon - snow. In this country we have a limited range of words to describe this physical condition. Three words come to mind; snow, sleet and slush. Given the frequency and difficulties caused by snowfall in this country we may argue that three words are enough. Some cultures are more snow dependent than our own. The author is led to believe that Eskimos have twenty-two words to describe snow. Thus in a situation where we might identify snow which ‘bonds together and is
good for snow balls' Eskimos may name this type of snow with one word.

This author believes that a similar situation exists concerning technology. Rather than being able to use a single word to identify an aspect or consequence of technology a phrase has to be articulated. The limited choice of words and the need to articulate descriptions of technology as phrases have a significant impact for the conduct of this investigation in terms of clarity of meanings and the cognitive ability required by respondents to articulate their conception. It would be possible to create any number of additional words to aid the description process so that aspects to do with technology can be accurately identified and articulated. However this approach has not been adopted. It would not, in any case, be practical at this time because before the aspects which build up conceptions can be named they must be known. Identifying these aspects is in itself a function of this inquiry, so ‘naming’ could only be carried out following a comprehensive pilot investigation but more reliably as the conclusion of the enquiry.

However this is not the sole difficulty. Notwithstanding the process required to be able to name aspects of technology, before they could be used they would need to be known and understood by those who were taking part in the investigation. This author believes that a sustainable argument can be presented to support the hypothesis that in providing a participant in the study with an explanation of new ‘technology names’ their conception of technology will be challenged and modified. This argument is detailed in the consideration of a suitable methodology to capture students’ conceptions. In the context of this study, it is then both impractical and undesirable to provide additional names for aspects of technology.
Considering the two existing words for naming these aspects - 'technology' and 'technological'. Firstly referring to a dictionary, 'technological' is noted as an adjective; technological describes the application of technology. Asking “what is technology?” allows the respondent to consider all of their abstract conception of technology. If they are asked “what is technological?”, then the response is focused towards the description of objects or activities to which technology might have been applied.

Secondly since the intention of this inquiry is to investigate students’ conceptions of technology, the terminology used to explore their conception should be that with which they are familiar. Based on discussions with students in the author’s home institution the indications are that students use a low level of grammatical construction. For example they are not ‘involved in technological activity’; they suggest that they are ‘doing technology’. Students were asked what activity they would be involved in if they were working with maps in a geography lesson. The response was map work. When asked for a term to describe any geography activity they would be ‘doing geography’. This generalist term for participation in a school subject or activity was extended so that they were, for example, ‘doing maths’, ‘doing French’, and ‘doing science’. Student language is informal; they do not describe themselves as participating in work which is: geographical, mathematical, linguistic or scientific. This same reasoning is extended to the subject technology. This use of language was adopted in this investigation and was reviewed following the pilot study.

It should also be noted that this enquiry is concerned with conceptions of ‘technology’. It might be shown by other studies (for example students’ conceptions of ‘technological’) that the two words evoke differing conceptions. Recognising the areas of concern
outlined above regarding the words technology and technological; and the impracticality of providing new ‘technology words’ to specifically label certain aspects of technology, only one label or name will be used throughout this study. No doubt that in the same one word manner as describing snow in English, describing technology will require the construction of longer phrases. Also some grammatical unease will be created, for example: ‘technology activity’ and ‘doing technology’. Presenting only the single term ‘technology’ to students will provide a consistent label for students, encouragement to a view away from a more limited focus, a reflection of their language use and questioning which is consistent with the stated title of the enquiry.

References


J Eggleston, Teaching design and technology (second edition), Milton Keynes: Open University Press 1996


D Lee, TVEI and curriculum theory, Bishop Norton: David Lee & Humberside Education Services 1996


CHAPTER TWO

Literature survey

This survey has been conducted to review published materials for two specific purposes. Firstly to gather conceptions of technology to enable a theoretic framework to be developed, against which the conceptions of technology which students held could be considered. Secondly to review the methodologies which other researchers have applied to studies of this and related fields. These two purposes provide the structure for the subsections of this chapter.

2.1 Conceptions of technology.

2.1.1 Conceptions of technology: their development in the curricula of secondary phase schools in England and Wales before 1990.
2.1.2 Conceptions of technology in the National Curriculum.
2.1.3 Conceptions of technology outside the field of education.

2.2 Prior studies.

2.2.1 Prior studies: examination level technology subjects.
2.2.2 Prior studies: conceptions, perceptions and attitudes to technology.

2.1 Conceptions of technology

The first section of this chapter concerns published conceptions of technology.
Technology is a recent addition to school curricula, and in historical terms the philosophy of technology is only a little older. In discussing this issue Layton (1993) refers to the origins of academic journals in technology and science noting that:

> Although men and women have been engaged in the practice of technology since the beginning of history, our understanding of the nature of technology is very recent. […] By the opening of the second half of the twentieth century, there were sufficient scholars working in the field to support the foundation of a society for the History of Technology. (1993 p23)

The development of technology teaching in England and Wales has been documented by a number of authors, Porter (1967), McCulloch, Jenkins and Layton (1985) for example. When examining the development of technology teaching in schools and the various curriculum models which have been proposed for its delivery, it is apparent that certain traditions of technology teaching can be identified. Whilst some aspects are common between traditions, each can be considered as having a conception which is distinct from the others. For de Vries:

> All the possible approaches in technology education together form a spectrum which can be described by mentioning some of the most striking ‘wavelengths’ in this spectrum. (1994 p153)

Although this spectrum is presented as describing European examples, a reasoned argument can be made that all the wavelengths are identifiable patterns of technology adopted by schools in England and Wales during the development of technology as a subject. Schools may adopt a curriculum model which is or has aspects of:
• a craft-oriented approach, in which teaching how to handle tools and materials by making redesigned workpieces is the main context;
• a production-oriented approach, in which preparation for contributing to industrial production is the main aim;
• an applied science approach, that sets all technology in the context of science learning;
• a high-tech approach, that teaches how to deal with advanced technological products;
• a technological concepts approach; that teaches major technological theoretical concepts, e.g. the systems concept, and is rather analytical in nature;
• a design approach, in which the process of designing new products forms the heart;
• a key competency approach, in which the learning of competencies like co-operation, creativity and innovative thinking are central;
• an STS (science, technology and society) approach, that teaches primarily science-technology and technology-society relationships.

( Ibid p152)

Whilst de Vries identifies 'wavelengths' to mark different conceptions of technology this author has identified a number of recurring 'traditions' of technology teaching in schools: craft, design and technology; science for technology (and society); technology literacy and technology determinism. Conceptions often favour one tradition more than another, but are rarely exclusive to one tradition. Tensions between these traditions have been evident as technology teaching has developed. Tensions are also evident within the Craft, Design and Technology (CDT) tradition. Procedures undertaken in design activity, in craft activity and in technology activity share common aspects or knowledge. Tensions are centred around the notion of ownership of particular areas of knowledge, particularly knowledge for design and knowledge for technology.

In the paper 'Time for a Revolution in Art and Design Education' Archer builds a line of argument to distinguish Design from Science and Humanities. He suggests that outside the areas of science and humanities there is, at least one other area.
Any discipline falling into this area must therefore be aspirational in character, and, to take them clearly out of both the Science and Humanities fields, it must be operational, that is to say, concerned with doing or making. (1978 p5)

This other area is:

..... ‘Design’, spelt with a big D and used in a sense which goes far beyond the day-to-day meaning which architects, engineers and other professional designers would assign to it. (ibid p6)

In terms of Archer's other area aspects concerned with ‘doing and making’ form part of the area ‘Design’. Although Archer is not setting out to provide a concise conception of technology he makes reference to technology at a number of points. He reflects in this paper on the phrase coined by Sir William Curtis MP concerning the 3 R's. The third ‘R’ (his old great-aunt protested) should have been ‘Wroughting and wrighting’; Archer explains that ‘By wroughting she (his old great-aunt) meant knowing how things are brought about, which we might now call technology’.

In establishing the ‘language’ and distinctive features of each area he notes that some authors concerned with science often ‘mention technology and the useful arts as being excluded from their purview’ (1978 p5). He continues to note that this third area, Design could:

... claim technology and the fine, performing, and useful arts, although not their scientific knowledge base (if any) or their history, philosophy and criticism (if any) without treading on anyone else’s grass. (ibid p5)

Archer suggests that the ‘language’ of Design is modelling and again he makes reference to technology in explaining this concept.

Everyone engaged in the handling of ideas in the fine arts, performing arts, useful arts or technology employs models or representations to capture, analyse, explore and transmit those ideas. (ibid p6)
In a list of possible areas for a Design taxonomy ‘design technology’ is included as ‘the study of the phenomena to be taken into account within a given area of design application’. This technology could well be concerned with the management of scientific information to enable a design application to be completed.

This tends to suggest a conception of technology which is to do with procedural knowledge, it is about action and doing. Archer showed his view of the relationship of science, technology and design in two diagrammatic forms. These are shown in Figure 2.1 and Figure 2.2.

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**Figure 2.1 The relationships between the three areas of human knowledge (1978)**

*Source: RCA Papers No6 / 1978 p6*
The diagram in Figure 2.1 shows technology related to science in the 'world of learning'. Figure 2.2 shows a revised 'triangular diagram' in which technology is placed between the areas of science and design - marking a recognition that the most common type of knowledge acted on for today's technology is that related to science.

![Diagram of the relationships between three areas of human knowledge](image)

**Figure 2.2 The relationships between the three areas of human knowledge (1986)**
*Source: Technology in Schools 1986 p55*

In a later work Archer provides a more concise conception of technology:

Mankind's collected knowledge about tools of every sort; about the way they work; and about where and how to use them, is what we call Technology. (1992 p7)

and regarding the relationship of science and technology:

Science is knowing what is the case, making informed judgments as to why things are the way they are, and predicting what is most likely to happen in given circumstances. Technology draws on this knowledge and its own experience in order to make things happen in a desired way. (ibid, p7)
Eggleston (a contemporary of Archer's); examined the developments made in design education in schools. Like Archer, he believed the term design covered more than the act of producing a drawing or scheme. Eggleston reviews the changes in schools which allow a redefinition of an area of the curriculum to form:

\[
\text{design education: a subject that is concerned with the identification and solution of problems in the use of materials that occur in the social systems in which our students will be adults. (1976 p14)}
\]

However, in other sections he implies that technology lies outside design education, not apparently recognising 'the use of materials' as technology. He advises Heads of Design Departments to:

\[
\text{......maintain close liaison with the science and mathematics departments, so that work in technology and applied science may be adequately sustained. (ibid p55)}
\]

Eggleston presents a conception in which technology is neither part of science or part of design education.

In considering the design process in schools, Eggleston presents two diagrams of 'the design process'. Figure 2.3 is taken from the Schools Council project on Design and Craft Education at Keele University and Figure 2.4 from Project Technology at Loughbrough College of Education. Eggleston comments:

\[
\text{Both diagrams illustrate clearly the detailed and analytical process of enquiry that leads to the achievement of design, and the meaningful social context and range of participation within which the process is undertaken. (ibid p20)}
\]

It would appear that Eggleston views 'the process of technology' from Project Technology as a model of the process of doing design, and he acknowledges that this same process diagram explains the process of technology. It may be reasoned that his conception of design is the
same as his conception of technology. The difference between design and technology would then need to be found within the areas of knowledge to which the process is applied.

Figure 2.3 Design Process - Design and Craft Education Project
Source: Developments in Design Education 1976 p21
Figure 2.4 The Process of Technology - Project Technology
Source: Developments in Design Education 1976 p22
Practical subjects in school have a strong craft tradition. For most of their recent history they have been seen as lacking in academic legitimacy. They tended not to attract the most able students and the association with the less able students tended to perpetuate the low status of the subjects. The introduction of work which involved the application of scientific principles past the experimental or prototype stage required the use of production areas, the province of the crafts. Links were made with other curricular areas (as advocated by Eggleston above for example) to undertake work which was applied science or technology. Science teachers of the time thought that this new area of study lowered the esteem of their own subject. In considering the relationship between science and technology Allsop and Woolnaugh note that:

During the 1960s, the development of O level Nuffield courses, with their emphasis on ‘science for the inquiring mind’, led the sciences into a purer, less applied curriculum. Only in the Nuffield Secondary Science course, aimed at the less able student, were technological influences apparent, reflecting again the provision of high-status, pure-science knowledge for the more able and the low-status, more relevant and technological knowledge for the less able. (1990 p130)

This ‘technological’ type of work continued to be developed within the craft departments and in 1982 the Assessment of Performance Unit (APU) in a paper Understanding Design and Technology noted that:

In schools, technology is generally thought of as one of a range of subjects within the curriculum area of Craft, Design and Technology. (1982 p2)

This document contains other key passages which enable a conception of technology to be framed. The opening paragraph also notes that this curriculum area ‘forms part of the design dimension of the curriculum’ and that ‘technology also involves links with science’ and links with ‘mathematics ...... when used for modelling’. The APU document indicates a conception which is or is not technology by virtue of the ‘technological-ness’ of the knowledge base with which children operate.
Children of pre-secondary school age show evidence of these skills - to a greater or lesser degree - whilst engaged in activities which a teacher might not instantly recognise as being technological. They can be described as such when they rely upon technological concepts as described in the 'knowledge' component of the framework which follows. (ibid p5)

This 'design dimension' of the curriculum may be equated to Archer's third area. The framework for assessment proposed in the APU document covers three major areas: skills, knowledge, and values. It is in the section of the paper detailing the knowledge content of the subject that an explanation is given about the relationship between 'design' and 'technology'.

In one sense, every sort of design activity is built upon a related form of knowledge, specific to the type of problem involved - in other words, upon its relevant technology. Most people, however, would recognise that some design activities are more technological than others, in the sense that they rely more upon information about the nature and behaviour of materials and processes, particularly of the more resistant materials and the more power-using processes.

(ibid p5)

This conception of technology was reflected in a concise definition used by the Secondary Examinations Council for the examination subject CDT:Technology.

Technology is primarily concerned with design and problem-solving processes leading to the making and evaluation of artifacts and systems. It draws upon scientific principles. Technology also involves management of the environment, and familiarity with the concepts of materials, energy and control. (1985 p2)

In this conception technology is anchored in the CDT curriculum area in so much as the concept of materials is included. The first sentence makes careful reference to the 'making and evaluation of artifacts and systems'. Without this technology cannot be taking place.
A number of the conceptions above have related technology to science. A tradition has been identified concerning science for technology. Layton (1992) in considering ‘school technology’ and ‘real world technology’ identifies the need for ‘school technology’ to develop a relationship with ‘school science’. Layton is careful to explain what form this relationship should take:

*What I am considering is science for technology, where the science is a resource,*

(1992 p12)

This use of science as a resource for technology is noted in the pilot study report of the Schools Council Project Technology (1968). The report notes that teachers are having difficulty defining the place of technology in the school curriculum. This pilot study report notes the relationship of science and technology offered by the Committee on Manpower Resources for Science and Technology:

*..in every technology the ultimate purpose is to exploit existing scientific and other knowledge for productive ends..*

(1968 p1)

In his paper ‘The place of technology in schools’, Woolnough states that:

Technology ought not to be a separate subject, apart from the main line teaching, but should be an integral part of all our science teaching. I think it was John Lewis who spoke of our science teaching moving from merely being a pure ‘science for scientists’, to embrace more applications in ‘science for action’, [...........] if our science teaching can widen in this way we will have no need for ‘technology’ as such.  

(1975 p444)

Twelve years later Clegg, Medway and Yeomans (1987) when considering the historical development of school technology note that:

*In the majority of cases, however, the subject ‘Technology’ has been established within the CDT department, not least because of the increased status it gives to the department. This is reflected in funding, promotion prospects and an*
entry into the academic end of the curriculum. Science departments in these respects, have much less to gain by embracing technology. (1987 p7).

Technology and science continue to be linked in considering the development of technology literacy. This movement sought to equip students to cope with the modern world through two identifiable strands. Firstly, by developing the capability to deal with the artifacts of technological developments - this is particularly associated with the Technical and Vocational Education Initiative (TVEI). Secondly, by enabling students to make value based choices about these developments; this would allow them to break the hold of 'technological determinism' which may have shaped the judgments they made. This approach is particularly associated with the Science Technology and Society (STS) movement.

The grants which supported the introduction of TVEI enabled schools to obtain equipment to support this 'technology literacy' initiative. In the main this equipment was electronic in nature, and for many schools TVEI funding followed close on the heals of the increased use of microprocessors in schools with the introduction of BBC computers. The use of Information Technology (now Information and Communication Technology ICT) had promoted the notion of a conception for technology which was cross-curricular in nature. Dutton notes the technology philosophy of a school involved in the British School Technology scheme 'technology across the curriculum'.

From the inception of the project, the philosophy has been that technology should be regarded in the same light as numeracy and literacy. (1987 p5)

In this respect technology is conceived as the use of the artifacts of technological development.

However, the origins of the STS movement go back to before the introduction of TVEI in schools. STS has developed for a number of
different reasons. The ‘Special STS features within science education’ noted by Solomon include an:

... understanding of the environmental threats, including global ones, to the quality of life. The economic and industrial aspects of technology. Some understanding of the fallible nature of science. Discussion of personal opinion and values as well as democratic action. A multi-cultural dimension. (1993 p18)

Whilst these features suggest that the STS movement is apparently concerned with the ‘economic and industrial aspects of technology’ Lewis (1991), in considering this conception of technology notes in:

... this regard technology is viewed as ‘the application of knowledge, scientific and other for social purposes’. (1991 p149)

The notion of preparing students for the ‘technological world’ is not a new one. The pilot study report of the Schools Council ‘Project Technology’ noted in the introduction:

.. some teachers had been feeling that the present methods of education were inadequate for preparing children for a changing technological environment... (1968 p1)

As the introduction of technological artifacts increased in schools the calls for technological literacy became more urgent in nature. For example from the manifesto ‘Our future needs technology’ St. Williams Foundation, York:

Everyone is caught up in technological change: all must be enabled to understand what is happening, to readjust and to participate. (1985 p1)

The notion of participation and vocational capability were common themes in ‘technological literacy’, the links were reinforced by the developments supported during the TVEI initiative. This tradition of technology literacy (along with the other traditions) was to be evident in the proposals for the National Curriculum.
2.1.2 Conceptions of technology in the National Curriculum

The tension between the traditions of technology identified by this author were again apparent during the introduction and revisions of the Orders for Technology in the National Curriculum. The Design and Technology consultation documents available to schools in June 1989 outlined the form of the subject. In her letter to the Secretary of State for Education and Science, and the Secretary of State for Wales Lady Parkes notes:

The aim of our proposals for design and technology is to prepare pupils to meet the needs of the 21st Century: to stimulate originality, enterprise, practical capability in designing and making and the adaptability needed to cope with a rapidly changing society. (1989 p.vii)

The processes of ‘design’ and ‘technology’ were seen to be similar and to have a form such that.

The attainment targets - now four in number - are derived from design and technological processes and their holistic and iterative nature. (ibid p.viii)

Design activity and technology activity are visualised in much the same form. The detail of the document expands further on this relationship, and suggests that design and technology can in fact be distinguished from each other.

The activities of design and technology overlap considerably. As we said in the Interim Report, “most, though not all, design activities will include technology and most technology activities will include design”. (DES 1989 p3)

This subject ‘design and technology’ has relationships with other core and foundation subjects:

Design and technology has a special relationship with science and mathematics. Although its aims are different from those of science and mathematics, it is intimately associated with them, drawing upon their knowledge and skills and, in turn,
contributing in ways which stimulate and assist further advances in them. (ibid p2)

The most concise articulation of the nature of 'design and technology' is provided in the terms of reference for the working group:

... the Working Group is to view technology as that area of the curriculum in which pupils design and make useful objects or systems, thus developing their ability to solve practical problems. The Working Group should assume that pupils will draw on knowledge and skills from a range of subject areas, but always involving science or mathematics. [..........] Technological education should equip pupils with basic IT skills and develop an awareness of the potential use of IT and computer technology... (ibid p93)

The vision of technology which can be drawn from the details of the document is of technology as an activity. Technology is the practice of the skills of design activity and of technology activity (which both share a common process base). This is always based on the application of science or mathematics knowledge, but may also be informed by knowledge from other areas. This vision is supported by the non-statutory guidance published to support the implementation of the orders:

Technology is a new subject, which requires pupils to apply knowledge and skills to solve practical problems. The statutory Order divides the subject into two profile components:

| design & technology capability | information technology capability |

The reference to capability in both components emphasises that technology is a subject concerned with practical action, drawing on knowledge and understanding from a wide range of subjects. (NCC 1990 p.ii)

The foreword to the November 1989 document contains a section which
has echoes of the 'technology literacy' and 'technology determinism' traditions:

Pupils will become aware of technological developments and the way in which technology is changing the work place and influencing life styles. They will learn that technological change cannot be reversed and understand its enormous power. Knowledge of technology enables citizens to be prepared to meet the needs of the 21st century and to cope with a rapidly changing society. (NCC 1989 p7)

In December 1992 changes were proposed, the document provided; at the head of its recommendations for the design and technology component the following statement:

Design and Technology involves applying knowledge and skills when designing and making good quality products fit for their intended purpose. (DFE 1992 p13)

Whilst the application of knowledge and skills is consistent with the conception from the first series of documents the inclusion of the concept of 'quality' and 'fit for purpose' is indicative of the traditions of craft and design and other practical teaching in schools. In September 1993 further recommendations were published. Following a consultation exercise a change to the description of the form of technology was recommended:

Some respondents commented that the description of technology [...] fails to recognise the importance of flair and creativity in developing technological solutions, and gives insufficient attention to the development of understanding. Moreover, the description is tautologous, as good quality products are, of necessity, 'fit for their intended purpose'. Council has therefore used an amended description as the basis for its work:

Technology is the creative application of knowledge, skills and understanding to design and make good quality products. (NCC 1993 p5)

The draft proposals for the revised order for Design & Technology
(D&T) were published in May 1994. The commentary on the proposals provided detail about the nature of D&T:

To clarify the nature of D&T, which has been open to a range of interpretations, the following statement has been included in the programme of study for each key stage: 'Design and Technology capability requires pupils to combine their designing and making skills with knowledge and understanding, in order to design and make products.' (SCAA 1994 p.iii)

The revised ‘Orders’ published in early 1995 included a statement about the form of D&T at the head of the programme of study for each Key Stage indicating how D&T capability should be developed:

Pupils should be taught to develop their design & technology capability through combining their Designing and Making skills [...] with Knowledge and Understanding [...] in order to design and make products. (DFE 1995 p2)

In this vision, design and technology are still linked but the extent of any overlap remains unclear. In the guidance above technology appears to be equated with making, what Archer (1978) might call ‘wroughting’.

2.1.3 Conceptions of technology outside the field of education

Mitcham (1994) provides a detailed commentary on the philosophy of technology, an historical account of the developments in this field. The later chapters in his work categorise technology into four broad concept bases: types of technology as object, types of technology as knowledge; types of technology as activity; types of technology as volition. Pacey (1983) explores the problems of definition and outlines three aspects associated with constructing a meaning (conception) of technology. He summarises the interaction of these three aspects using the diagram reproduced as Figure 2.5 below.
Pacey also provided a definition for technology:

"...the application of scientific and other knowledge to practical tasks by ordered systems that involve people and organizations' living things and machines. (1983 p6)

Skolimowski (1983) considers claims that technology is a composition of various crafts, also that technology has no independent methodological status. Its methodology being derived from other sciences. Skolomowski makes a clear distinction between this claim and his conception of progress based on the intent for action; that is science solves cognitive problems - technology technical ones.

My thesis is that technological progress is the key to understanding technology. Without the comprehension of technological progress, there is no comprehension of technology and no philosophy of technology. Attempts that aim at reducing technology to the applied sciences fail to perceive the specific problem inherent in technology. Although
in many instances certain technological advancements can be accounted for in terms of physics or chemistry - in other words, can be seen as based on pure science - it should not be overlooked that the problem was originally not cognitive but technical. (1983 p43)

For Skolimowski the line of technology progress might provide new opportunity for scientific investigation. The nature of the knowledge gained in solving technical problems may not be presented in a logical, ordered or complete way. Technology progress is selective and, whilst many possible channels of action exist, very few are investigated in the line of technology progress.

For Jünger technological progress is more than a series of technological solutions. Unlike authors who see the range of technology expanding, Jüngers' conception of technology is of a diminishing range as technology develops. In a paper first published in 1932 (and translated in 1983) he articulates his conception of technology.

For a long time technology was imagined as a pyramid standing on its apex and undergoing unlimited growth, its free surfaces enlarging immeasurably. On the contrary, we must try to see it now as a pyramid whose free surfaces shrink continuously and will terminate in the foreseeable future. This as yet invisible apex has already been determined by the extent of the base. Technology contains within its self the roots and buds of its final power. (1983 p278)

Whilst other authors take account of the social implication of technological developments, in this context technology is a means of communication linking members of society together.

The inverted pyramid model of technology is valid because:

The development of technology is not infinite; it is completed at that moment in which, as a tool, it corresponds to the specific demands posed for it by the Gestalt of the worker. (ibid p276)
The term Gestalt is understood here to describe the total world view of the worker class. As the development of technology becomes closer to the apex of the pyramid so the conception of technology is closer to that world view held by the worker class.

Jünger notes that the bourgeoisie sections of society perceive a state of technological determinism as technology progresses. This will throw these sections of society into crisis and anarchy will prevail.

This anarchy is nothing more than the first step leading to a new social hierarchy. (ibid p274)

Jünger provides a concise view of what technology is.

Technology is the ways and means by which the Gestalt of the worker mobilizes the world. (ibid p269)

In considering technological determinism the extent to which a man is destroyed or benefited by technology is determined by the degree to which he represents the Gestalt of the worker; so that.

In this sense technology is mastery of the language that is valid in the realm of work. This language is no less important nor profound than any other since it possesses not only a grammar but also a metaphysics. In this context the machine plays as much a secondary role as man; it is only one of the organs through which this language is spoken. (ibid p269)

Another way in which technology is identified with the notion of progression is the view expressed by José Ortega y Gasset. He provides a careful examination of man’s relationship with the necessities of life to provide a justification for his conception of technology.

Life - necessity of necessities - is only in a subjective sense: simply because of man’s peremptory resolve to live. [..........]
So ardent is this desire that, when he is unable to satisfy his vital necessities because nature does not grant him the indispensable means, man will not resign himself. If for lack of fire or a cave, he is unable to perform the act of warning himself, or for the lack of fruits, roots, animals he is unable to eat man mobilizes a second line of activities. He lights a fire, he builds a house, he tills and hunts. [.....]
But note that making a fire is an act very different from keeping warm; tilling is not feeding; .......

(1983 p291)

This line of argument is extended. By this second line of action man can undertake the 'invention of a procedure which guarantees (1983 p292)' the necessities not always found in nature. This 'second line' may require a procedure for operating simple tools. These actions are seen to 'modify or reform nature' which in turn creates something that did not exist before, or not in the location in which it was needed.

Here, then, we have at last the so-called technical acts which are exclusively human. In their entirety these acts constitute technology, which may now be defined as the improvement brought about on nature by man for the satisfaction of his necessities.

(ibid p292)

These types of acts are exclusively human because other species are not seen by Ortega y Gasset to modify nature by this second line of action. The justification for this is that man is engaged in a 'project of life'. If animals do use 'tools' they do not have enough imagination to draw up any project for life which is not the monotonous repetition of previous actions.

Ortega y Gasset outlines the progression of technology through three 'ages' which are identified by the characteristics of the technology used. The technology of chance, where man takes an opportunistic advantage of the events which may surround him. A chance discovery may lead to a more effective method of achieving a desired outcome.

The second age is that of the technology of craftsmanship:
...... we may now state that by this time technical acts have enormously increased both in number and complexity. It has become necessary for a definite group to take them up systematically as a full time job. (ibid p308)

Technology is integrated into a system of skills or arts. Thirdly the age of engineering science which has enabled man to control machines which use tools:

...... the technician and the worker who were united in the artisan, have been separated and the technician has grown to be the expression of technology as such - in a word, the engineer. (ibid p311)

In the modern factory the engineers create and set machines, workers wait on the machines tending them. Although these three ages provide a view of progress of the complexity of technological activity Ortega y Gasset warns:

... there always remains the danger that the concept of absolute progress will be defined from the standpoint of the person speaking. And this standpoint is, at best, not absolute. While he maintains his definition with blind faith, mankind may be preparing to abandon it. (ibid p296)

Lewis and Gagel in their paper concerning technological literacy set out some conceptions of technology from science. They note that the authors reviewed in the section 'conceptions from science'

... do not as a rule agree that technology is a realm of knowledge. They tend to view it more as 'objectified science'. (1992 p126)

The relationship of science to technology can be presented between two polarised conceptions. On the one hand that science and technology are two distinctly different activities; and on the other hand one activity cannot be explained or developed without the other.

Firstly that science and technology are apart. Science is concerned with
discovery and explanation of phenomena; technology is concerned with providing the means to create useful solutions to tasks. In addition to this some suggest that all science investigation is a worthwhile activity since the science knowledge base is increased. The worth of technology is a matter of judgment by society based on the usefulness of the product.

Feibleman (1983) in his paper, 'Pure science, applied science and technology an attempt at definitions', outlines three different activities. Pure science is concerned with discovery and description of natural law and nature. This enquiry is likened to a religious or artistic quest in its seriousness of purpose. The second activity, applied science is concerned with the development of applications directly from pure theory; that is using the pure theory as the starting point or the intent for development.

The third activity, technology, is closely related but distinct from the application of science. Whilst both activities may have common stages of process or development (such as experimentation) the intent for a technological development is the desire to find solutions to problems. Feibleman views the starting point for the activity as an important factor in his conception of what technology is. He notes that 'technology is more apt to develop empirical laws than theoretical laws'. Like a number of other authors he views technology as concerned with knowledge that is acquired from action, rather than knowledge which is understood as theory and then applied to the real world.

Skolimowski (1983) also notes that science and technology have been linked together. This link, to do with the notion of application of science, occurs when technology action is reviewed and 'decomposed into particular sciences'. What makes science and technology distinct activities is the different basis for progress; the progress of technology is driven by creativity, the progress of science by investigation. For Skolimowski comprehension of technology is only possible through
comprehension of the process and progress of technology action. The progress of science activity is measured by the increase in the scientific knowledge base, for technology the progress is measured by a development of effectiveness. Skolimowski also notes that technology is subject to judgments in the social context, unlike scientific activities which are analysed only in terms of the context of science.

Thus in one sense science, that is pure science, is but a servant to technology, a charwoman serving technological progress.

(1983 p44)

The conception of technology as progress is supported and extended by Jarvie (1983) in his paper ‘The social character of technological problems: comments on Skolimowski’s paper’. Jarvie considers two other questions about the philosophy of technology. What is the epistemological status of technological statements? and how can these be differentiated from those concerned with science? In considering epistemological status Jarvie reflects the views of Feibleman and other authors regarding the nature of technology knowledge. Some societies Jarvie notes have no recognisable science, but do have a recognisable technology. This might raise issues concerning how science or technology are recognised. However this provides an interesting observation since Jarvie also notes that societies are not found having activities which are only recognisable as science and not as technology. Considering the demarcation between scientific and technological statements Jarvie notes an air of caution.

Wherein then, lies the core of the differences? The answer is, I am sure, that there is no absolute demarcation: it is very much a matter of context, and particularly of problem context.

(1983 p53)

Later in the article, Jarvie makes his conception of technology clear.

Viewed anthropologically, knowledge is part of man’s multiform attempts to adapt his environment which we call his technology.

(ibid p54)
Some authors view technology as technique. For example, Lewis (1991) notes.

In its popular meaning technology is often used synonymously with 'know-how' or 'knack'. (1991 p142)

This issue is also brought into focus by Rapp.

In the narrow sense, we understand 'technology' as 'technique' - a certain procedure. This refers in the simple case to a learnable skill, such as the technique of driving a car, playing the piano, or skating. (1981 p31)

and:

Strictly speaking since every action that is consciously and purposefully executed follows a methodological pattern, however rudimentary, one would have to classify all purposeful (individual as well as social) action as technological, we have to distinguish this very broad definition of 'technology' from the narrower sense of the word which restricts 'technological activity' to the performance of the engineer. (ibid p35)

This 'technique as technology' conception is strengthened if a consideration is made of the types of knowledge evident in technology activity. Many authors point to two types of knowledge in design or technology activities. If for example I 'know-that', I have explicit knowledge of a particular field of experience, I can make this detail available and others may also have ownership of it. The other type of knowledge which I possess is 'know-how' this is the skill or knack of doing something. Cross, Naughton and Walker provide a commentary in their paper 'design method and science method' to explain this concept:

For instance, knowing that is the kind of knowledge possessed by a football spectator or football coach. He knows that the way to play football is so and so.[...........] Yet it is not the same as the incommunicable know-how of the players. A
A football player knows how to play football. His know-how is embedded in the tiny interrelated details of performance. He cannot say how he does it. The knowledge cannot be transferred in talk or on pieces of paper. This is not because the player is inarticulate, but rather that his form of knowledge is intrinsically non-verbal. (1986 p30)

This notion of know-how tends to support the ‘technique as technology’ conception and would include a wide range of activities.

Naughton in his definition of technology, makes note of two types of knowledge, one is ‘scientific knowledge’ which ‘explains a particular phenomenon’. Naughton takes particular care to make this use of the word science clear:

...to highlight two important features of scientific knowledge. The first is its tendency to explain everyday events, problems or phenomena in abstract, theoretical terms. The second is the tendency, [...] for scientific theories to be conceptually linked to other theories at deeper levels of abstraction.

(1979 p27)

The second type of knowledge is ‘organized knowledge’. This is explained by reference to the builders of Durham Cathedral, although the builders had a knowledge of the properties of the materials they were using they could not relate the rules and principles of construction to abstract theories involving properties of materials. This can be equated with the ‘empirical laws’ which Feibleman refers to in his paper.

We may say that these builders had craft knowledge. Craftsman had knowledge of working in a particular area or material. They knew the rules and principles associated with that craft and this knowledge of methods was embodied in the techniques which were passed down the generations. For Naughton.

Technology is the application of scientific and other organised knowledge to practical tasks by hierarchically ordered systems that involve people and machines. (1979 p27)
Naughton's conception is similar to that of Pacey (1983) and to the views of other authors which Rapp (1981) articulates in his consideration of his first standpoint 'the engineering perspective'. The aspects of team work, and organised work plans are reminiscent of Naughton's conception. Rapp also notes that:

..modern technology cannot be reduced to either inventive skills alone or to mere application of scientific knowledge. Modern technology results from joint efforts of engineers (and scientists, as required by circumstances) who apply their professional knowledge to the creation and development of a product to the point of routine production. (1981 p7)

This 'professional knowledge' is of the same kind as the craft knowledge noted by Naughton. Bunge (1967) notes a distinction between pure science and technology. In his articulation of his philosophy of technology justification is based on the manner in which 'rules of thumb' and 'empirical laws' are constructed and tested. Bunge can distinguish a genera of four types of rules. The first concerned with social and moral rules, the second with the region of prescientific or craft knowledge, the third with signs and signal interpretation and lastly 'rules of science and technology: grounded rules of research and action.' Bunge considers that rules of thumb although apparently workable may be in part false, the rule could be made more efficient.

the best policy is first, to try to ground our rules, and, second, to try to transform some law formulas into effective technological rules. The birth and development of modern technology is the result of these two movements. (1983 p69)

Bunge articulates the methodology of rule and law. He is able to make a clear statement regarding 'craft knowledge', applied science and technology.

This is also why technology - in contrast to the prescientific arts and crafts - does not start with rules and ends up with theories but proceeds the other way around. This is, in brief, why technology is applied science whereas science is not purified technology.' (ibid p71)
In contrasting the actions of scientists and technologists in forecasting, Bunge points to the differences in their roles. The scientist is an observer of a process, the technologist however aims to influence the process to try to achieve an outcome which he feels is the most desirable:

"...technological forecasts suggests how to influence on circumstances so that certain events may be brought about, or prevented, that would not normally happen." (ibid p72)

If technologists are able to influence the outcome of actions they must make judgments about which outcome is most desirable. Their judgments (and the manner in which they make them) impact on all in society. The effectiveness of the technologist's work is itself judged by the artifacts which are produced. These tangible artifacts of technology are often seen to be neutral. Although the use may be seen as being good or bad. In considering value judgments Layton notes:

> It is always difficult to isolate the material artifact from the network of human activities in which it is inextricably enmeshed - and hence from the values of people. Also, an artifact - such as a motor car - can reshape people's values and call new ones into play. It makes possible new kinds of actions between which people have to choose; they are inexorably driven into the realms of value judgment. The essential point here is that technological innovations alter the circumstances in which our choices have to be made.'

(1992 p9)

Layton points to the way in which technological developments are accepted by society as being fact. He warns that:

> What we encounter today is the result of decisions which reflect the value judgments of those who shaped a development which was in no sense inevitable. (ibid p10)

This line of argument can be extended further. New technologies shape future value choices. This change in value choice marks a turn in the driving force of technology developments, rather than society's value
judgments shaping technology; it is technology which is shaping our value judgments. Technological determinism is upon us. Technology is held as a pervasive force which subjugates man. Who and what we are is determined by our technology. Mackay provides comment about the notion of technological determinism and notes:

By technological determinism is meant the notion that technology is autonomous from the society in which it is developed and operated; technology shapes society in a one-way, linear, causal relationship. Technology is somehow outside society, with a momentum all of its own; and has effects on society - in other words, technical change causes social change. (1991 p6)

For Lewis (1983) the application of scientific knowledge (that some authors may call technology) allows man to exercise power over nature. This line of argument is developed to illustrate how individuals may, by controlling nature, control other men.

This modifies the picture which is sometimes painted of a progressive control of natural processes resulting in a continual increase of human power. In reality, of course, if any one age really attains, by eugenics and scientific education, the power to make its descendants what it pleases, all men who live after it are the patients of that power. They are weaker, not stronger: for, though we may have put wonderful machines in their hands, we have preordained how they are to use them. (1983 p144)

2.2 Prior studies

A number of studies have been undertaken which were concerned with varying aspects of students conceptions of technology. Two areas of research are evident. Firstly studies which investigate students rationale for their choice of 'technology subjects' at examination level; these studies include a comparison of students impressions of technology
courses and courses in other subjects, and investigate the impact of ‘technology subjects’ on their career intentions. The second group of studies explore what students conceptions of technology are, albeit at a variety of levels of complexity.

2.2.1 Prior studies: examination level technology subjects

Nash, Allsop & Woolnough (1984): Factors Affecting Pupil uptake of Technology at 14+

Data was gathered using an instrument which contained open and closed questions. This was administered by teachers in the participating schools under examination conditions. The responses to the open questions were categorised ‘in a manner akin to that employed by Selmes (1969)’ who (in his investigation into the attitudes of 12 / 13 year olds to science and scientists) collected tape recordings of students talking about their reactions to science and science teaching. The recordings were reviewed with the aim of looking for recurring phrases and expressions.

The recording of informal discussion was used by Hine (1990) although the discussion was structured and guided by the ‘interviewer’. In the case of Selmes no teacher was present and the discussion was lead by an older student. Selmes notes.

The presence of a skilled interviewer might have helped; not only would it have been possible to keep the discussions relevant but he could have probed more deeply into some of the generalisations and platitudes uttered by the children. (1969 p8)

Considering the results obtained by Nash, Allsop and Woolnough. The structure and analysis of some of the open questions may contain anomalies. In many cases the most popular response is a generalist one, more specific statements are less frequent. Some specific responses may have been subsumed into generalist categories, either by a lack of
specification on the part of the student or clarity in the construction of the instrument.

For example Table 2.1 outlines the responses of boy technologists to the question: Please explain why you opted to study technology?

<table>
<thead>
<tr>
<th>Categories</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>Interesting, good course, enjoyed it in third year</td>
</tr>
<tr>
<td>2</td>
<td>Like making and inventing, designing and solving problems, tinkering and finding out how things work</td>
</tr>
<tr>
<td>3</td>
<td>Useful subject for future career interests</td>
</tr>
<tr>
<td>4</td>
<td>Useful subject for life</td>
</tr>
<tr>
<td>5</td>
<td>Interested in electronics, computers, electrical things</td>
</tr>
<tr>
<td>6</td>
<td>Like physics, course combines well with physics</td>
</tr>
<tr>
<td>7</td>
<td>Enjoy theory and practical, applying scientific theory</td>
</tr>
<tr>
<td>8</td>
<td>To avoid studying another option subject</td>
</tr>
<tr>
<td>9</td>
<td>Course relevant to technological age</td>
</tr>
<tr>
<td>10</td>
<td>Subject provides knowledge of working with materials, enjoy practical work, etc.</td>
</tr>
<tr>
<td>11</td>
<td>To learn, might be good at, new subject</td>
</tr>
<tr>
<td>12</td>
<td>Provides experience of putting ideas on paper</td>
</tr>
</tbody>
</table>

No. of responses = 91
No. of pupils = 60
No. of pupils giving no reply = 2

Table 2.1 Reasons provided by boy technologists
Source: Research in Science and Technological Education p9

The most popular category is: 'Interesting, good course, enjoyed it in third year'. This had a 30% response rate, but may have contained responses from students who enjoyed it because of the following qualities which were specifically noted by 9% of the response that is: 'Interested in electronics, computers, electrical things'.

The study was concerned with students' views of the school subject technology, not what their view of what technology was. Some
questions did move towards this inquiry, by exploring a comparison between the subject technology with the school subjects science and craft.

When you made your option choices did you think technology would be different from the science subjects in the option list?

When you made your option choices did you think technology would be different from the craft and technical subjects in the option list? (Nash et al. 1984 p14)

The report notes that of the two questions a larger proportion of 'technologists' believed technology to be different from science than from craft and technical subjects. The difference was concerned with the process of the subject technology in terms of its outcomes compared to science, that is the making of products. The following categories are reported for student responses which may be considered in developing the research programme for this study.

Technology is different from science. Technology is:
- designing and making and inventing, problem solving and working things out.
- about engines, mechanics, structures, machines.
- more practical, or technical, like craft.
- finding out how and why things work.
- more electronics.
- not involved with equations, experiments, organisms etc.
- harder, more difficult maths, must work faster.
- about modern age, future and silicon chips.
- more general, covers subjects not in science.
- more exciting, interesting.
- a mixture of all the sciences.
- the application of science.

Technology is different from craft & technical subjects. Technology is:
- more theoretical, more writing, planning, accuracy involved.
- finding out how things work.
- science subject, contains science, physics, chemistry.
- more choice of what to do, design.
mixture of crafts and technical subjects.
involving machinery, engineering, structures, hydraulics, electronics etc
not like craft, but like technical, TD.
completely different has different name.
ot practical, constructive. Don't learn how to make things
more practical, construct things.
involving more work on electricity and computers.
more useful.

In Control Technology there are more problems to solve.
In Control Technology - make things which work by power source.

(ibid 1984 p14)

Bartlett (1987): Pupils’ perception of technology

Bartlett examined students conceptions (although the study was titled perceptions) of the subject technology; and considered the career aspirations of students post-16. The student sample for the research group was not representative of the school population as a whole.

It was decided to restrict the survey to the more able pupils; a specific criterion was that they should be studying for O level / 16+ Physics. From an economic standpoint it is these able pupils who are in many ways the most crucial. (ibid 1987 p1)

The research instrument consisted of nine questions,

1. What O level and 16+ examinations are you taking?
2. What do you hope to do next year? If you are staying in full time education, what courses do you want to do?
3. Do you have a career in mind? If so, what? Why are you choosing the courses given in question 2?
4. What are the pro and cons of a 'mixed' A level course?
5. How much technology have you done since the age of 11?
6. Do you think technology should be taught in schools? Why?
7. What do you like/dislike about taking part in technological work?
8. What do you feel a ‘professional technologist’ is like? What springs to mind? How is such a person like you or different from you?
9. Why do you think attention is now being given - nationally - to the question of technology in schools? (ibid p2)

These were read to students who then provided a written response. The questions were of an open nature and the instrument was conducted in an informal atmosphere. Students were able to seek further guidance from researchers if they did not understand the questions. Although all the questions were related to technology no question sort any indication as to what technology was. The report provided by Bartlett does provide support for the justification of this author’s research study. In reviewing the questions asked he notes:

In general this list worked well and the questions were understood, but the whole survey was conducted in an informal atmosphere and if a group did not understand a question they could ask for it to be clarified; this was relevant to question 5 in particular as the meaning of the word ‘technology’ was by no means well understood or agreed. (ibid p2)

Although the report for this study notes that ‘in many cases a good deal of informal and unstructured discussion’ was possible by the use of small groups in an informal atmosphere, there is no indication that this discussion was used to challenge, verify or explore the concept of what ‘technology’ was conceived to be. The questioning of small groups of students and the use of informal discussion is consistent with the approach used by Hine (1990). In considering the responses to the questions Bartlett notes that:

Most of the questions were open-ended and allowed a free response. Nevertheless for any given question the vast majority of responses could be grouped into one or more of a relatively small number of categories. These categories were not pre-determined but were defined as a result of a preliminary analysis of the responses. (op cit p3)

The report provides an analysis to the results generated by the research to each question. Four major findings are reported:
There was no evidence from this study that any major breakthrough had yet been made on 'the gender problem'. Technological work/aspirations in schools was dominated by boys.

As a school subject technology was perceived as a ‘two edged sword’ [students were very successful - or failed to achieve anything]

Many pupils were aware of and valued the purely educational arguments - as opposed to the directly vocational arguments - for the existence of technological work in schools.

Many pupils had a sophisticated grasp of the dilemmas posed by the confrontation between purely educational and pragmatic considerations. Many pupils are quite well aware that pressures relating to jobs/ status/ money and image generally affected decisions on subject choice which might be different if made on purely educational grounds. (ibid p25)

In the final section of his report Bartlett speculates on other aspects of students conceptions of technology. In terms of this study it is the final section of Bartlett’s report which is of most interest. He points to a number of areas of inquiry; and articulates his concerns:

It is interesting to speculate that there is an integration between pupils’ perceptions of technology in schools, and of their perceptions of ‘the professional technologist’ and technology as a career. One may speculate that the interaction is a dynamic one. That is, experience in school affects the image pupils have of technology in the world at large and of technologists; but also that their image of the latter affects their attitude to technology in schools. There are a number of perceptions which appeared in this survey and which may form part of a general technology ‘image’. Firstly that technology is very hard work. Secondly, that you have to be clever to do it. Thirdly, that it has an insecure feel to it: that may prove very satisfying but it may also prove extremely frustrating. A fourth possibility, though support for it cannot be claimed from this survey, is that technology is such a wide field that to date it has often proved almost impossible for pupils to form a really clear idea of what technologists actually do - and thus very difficult for them to identify with it, either as part of the curriculum or as a career. One might speculate that such identification has been easier in the case of the two most popular
career aspirations categories which emerged from this survey, namely medicine and accountancy/banking, and that in these cases many pupils had a clearer image of what was involved than they did in the case of 'technology'. (ibid 1987 p26)

McCarthy and Moss (1990) Pupils' perceptions of technology in the secondary school curriculum: a case study

This study investigated student attitudes to Craft, Design and Technology (CDT) and Technology GCSE and A Level examinations. The findings are reported as:

Technology is regarded by the pupils as intellectually demanding and having a high 'employment value'. This seems to attract more able pupils (of both sexes) than would be the case for other CDT subject areas. Pupils perceive CDT: Technology to have the characteristics of Science subjects rather than those of Arts or Crafts. A significant proportion of female students in this case are attracted to study A level Technology. (1990 p207)

This study was undertaken in the home institution of one of the researchers following the identification of a particular trend in course options made by pre and post 16 students. Considering the methodology McCarthy and Moss note:

A total of 40 pupils following Technology courses in years 4 - 7 [now years 10 - 13] were asked to complete a questionnaire. The questionnaire was designed to measure their attitudes towards CDT: Technology (at GCSE level) and Technology (at A level) in terms of the following factors.

1 Reasons for choosing technology.
2 Perception of Technology in relation to other subjects.
3 Perception of Technology in relation to gender.
4 Differences in perception of Technology between GCSE and A level. (ibid p209)
No indication is given in the report as to the use of open or closed questions; however, the results which were published (Table 2.2) have categories listed. Three of these have zero responses, and this would tend to suggest that categories were offered for students to choose from. This approach may have prevented students offering their ideal response, rather they had to choose the best fit from the options offered.

<table>
<thead>
<tr>
<th>Reasons for choosing CDT: Technology</th>
<th>GCSE</th>
<th>A level</th>
<th>All males</th>
<th>All females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest in new subjects</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Not interested in others on offer</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Told to by parents</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Friends opted for subject</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Do not care what option is followed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Believe it to be useful in future</td>
<td>22</td>
<td>8</td>
<td>18</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 2.2 Reasons for choosing CDT: Technology

Source: Educational Studies p214

In considering the relation of technology to other subjects students were asked to rate science, arts, CDT: Technology and other CDT subjects in terms of 16 skill attributes. The visual plot was then produced to display the rating given in each of the 16 skill attributes (Figure 2.6).

McCarthy and Moss note:

Pupils were invited to complete such a profile separately for Sciences, Arts, CDT: Technology and for Wood/Metalwork subjects [.....] we are able to see that the profile for CDT: Technology is a closer match to the overall profile for Science than for the Arts or Wood/Metalwork. (ibid, 1990 p213)
The use of profiles may provide a basis for representing the conception of technology which students hold.

The use of a questionnaire is common to the three studies above. All the studies have been undertaken in such a way that the results produced could be published in statistical form. Even in situations where open ended questions have been used the norm is to reduce the responses to a number of categories to enable a numerate value to be obtained for each category or cluster of responses.

To some extent the three studies touch on the question of what is technology?; albeit at a superficial level, asking is technology more like science than other subjects. All studies have provided indications that
the school subject technology can be compared with other subjects although the evident categories and skills profile (of the first and third studies) and the reasons for studying technology in the second are all based on subject skills. No consideration is given to asking what qualities make a subject different from others. That is, what makes the subject technology like or different from other subjects, rather than what essential aspects identify a subject as technology.

2.2.2 Prior studies: conceptions, perceptions and attitudes to technology

The studies reviewed in this subsection are concerned foremost with students thoughts about technology, as distinct from the examination course 'Technology'. A key study in this area is that carried out by Raat. and de Vries (1986). Their study 'Pupils' Attitude Towards Technology' (PATT) has through its later development stages been taken up by researchers in a number of countries worldwide using a culturally adjusted version of the original instrument. The PATT study was a development from a research project 'Physics and Technology'. Following research initially undertaken in the study 'Project Physics' and Technology the instrument was developed through the following stages: 1). Interviews were held with 12 students asking 'what do you think technology is?', 'how important is technology for you?' 2). Then 48 students in two schools were asked to respond to 10 open ended questions about their ideas of technology. 3). The answers were formulated into eight sections and used to construct the questionnaire. Raat and de Vries provide a brief outline of the development of PATT.

Inducement to organize the PATT - workshop
In 1984/5 in the project Physics & Technology (Section Teaching of physics, Department of Technical Physics, Eindhoven University of Technology), we carried out an investigation into the concept of and the attitude towards technology. In our research we were concerned with pupils in the second year of schools for secondary general education. These pupils are about 13 years old.
It appears that the concept these pupils have of technology is obscure and there are many gaps in it. There are many significant differences between boys and girls as far as their attitude towards technology is concerned.

At this stage pupils make the first choices concerning the subjects they want to study, [.........] but it appears that they know little about technology. ........

This does not only apply to the Netherlands. It is a fairly common phenomenon. A small literature study shows that so far the attitude towards technology has hardly been investigated. This was an immediate cause for us to make a proposal for a possible internationally comparable investigation. ........

The proposal implied that researchers would carry out a pilot study based on the questionnaire we developed and translated into English, among 200 pupils aged about 13 of schools for secondary general education.

This in order to find out whether it is possible to develop one international instrument to measure the attitude pupils have towards technology. With this instrument we can then carry out the measurements and discuss and compare the obtained results. In the end 13 investigators in 11 countries decided to take part in the investigation.

We then invited people to participate in the pilot studies we also asked the participants to come to the PATT - workshop. The aim of the PATT - workshop was: to compare the results of the various pilot studies and if possible, to construct an internationally valid instrument. (1986 p13)

The instrument used was a five point Likert scale. The instrument consisted of a number of statements (between about 50 and 100) which were based in a number of attitude scales. These scales are perhaps best thought of as areas (or aspects) of interest. Seven scales were identified:

- consequences of technology;
- sex differences;
- interest in technology;
- technology in the curriculum;
- difficulty/ accessibility of technology;
- creativity in technology;
- careers in technology.
The response required for each statement was recorded on a five point gradient:

Strongly agree, agree, undecided, disagree, strongly disagree.

Analysis of the responses allowed data to be compiled which outlined the response rate to each level of the scale. Thus an indication of the student’s awareness of technology is obtained by considering their strength of opinion (response away from the midpoint) about the statements contained in the questionnaire.

The report of the PATT - workshop (1986) contains details of 9 pilot studies undertaken to ascertain if the instrument could be used internationally (Raat and de Vries 1986). No interpretation of results is given for any of the studies. However; a number of subsequent studies have been published which have used the 'PATT' format instrument, these are examined below.

Two of the pilot study reports presented at the PATT (1986) workshop note the difficulty students had in dealing with the word ‘technology’. Bukunola Osilodu (1986) notes:

For example, the word ‘invention’ in Q37, and the term ‘technology’ itself in its different contexts created problems. (1986 p95)

also Parker and Rennie (1986) note the number of midpoint responses on the Likert scale:

The lack of definition of technology appears to be related to the large number of midpoint responses to the questionnaire. Students were quizzed after completing the questionnaire to establish the manner in which they had used the middle response category.

They had reported that they used the undecided response in any of three circumstances - they did not understand the question, or they had no opinion, or they were genuinely undecided. Several students claiming not to know the meaning of technology used this midpoint response for many of the items which contained the word ‘technology’. (1986 p101)
Whilst this may have distorted the response rate of the pilot studies this anecdotal evidence tends to provide further justification for the rational behind this author's research.

Rennie (1987) Teachers' and Pupils' Perceptions of Technology and the Implications for Curriculum

Rennie's article reports two investigations in Western Australia; the perceptions of pupils and the perceptions of teachers. She suggests that the analysis of responses indicates that students do not have a clear understanding of technology:

........ clearly most students agree that technology is important, yet their responses to the other items [....] suggest that many do not have an understanding of technology. The results for Item 11 [In everyday life you do not have much to do with technology.] reveal that about 44% disagree with that item, indicating that more than half of the students are unaware of the pervasiveness of technology in modern life. All students use technological products everyday, but it seems that many students do not recognise their radio, their bicycle and their pencil case as products of technology.

(1987 p128)

This may be another factor of the instrument which was skewed by students not understanding what 'technology' was taken to mean. However, this finding might equally suggest that students identify technology in some other form, not with products.

The investigation of teachers' perceptions of technology (this author would argue they were conceptions) was undertaken by asking teachers at two inservice science courses to write down, in less than 5 minutes, their definition of technology. The teachers were also asked to indicate if their definition was based principally on a published definition. The responses from the 94 teachers were grouped to form the following areas of consensus: Technology as the application of scientific knowledge, Technology and Society, The history of technology and in the case of 3 responses, Technology and the teaching of science. This
range of views might have been expected considering the sample.

Rennie notes:

Not surprisingly, science teachers see science and technology as related. However, the definitions of nearly all of the teachers could be interpreted as a view that technology is dependent upon science, because the idea that technology is the application of scientific knowledge/principles implies that the science necessarily came first. This view of technology is restrictive in two ways. First it suggests that new artifacts or processes cannot arise other than from the basis of scientific knowledge. [...] Second, this view of technology suggests that technology could not exist before there was scientific knowledge. (ibid p126)

Bame and Dugger (1990): Pupils' Attitudes and Concepts of Technology

This investigation was undertaken using the PATT - USA instrument administered to over 10,000 middle and junior high school students. The article is concerned with 'pointing up' aspects of the results although no details of response rates are given. The only details of administration of the instrument relate to the number of questions, their division into sections and the scales which were used. The instrument contained 100 questions, 58 of these related to the attitudes students had towards technology and more interestingly 31 questions which enquire about their concept of what technology was. The report outlines how these questions were arranged in 'scales':

The questions dealing with the students’ concept or knowledge about technology were organized into four scales:

1. Technology and Society - the relationship between technology, humans and society.
2. Technology and Science - the relationship between technology and science.
3. Technology and Skills - skills in technology.
4. Technology and Pillars - the raw materials in technology.

(1990 p10)

The concept scales were developed up by the organising group of the
PATT-86 workshop. This comprised five ‘scales’ based on the characteristics of the concept ‘technology’ which were identified from a literature study for the project Physics and Technology. This project had three main parts:

1. research into pupils’ attitude toward technology.
2. research in the meaning of the concept ‘technology’.
3. development and evaluation of courses.

de Vries (1986) outlines the five scales or ‘characteristics’ in his paper What is Technology? However, Bame and Dugger (1990) combine the characteristics:

1. Technology is a specific human activity.
5. Technology thoroughly intervenes all aspects of society: economy labour, social relations.

to form the first scale in their study. In the analysis section of their paper they consider the responses of students and note:

.... analysis of the four concept scales indicated a weak understanding of technology. Students were asked to define technology; they often related technology to machines, especially the computer. Only a small number of students understood the relationship between technology and humans or science.

(ibid p11)

The research took into account demographic data, including details of parents occupations; the students home, and environment:

Comparisons of the demographic data and the students’ attitudes and concepts of technology were quite revealing. The home environment has a lot to do with young people knowing about technology. The students with the most knowledge about technology were those who had an exposure in the home to:
  technical toys
  technical workshops
  personal computers
Of these three—the presence of technical toys in the home had the most impact on the students’ attitudes related to technology.

(ibid p10)
Perhaps it is not surprising that the home environment should influence their concept of technology or for that matter that their concept of technology is also influenced by their exposure to subjects in school:

Enrolment in an Industrial Arts / Technology (IA/Tec Ed) course made a significant difference on students’ responses to all attitude scales as well as the concept scale. (ibid p10)

and:

A large number of students related technology to the Technology Education lab in school. (ibid p11)

These findings reflect those of Hine (1990), students recognise technology as the experience which has been introduced as technology. The notion that students adopt the school concept of technology is also reported by Householder and Bolin (1993). Their study had the duel purposes of determining the effects of immersion in a ‘technology rich’ learning environment and on achievement and attitude towards technology. The instrument was a development of the PATT - USA model. In their report they noted:

The changes in student attitudes towards technology during the academic year are particularly provocative. Participation in the TEC - Lab project, whether in one of the TEC - Lab classes or in one of the comparison classes taught by the TEC - Lab teachers resulted in positive changes in attitude towards technology. The shift was consistent, appearing in each of the factors as well as the overall attitude scale. (ibid p16)

Thompson and Householder (1995): Perceptions of technological competencies in elementary technological education

This paper reports two investigations. One is a development of the earlier work of Householder and Bolin (1993). They report student attitude towards technology in relation to computers.
The first study outlined in their paper is perhaps the more interesting in the context of this author's investigation. Various education groups were asked to outline their perceptions of technology. The methodology outlined by Thompson and Householder may provide a starting point for this author’s research methodology.

In this exploratory study, individual respondents were asked to provide written responses to the open-ended question, ‘What do you think technology is?’. The following groups provided information for this preliminary study:

1. Academic staff from a teacher training establishment in Scotland
2. Secondary school mathematics teachers from United Kingdom
3. Primary teachers from a variety of schools in the Highland region of Scotland
4. Student teachers at the beginning of a Bachelor of Education course.
5. Primary school pupils aged 11 - 12 years from two schools.

The groups were not informed in advance that they would be asked to respond to the question, had no time for discussion of the question, and were given no explanation of the purpose of the collection of their perceptions. Responses were collected immediately after they were completed. (ibid p28)

The responses were analysed for range, frequency and consensus within the groups. The approach to the gathering of conceptions is consistent with that used by Rennie (1987).

Jones and Carr (1992): Teachers Perceptions of Technology

This research tends to support the findings of other studies which suggest environment and subject experience directly influence the individuals conception of technology. Jones and Carr note that:

Subject subcultures were found to be consistent and a strong influence on secondary school teachers perceptions of technology education. Science teachers emphasised applications, social studies teachers focused on societal aspects, English teachers on
journalism, media studies and drama.

Teachers perceptions of technology education were influenced by their past experience both in and out of school.

Those teachers who had worked outside teaching were influenced by these past careers and tended to focus on 'high-tech' as being the highly visible technology. (1992 p1)

Hine (1990): An evaluation of pupils perception of technology and its location in the curriculum of Wayland High School

This study formed this author's initial work in the field of conceptions of technology. Since it was undertaken the author has made careful consideration of the notions of perceptions and conceptions. The author now concedes that the work was miss-titled; a more considered title would have noted 'pupils conceptions'. The author's concerns regarding language were rehearsed in the first chapter.

Hine (1990) video recorded small groups of students who were informally discussing various aspects of technology. Students were asked questions in order to stimulate discussion. This discussion was guided by the interviewer through four 'sections'. 1). An examination of work produced by students during a suspended timetable activity 'technology week', 2). An identification of what made something to do with technology, 3). Subjects they could identify as teaching technology. 4). The final section allowed students to comment on other issues to do with technology which they had not previously had the opportunity to raise.

Whilst the written response used by Bartlett (1987), Thompson & Householder(1995), Rennie (1987) and the open PATT questions may have reduced the time taken to produce an analysis of results (because no transcription was required) the method used by Hine allowed students to develop and articulate their conception. He notes:
It was evident [...] whilst conducting the interviews that most pupils had not formulated (or been asked to formulate) notions of what technology is, the feedback from other members of the group allowed them to bounce ideas around and formulate answers which would not have been possible for an individual. (1990 p17)

This process of formulation was evident in the comment of a Fourth Year (now Year 10) student as the group described technology:

Kate: “When you say technology you automatically think of electronics - everything we've done so far has been; - but now I'm thinking - all aspects of technology if I had had that picture in my mind before we started talking”. (ibid 1990 p24)

It should be noted however, that this approach was made possible because the aim of the study did not seek to generate quantitative data.

References

T Allsop and B Woolnough, The Relationship of Technology to Science in English Schools. In Journal of curriculum studies Volume 22 Number 2 1990 pp127-136

APU, Understanding Design and Technology, Assessment of Performance Unit 1982


B Archer, The Nature of research in Design and Design Education, In The Nature of research in Design and Design Education: Design Curriculum Matters, Loughborough: Loughborough University of Technology 1992

A Bame and W Dugger, ‘Pupils attitudes and concepts of technology’, The Technology Teacher, Volume 49 Number 8 1990 pp10-11


DES, *Design and Technology for ages 5 to 16: Proposals of the Secretary of State for Education and Science and the Secretary of State for Wales*, HMSO 1989


DFE, *Design and Technology in the National Curriculum*, London HMSO 1995


D Layton, Technology’s challenge to science: cathedral, quarry or company store?, Buckingham: Open University Press 1993


C Mitcham, Thinking through technology: the path between Engineering and philosophy, Chicago: The University of Chicago Press 1994


J Naughton ‘What is ‘technology’ anyway?’, Introduction to T101, Milton Keynes: Open University Press 1979
NCC, Technology programmes of study and attainment targets: recommendations of the national curriculum council, York: NCC 1993

NCC, Technology 5-16 in the national curriculum: a report to the Secretary of State for Education and Science on the statutory consultation for attainment targets and programmes of study in technology, York: NCC 1989

NCC, Non-statutory guidance - Design & Technology Capability, York: NCC 1990


A Pacey, The culture of technology, Oxford: Blackwell 1983

L Parker and L Rennie, ‘Attitude towards technology: Administration of the questionnaire in Western Australia’, J Raat and M de Vries (eds), Pupils’ attitude towards technology, Eindhoven: Eindhoven University of Technology 1986

M Parkes, Letter to the Secretary of State for Education and Science and the Secretary of State for Wales, In DES, Design and Technology for ages 5 to 16: Proposals of the Secretary of State for Education and Science and the Secretary of State for Wales, HMSO 1989


J Raat and M de Vries (eds), Pupils’ attitude towards technology, Eindhoven: Eindhoven University of Technology 1986


St Williams Foundation, 'Our future needs technology’ [manifesto document], York: St Williams Foundation 1985

C Thomson and D Householder, ‘Perceptions of Technological competences in elementary technological education’ Paper for IDATER 95 Loughborough University of Technology 1995


B Woolnough, 'The place of Technology in Schools’, *School science review*, Volume 56: 443-448 1975
CHAPTER THREE

Development of a methodology

The development of the research methodology is considered in three subsections:

3.1 the establishment of a theoretic framework;
3.2 methodological considerations;
3.3 pilot study investigation.

3.1 The establishment of a theoretic framework

The second chief question concerned gathering the conceptions of technology which are evident in education and other fields. The review of published conceptions of technology can be used to establish a framework against which an individual’s conception (or a portion of it) can be matched. The framework also provides an indication of the conception which an individual may hold, hence it provides an indication of the areas into which it may be profitable to inquire.

3.1.1 Focusing from general to specific conceptions of technology

This section outlines the theoretic structure on which the active research programme is based. It explores the aspects of technology to be examined and the context in which they are to be considered.
In the introduction it was noted that the use (or misuse) of language presents difficulties for a study in this field. Confused interpretation and articulation of the different conceptions of technology which are held, is in part also due to the limited range of language available for the description of ‘technology’ or ‘aspects of technology’. This issue is explored by Fores and Rey (1986). Rather than being able to use a single word to identify an aspect or consequence of technology a phrase has to be used. The limited range of words used to describe aspects of technology have, because of ‘over-use’, become associated with a number of meanings. In fact the number of aspects has become so large that these words now convey only a ‘global’ meaning. We lack specific words to describe the small segments or aspects of technology and thus we lack descriptive ability. This association with a global meaning itself exacerbates the difficulties in articulating a conception since the global view is so large it cannot be contemplated without breaking it down into smaller more identifiable parts; work in this area has been reported by Daamen, van de Lans and Midden.

Imagine the cognitive task respondents must perform to give their global evaluative judgment about “technology in general”. The ideal respondent has to hold all technological applications in mind (for example cruise missiles, home computers, test-tube babies, etc.) and assign scores to each of these applications with respect to all consequences that seem important. Next the respondent must combine these scores into one overall judgment; this task is very difficult, especially if the scores diverge.

(1990 p216)

Previous research work suggests that when considering technology respondents tend to return to a particular aspect or context with which they are familiar. For example in questioning science teachers about technology Rennie notes:
Not surprisingly, science teachers see science and technology as being related. (1987 p126)

In a preliminary study carried out in 1990 this author noted the tendency for students to identify as technology the experiences which had been presented to them as ‘technology’ by the school.

A theoretic framework was constructed for use within this study to support two aspects of the inquiry. Firstly to provide a number of ‘fixed’ or focus points around which an individual’s conception of technology could be developed, articulated and recorded. When considering the development of a methodology the most fruitful course of action appeared to be not to ask “what is technology?” in global terms but to inquire about a range of aspects which are considered by this and other authors to be concerned with technology and from these specific segments to construct a more complete conception. These focus points; the ‘key aspects’, frame the inquiry.

The second form of support provided by the framework relates to the intention of comparing one individual’s conception of technology with that held by another. The methodology adopted must support the capture of data (conceptions) in a form that can be used to undertake direct comparisons between individuals. It may be possible to ask two respondents “what is technology?” and (notwithstanding the difficulties concerning the articulation of a conception in other than global terms) the respondents each provide an articulation of their view of ‘what technology is’ which is focused on specific areas. There is no certainty that the specific areas which they mention will be common to both respondents. This is not because they do not have views on areas which could be common to them both, only that these areas were not at the forefront of their thinking when they articulated their views.
In a study which was to report on the aspects (and their frequency) which respondents identified as being to do with technology, then asking “what is technology?” may be a valid methodology. However given that this study is to report on the comparisons of conceptions of technology a high degree of commonality of aspects identified is required. The intention is to use the theoretic framework as a schedule of key aspects to be investigated. As such all respondents will provide details of a conception which is articulated around the same common points.

The identification of these ‘key aspects’ was made following a review of published literature, the research findings of other investigations and the comments of students; gathered by the author (whilst conducting peer group interviews) during the preliminary study (Hine 1990). Figure 3.1 indicates the relationship of authors to the key aspects. These key aspects are by the nature of the inquiry concerned with school and school students.

Initially ten key aspects were identified:

A. technology as a learnt sequence or process.
B. technology as problem solving or invention.
C. the influence of the subject craft and design.
D. the influence of the subject science.
E. the influence of technological literacy.
F. the influence of home environment.
G. identification in the world outside school and home.
H. products of technology: tools and machines.
I. products of technology: applications for the non-craftsman.
J. products of technology: smart artifacts.
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Figure 3.1 The relationship of authors to Key Aspects of this inquiry
During the subsequent development of the research instrument difficulty was encountered working within this framework and some key aspects (which could be thought of as different sides of the same coin) were combined to form the following six 'areas of interest' which frame this investigation:

1. **Recognising technology activity** which subsumes the key aspects of:
   A. technology as a learnt sequence or process.
   B. technology as problem solving or invention.

2. **Participating in technology activity** which subsumes the key aspects of:
   A. technology as a learnt sequence or process.
   B. technology as problem solving or invention.

3. **Which subjects teach technology?** which subsumes the key aspects of:
   C. the influence of the subject craft and design.
   D. the influence of the subject science.

4. **Living with technology** which subsumes the key aspect of:
   E. the influence of technological literacy.

5. **Influence on conceptions from outside school** which subsumes the key aspects of:
   F. the influence of home environment.
   G. identification in the world outside school and home.

6. **The products of technology** which subsumes the key aspects of:
   H. products of technology: tools and machines.
   I. products of technology: applications for non-craftsman.
   J. products of technology: smart artifacts.

Other researchers might 'divide the cake' in a different manner for their work; for example, Raat and de Vries (1986) note five 'characteristics of technology' and later their instrument contained seven 'scales' (or areas of interest) which were adapted for the
PATT - USA instrument as six 'scales' (as reported by Bame and Dugger (1990)). No doubt a critical observer might identify other areas for inclusion that were not identified by this author. If a sustainable argument could be presented showing that other areas could be included in this study the comparison of conceptions reported here would still be valid. At worst the comparison would be based on an incomplete view; however, the areas that are compared are the same for each student.

3.1.2 Context for questioning about technology

Three contexts were identified in which questions about technology could be set. These were school, home and other. This inquiry is concerned chiefly with the school situation. It may be reasoned that should a student’s conception of technology contain aspects which cannot be attributed to part of the school’s stated or hidden curriculum then the influence must be external. Educationalists have often identified the home and family as a source of influence in child development. It may be reasoned that aspects of a student’s conception of technology may be based on experiences from their home. Some experiences of technology may be derived from outside the ‘school’ or ‘home’ contexts. The final context ‘other’ contains those aspects of experience which cannot be attributed to the ‘school’ or ‘home’ contexts; for example students may be influenced by peers, computers, broadcasting, publishing and other ‘information technologies’.

Questions investigating a student’s conception within each key aspect were set through these three contexts. Figure 3.2 provides an outline summary of the areas of interest and associated aspects; the authors initial thoughts about the structure of the questions; and the context in which questions could be set.
<table>
<thead>
<tr>
<th>Area of Interest</th>
<th>Key aspects &amp; additions</th>
<th>Question about:</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recognising technology activity</td>
<td>Technology as a learnt sequence or process Identification of: activities/processes; tools or products; proposals or making; technology as new idea; technology in other cultures or times.</td>
<td>School Home Other</td>
<td></td>
</tr>
<tr>
<td>2. Participating in technology activity</td>
<td>Technology as a learnt sequence or process Identification of technology as: following directions, having intention to act, knowledge of field of work, knowledge of how to act.</td>
<td>School Home Other</td>
<td></td>
</tr>
<tr>
<td>3. Which subjects teach technology?</td>
<td>The influence of the subject craft and design The influence of the subject Science which other subjects teach technology?</td>
<td>Identification of technology: in other lessons, in RE or History, characteristics which make this technology?</td>
<td>School</td>
</tr>
<tr>
<td>4. Living with technology</td>
<td>The influence of technological literacy technology determinism awareness of contacts with technology</td>
<td>Identification of: technology you come into contact with, frequency of contact, effects on ‘life style’.</td>
<td>Home Other</td>
</tr>
<tr>
<td>5. Influences from outside school</td>
<td>The influence of the home environment Identification in the world outside home and school</td>
<td>Identification of factors which have influenced ideas about technology outside school, naming of specifics.</td>
<td>Home Other</td>
</tr>
<tr>
<td>6. Products of technology</td>
<td>Products: tools and machines, applications for non - craftsman, smart artifacts.</td>
<td>Identification of: products to do with technology, characteristics which make them technology?</td>
<td>Home Other</td>
</tr>
</tbody>
</table>

Figure 3.2 The relationship of ‘Areas of Interest’ to aspects and contexts of questioning about technology
3.2 Methodological considerations

The methodology used for this study has been developed through a number of stages. The following subsections mirror the five stages of the research methodology.

3.2.1 Proposed methodology

A review was made of other studies which have been undertaken in this field; and consideration was also given to establish the most suitable format in which to collect data in order to support a comparative analysis. The following methodological stages were proposed:

- a questionnaire to be completed by all students participating in the investigation;
- processing of responses;
- interviews with a sample of students;
- document search to establish the school's vision;
- comparison of conceptions.

In preparation for the investigation of the conceptions of technology held by students in two institutions, a City Technology College and a Rural Comprehensive School, a number of trials were undertaken early in the summer term of 1996 which were followed by a full scale pilot study, conducted in July 1996, to assess the feasibility of conducting a comparative study across the student populations of two schools. The trials and pilot study investigation provided experiences which challenged and modified (but always strengthened) aspects of the methodology. Although considerable improvements were made to the operational details of the methodology the five stages and their sequence (which formed the initial proposal) were carried forward as the final methodology.
3.2.2 Development of the instrument

The preliminary study conducted in 1990 was based on data obtained from four ‘peer group’ interviews involving a total sample of twenty students. Given the need in this study to collect the conceptions of a large number of students the most effective method identified was the use of a questionnaire. This is a well-documented approach (eg Brown and Wake (1990)) and instruments have been developed for use in other studies relating to students experiences of technology in schools. Of the other studies in this field which have been reviewed many have used an instrument which contained closed questions. This format allowed responses to be gathered from a large sample group for a relatively small commitment of time for analysis. Two distinct approaches have been evident in the development process of the instrument used in this study. Stages in the development of the instrument are outlined in Table 3.1.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Location</th>
<th>Outcome / action taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trail of first draft instrument</td>
<td>AHI Sample A</td>
<td>Analysis of response patterns difficult. Concern about labels for response columns. Interpretation of conceptions difficult.</td>
</tr>
<tr>
<td>Redraft instrument</td>
<td></td>
<td>Questions and statement bank linked</td>
</tr>
<tr>
<td>Trail of section 1 of 2nd draft instrument</td>
<td>AHI Sample B &amp; C</td>
<td>Two positions and names of ‘U’ boxes used</td>
</tr>
<tr>
<td>Trail of complete 2nd draft instrument</td>
<td>AHI Sample D</td>
<td>‘U’ box printed offset position headed ‘don’t understand’</td>
</tr>
<tr>
<td>Trail of instrument and statement bank</td>
<td>AHI Staff sample</td>
<td>“Conception statements are ok but text a little ‘wooden’”</td>
</tr>
<tr>
<td>Instrument refined</td>
<td></td>
<td>Matrix and text refined.</td>
</tr>
<tr>
<td>Instrument in full trial</td>
<td>Pilot study</td>
<td>Data forms basis of pilot study</td>
</tr>
</tbody>
</table>

Table 3.1 Stages in the development of the research instrument
The intention was to construct questions to probe within each of the ‘areas of interest’. These questions would tend towards exploring the respondent’s conception of what technology was, rather than, as was the case with other instruments; what the respondent felt about technology developments, or their attitudes related to the notion of technology. Whilst the use of open-ended questions may have provided respondents with the opportunity to develop their arguments and explanations as to ‘what technology was’, the analysis of this type of open question requires some subjective interpretation by the researcher. The intention of gathering student conceptions in this study was to allow a comparison to be made between individuals and groups, clearly if the responses were open to subjective processing before any comparative analysis could be made then the later findings would have an inherent problem of reliability.

Open-ended questions have been used by a number of other researchers; Rennie (1987), Thompson and Householder (1995), Jones and Carr (1992), van den Burg (1986). In reporting these studies the authors provide comparisons between different groups of research subjects, or quantitative detail about the conceptions which they held. Thompson and Householder explain the analysis procedure applied to the collected responses:

Information collected was analysed for: (a) range of responses; and (b) frequency of responses; and (c) evidence of consensus within groups. (1995 p28)

The use of open questions with this programme of analysis was not suitable for this study. The analysis of responses is dependent on subjective interpretation by the researcher. Any subsequent comparison of conceptions held by individuals would be flawed since they would be placed on the theoretic frame by subjective analysis.
However, during the development of the instrument open-ended questions were considered and included in both the first and final sections of the instrument. The author has reported that whilst conducting interviews at Wayland High School students conceptions developed as they reflected on the points raised in the discussion. Glasersfeld (1989) supports this notion of reflection:

Knowledge cannot be reduced to a stock of retrievable ‘facts’ [...] To use Piaget's terms, it is operative rather than figurative. It is the product of reflection - and whereas reflection as such is not observable, its products may be inferred from observable responses. (1989 p12)

Freire (1989) argues that the use of ‘authentic dialogue’ is critical to the act of learning. The notion of ‘reconstructionism’ in technology education is explored by Hill (1997). These conditions exist in the interview situation in which a student’s understanding is challenged in the atmosphere of a group interview where other viewpoints are expressed.

The open question at the start of the instrument provided an opportunity to establish a base line against which to compare any change in a student’s conception which occurred whilst they were completing the instrument. That is, like the interview, would reflection on questions in the instrument also challenge students’ conceptions. Students were asked:

As you are going to look through statements to do with technology you and I will find it useful if you write down what you think technology is. Don’t spend more than 2 minutes doing this.

In addition to providing a method of verifying a portion of the findings from the instrument results, the response to this question also acted as a reference or focus for the student. In the second draft,
questions at the end of the instrument invited students to note any changes of view, and to list factors which they felt may have influenced their conception of technology.

Whilst considering the type of questions for inclusion in the instrument, it became more apparent that with the use of closed type questions students could be asked to agree or disagree with a given statement; for example: ‘humans have always been involved in technology activities’. Basing statements on the ‘areas of interest’ the responses would provide a more reliable and objective basis for comparisons between students. In order to obtain increased differentiation between students the use of a Likert scale was explored in the initial piloting. The students would indicate a level on the scale (ranging from strongly agree to strongly disagree) in response to the given statement. The statements would contain a positive or negative bias in an attempt to negate the tendency of some respondents to display an agree or disagree syndrome.

The first draft of the instrument contained ninety questions which were arranged into three sections, ‘technology at school’, ‘technology at home’ and ‘technology in other settings’ which reflected the contexts considered in constructing the theoretic framework for this investigation. As a result of this arrangement questions related to a particular ‘area of interest’ were spread through all sections of the instrument and the responses were difficult to collate.

Two versions of the first draft instrument were tested in this author’s home institution by two groups of Year 8 students. One group of 20 students was given a four point response scale: 1-‘strongly agree’, 2-‘agree’, 3-‘disagree’, 4-‘strongly disagree’, a fifth option was provided with this scale labelled ‘U’-‘don’t understand’. The second group of 23 students was given a five point scale: 1-‘strongly agree’,
2-'agree', 3-'undecided' 4-'disagree', 5-'strongly disagree'.

Students in the first group who completed the instrument with the four point scale and the 'don't understand' label, were less likely to use this option - 4% of all responses compared to the second group of students who used the mid-point 'undecided' option for 17% of all responses (Figure 3.3). Students stated that it was often easier to indicate 'undecided' than to make a decision if they found the question difficult. This tendency was also noted by Rennie (1987 p127) considering the PATT study Likert scale.

Although piloting revealed that a number of questions were poorly constructed there were some encouraging consistencies in the patterns of response between the two groups. Considering the frequency of responses to questions 6, 41 and 81 (Figure 3.3). The high 'don't understand' response rate to question 81 'Alternative technology is a simpler way of doing things' indicated that it was poorly constructed or outside the students' range of experience. Although the construction of the questions could be revised to make this draft of the instrument viable; considerable difficulties were experienced whilst undertaking the analysis of the results.

From the outset the intention was to design an instrument such that the responses provided by an individual could be displayed graphically. This would create a 'profile' of responses for the questions related to each 'area of interest' rather in the style of the 'skills attributes profile' used by McCarthy and Moss (1990 p214) showing 'pupil ratings of technology and science subjects' and 'arts subjects; and wood/metal craft subjects'. The responses provided by two students were used to construct a profile which is shown as Figure 3.4. The questions relate to the first 'key aspect' of the 10 considered during the planning of this instrument, namely 'Technology is a learnt sequence or process'.
Figure 3.3 Comparison of responses to instrument questions using four or five point Likert scales

Note. Column '3' has been printed out of position in the five point scale to provide a more direct comparison of the response patterns.
These profiles could be drawn to provide a comparison illustrating the differences or similarities between students.

Whilst it was possible to produce a profile which illustrated differences and similarities between individuals the data was not reliable. Studies which use an instrument with a Likert scale, such as the PATT instrument developed by Raat and de Vries or studies which require students to select the option which 'best' reflects their view after interpretation of the range of options, have a possible area of weakness. Individual students will place differing interpretations on the points of the scale or on response categories and their judgments will be subjective. Whilst subjectivity by the student may be viewed as 'part and parcel' of that individual's conception, should a number of responses be aggregated (in the sense of the Year cohort
response to a certain question for example) then the relative importance placed on interpretation of the scale by each student, or the accuracy of the classification undertaken by the researcher (in studies where an analysis is made of open questions) becomes an important consideration.

The profile of responses whilst providing a comparison between the conceptions of individuals, provided no articulation as to what a particular individual's conception actually was. In the view of the author this was a fundamental weakness of the instrument in this format; a sustainable argument might also be made in extending this criticism to any study using a scaled method of response which claimed to analyse views rather than reporting comparisons in response rates.

In the case of an individual student it may be possible to infer what their conception of technology might be by considering the responses that they have provided to the questions. This method has a drawback; in producing the conception some level of interpretation of the response is required. This is compounded as in some cases a number of responses (themselves at differing levels of agreement or disagreement) are to be considered in building up the conception around each 'area of interest'. This process of interpretation is inevitably subjective, and, although this does not in itself invalidate the process, there is little benefit to be gained from introducing subjective processes into the analysis of data.

The notion of producing a written comment about the respondent's conception (rather than a graphic profile) was considered. A written comment would allow that individuals conception to be easily articulated; thus providing more accessible results and transparency in the process of analysis.
Two other aspects were explored in the first draft. When making an analysis of the conceptions, consideration of responses was made within each of the 'areas of interest'. This arrangement was extended to the layout of the instrument. The sub-headings at the start of each section focus the respondents view of technology to that 'area of interest'. As an extension of this notion of focus, a photo stimulus was included for each section.

The intention was to place this focus into a contextual base. This line of development was explored following the authors experience of the use of 'situation drawings and photo' as a stimulus for students to identify problems as a basis for design work. These were the subject of a meeting in a North Yorkshire teachers support group for CDT in July 1989. The notion of a contextual base is also reported in the research pointing to the disadvantaging of certain students (particularly girls) when questions are set out of context. Considering assessment in science Murphy notes:

> Girls tend to value the circumstances that activities are presented in and consider that it gives meaning to the issues to be addressed. They do not therefore, abstract the issues but consider them in relation to the context which then becomes part of the whole problem. (1989 p329)

Murphy also notes that this is not confined to girls but tends to be the case for lower ability boys. Grant, in considering the introduction of values into design and technology project work, notes:

> Technology's association with objects, things, techniques, scientific concepts, inventions and 'technical fixes' becomes its overriding image; and technology's relevance to people, quality of life, social problems and values become submerged and invisible. As long as the subject so continues to be associated with the impersonal and objective it may remain as an anathema to girls. (1986 p346)
Whilst the provision of sub-headings was developed further in the second draft of the instrument the use of ‘photo sheets’ was not.

These were discarded for two reasons; firstly, students in the trial groups were questioned about the experience of undertaking the questionnaire once it had been completed and collected in. They felt that the headings had provided some degree of focus and that more should be included but that the ‘photo sheets’ were of questionable use. Some students had not referred to them at all. Suitable pictures were difficult to obtain and to some extent the content of the activity or object may have provided too much of a focus to the extent that suggestions of expected responses might have been presented to students.

The first draft of the instrument had been constructed so that pairs of questions presented a positive and negative bias towards the aspect under investigation. The intention of this had been to eliminate the tendency of a respondent to agree with statements. This method effectively doubled the length of the instrument and in some cases the drafting of questions was particularly difficult where they had to provide the two different bias points for each aspect. The bagginess of the instrument was reduced by presenting one statement rather than the two, whilst retaining a mix of the negative and positive biased statements.

The method of obtaining the ‘statement of conception’ was derived after consideration of the systems used in schools to produce the National Record of Achievement which is ‘statement banked’; also the process used by the careers package ‘Jiig Cal’ in which responses to an attitudes instrument are used to produce a printout of a student’s ‘top ten’ matches to possible occupations. The intention of the second draft was to produce a ‘matched’ instrument and statement
bank. As with the 'Jiig Cal' process, the production of the 'statement of conception' from the responses to the instrument was to be via a precise transcription procedure. The only subjectivity in interpretation of responses lies in the construction of the statement bank and transcription matrix. This opportunity for bias would be less significant for comparative purposes because all responses would be processed in the same way and thus uniformly affected; however, the error could be reduced to a very small margin by: trialling the process to refine questions, comments and processing of responses, and, in the actual study, by asking respondents to check their 'conception statement' to verify its accuracy.

In constructing the statement bank a range of views were provided within each area of interest. As previously noted the number of specific areas of interest was reduced from ten to six. Difficulty was experienced working with ten areas. Some of the areas were closely linked. For example, the first two: 'Technology is a learnt sequence or process' and 'Technology as problem solving or invention', became a new area: 'Participating in technology activity'. The two old areas can be thought of as two sides of the same coin 'participating in technology activity'. In trying to draft questions to challenge one area the tendency was to mention the other. Once the statement bank comments had been produced questions were sorted which related to the subject of the comments. They were linked by a matrix which could be thought of as a 'truth table'; if the response to this question is this - then the conceptual view must be that. At this stage of development the use of the Likert scale complicated matters, the response options to statements on the instrument was limited to 'agree' or 'disagree'. This response pattern tends to work towards the strengths of the instrument as a research 'tool', in that it provides descriptive information.
A third response option was also provided, ‘U’. Rather than permit a respondent to guess ‘agree’ or ‘disagree’ if they did not understand a question the third ‘U’ option was required. This would allow conceptions to be collected which were the product of reasoned thought rather than guesswork. The transcription process could be developed to accommodate ‘U’ responses. For example if a ‘U’ response was made to a question the transcription matrix would generate the coding for a blank section in the ‘conception statement’ or a comment that the student was unclear about a particular area. The strength of this method was that if a section was noted as unclear or not mentioned in the ‘conception statement’ printout for that student, the other information which it contained was still valid and reliable.

A second set of trials were undertaken to establish the title and position of the third option column. In two versions of the instrument the option was titled undecided. When placed as the midpoint between ‘agree’ and ‘disagree’ this option had a response rate of 25%. Placed after the other options as ‘agree’, ‘disagree’, ‘undecided’; the response rate reduced to 14%. In the same position titled ‘don’t know’ the response rate was further reduced to 12%. However, as was found in the first draft, if placed as the last option and titled ‘don’t understand’ the response rate fell to 6%. When questioned after the trial, students stated that it was often easier to indicate ‘undecided’ than to make a decision if they found the question difficult.

The transcription process which was developed for this study generated conception statements from responses to the questions in the instrument using three types of matrix: reflective, compound and speculative. The reflective matrix links the responses to a question directly with the statement (eg statement section ‘N’ - Figure A1.19).
The compound matrix uses the responses to a number of questions to generate a statement. The use of a number of responses allows some differentiation between respondents regarding their view of a particular aspect and can also be constructed to eliminate any agree/disagree syndrome in the responses made by a respondent, for example for statement section ‘X’ (Figure A1.5).

The speculative matrix refers to the nature of the statements which are generated rather than the construction of the matrix itself. The statements extend the notion of the respondent confirming the final printout produced by the transcription process by including sections which speculate or predict the stance that a respondent may adopt to an as yet unconsidered scenario. An example of this is given as statement section ‘D’ (Figure A1.9). A respondent who agreed with the speculative statement would indicate that their position was recorded adequately enough for the researcher to empathise with their views. The use of this type of matrix in this inquiry is limited since the intention of the printout is to confirm that a conception is adequately recorded rather than to generate areas for further investigation.

3.2.3 Analysis of responses

Analysis of completed instruments could be undertaken to provide the following data:

- frequency of response to individual questions;
- frequency of use of individual statements;
- frequency of identical responses or conceptions between individuals or groups of respondents.

The ‘raw data’ (in Figure 3.5) was used to generate plots of the frequency of agree and disagree responses for each question.
Figure 3.5 Relationship of stages in the processing of instrument data
The responses provided to questions in the instrument are used to generate a 'conception statement' which has twenty nine sections. Between one and four questions are used to generate each statement section via a transcription matrix. Each statement section has a number of different options dependent on the combination of responses provided to questions in the instrument.

A different length bar is printed for each option code letter. The pattern of bars provides a visual comparison between the conception coding for two or more students.

This is a development from the initial profiles (Figure 3.4) which plotted the extent to which students agreed or disagreed with the questions in the instrument.

Figure 3.6 Conception Profile: Laura, Rural Comprehensive School
This information was plotted by form and year groups both as a full sample and by gender groupings. A review of these plots provided a stimulus for further investigation in later stages of the inquiry whilst interviewing students. The response pattern of each individual was applied to the matrix and a coding obtained for their 'conception statement'. The coding contained 29 statement sections in the 'statement bank', each statement having between 2 and 6 options. This provided a range of more than 2.3 million possible conception combinations.

This coding was the starting point for three further stages in the methodology. Firstly the frequency of use of each statement could be determined and plotted in the same way as the response rate to instrument questions. The question frequency and statement frequency were linked - by virtue of the matrix and consequently, the plots were of limited value. Secondly the coding provided the instructions for which statement options had to be printed from the statement bank to produce the written 'conception statement'; or to produce the visual 'conception profile' (Figure 3.6). Finally the codings could be reviewed to find the frequency (and range) of identical codes. The term 'range' refers to the number of different conceptions which are held.

3.2.4 Interviews with students

The intention of the interview was to establish the reliability of the questionnaire data and the process of generating 'statements of conception' in two ways; by interviewing a sample of students and reviewing their interview comments against their 'conception statement'. These students would also be given a copy of their 'conception statement' printout (processed from the conception
review tapes is noted by Davies who reasons:

They [the students] were interested in the process of recording their conversations, and of replaying these conversations so that they could, amongst other things, draw my attention to those aspects of the conversation which they felt were noteworthy; so they could in other words teach me to see from their point of view. (1980 p261)

The replaying of sections of tapes 'that seem to raise problems' is also suggested by Adelman and Walker (1975) as a good starting point for subsequent interviews with students. Experience gained from the preliminary study confirmed that the process did provide an opportunity to undertake a rapid review of student comments and to ask supplementary questions to clarify points of uncertainty.

The proposed interview procedure was semi-structured in nature. This format had also been used in the preliminary study. Although the procedure was not scripted, and no notes were used by the author to prompt or record the proceedings the pattern and areas of questioning had been considered in advance and each section of the interview had been initiated by presenting the students with a scenario which had been developed in advance of the interviews and memorised by the author. The interview proceeded through six phases:

The opening phase contained closed questions or questions directly related to the experience of the students in completing the questionnaire.

*You did a questionnaire for me a week last Friday. Did you find it easy or difficult? Did actually filling in the questionnaire change your idea of what technology was?*

Students were asked to confirm their initial ideas of what they thought technology to be before they started the questionnaire. This
led into the second phase which explored the content of lessons which the school called technology, and identified other lessons which the students saw as being to do with technology. The questions in this section were more open in nature and time was taken to rephrase questions to check responses or to follow lines of argument put forward by the students then to return to the interview plan.

During the next two phases the students were given a scenario and its links with aspects identified as technology were explored. During the investigation of each scenario the questions were expanded and rephrased to establish the limit conditions within which that student’s conception operated.

The third phase explored, through the use of a lawn-mower, the following notions:

- the notion of intent in identifying technology activity;
- the extent of forward planning required for actions to be technology;
- the notion of using a ‘product of technology’ as ‘doing technology’ compared with ‘making or adjusting that product’ as ‘doing technology’.

For example:

*I want you to imagine now, can you imagine one of those old fashioned lawn mowers, the sort that doesn’t have a motor Your granny might have one. Its like a T-bar with a set of blades on the bottom that you push over the grass.*

*If I cut the lawn with one of those am I doing technology?*

*So if I’m actually using it, I’m pushing it - cutting the grass am I doing technology there or am I using somebody else’s product?*

*If I’d been forced to go out and cut the grass, even though I didn’t want to.*

*So just because somebody thinks its technology I’m doing technology am I?*

*So it doesn’t make any difference. If I had wanted to go and cut the grass I’d be doing technology but even if I didn’t want to, if I was sent to cut the grass I would still be doing it.*

*What about. I decide the amount of grass I’m taking off isn’t enough, and I look at*
it and I'm not quite certain how to alter the lawn mower but I fiddle around 'till eventually I can cut a bit more grass off.

Right. So if I said to you I'm definitely going to go and cut the lawn, I want to take this much off, so I adjust, I study the lawn mower and work out how and I adjust it down to the cut I want and I go out and push it have I done technology then?

Yes and its the...is it more to do with the fact that I've worked out how I want the cutters or is it to do with the fact I've decided I want to go out and do it?

The same conceptual aspects were explored in the next phase of the interview which asked students to consider the development, design or invention of a new drug. The same pattern of questioning was used to explore the limits of student agreement.

The fifth phase of the interview was intended to establish the experiences from home which had formed their view of technology and the extent to which the influence of technology was evident in other school subjects.

The final phase of the interview was again scenario based and used the example of the way in which otters crack open shell fish with small stones. The intention of this series of questions was to establish the factors which make an activity technology. Discovering or inventing an activity, learning or copying and, in the case of the scenario, if this is an instinctive reaction is it the doing of the activity which makes it to do with technology?

In the pilot study Year 9 students were given an additional scenario to explore the relationship between knowledge of how to proceed to solve a problem and the field of knowledge in which the problem is based. This scenario also explored the type of knowledge fields which the students saw as being linked to technology:

*I'll give you two problems. One is to find a way of opening a garage door without getting out of the car, and the other problem is that a local Scout group meet in a hall that's really shabby. Now you'll recognise those as two problems.*

*I might solve the first problem by designing some electronics, so I can sit in the car,*
press a button and the garage door opens. Technology?

I might solve the other problem by sitting down and going through the phone book and finding numbers for other people who have rooms I could hire.

But I'm still solving a problem, I've still solved a problem in both cases haven't I, and I've still gone through the same stages. I've done my research, I've decided what I'm going to do. I propose to design and make an electronic system. I propose to go through the phone book and find telephone numbers.

So in that case it wasn't the stages which made one technology and one not, it was the actual content of the activity.

So you are governed a little bit by the activity and a little bit by the way we go through stages.

Before the recorded interview proceedings were closed the students were asked if there was any area they thought they should have been asked about or comments they would like to make.

Analysis of the interview transcripts would not attempt to gather like phrases or take account of their frequency. Selmes (1969) in his analysis of 12 and 13 year old pupils attitudes to science and scientists notes caution in reviewing transcripts in that manner:

The main aim is to look for recurring phrases and expressions particularly descriptive ones, and to count the frequency of these responses. In long recordings difficulties are soon apparent: repetition of ideas and phrases takes place, particularly in small groups, when an individual is determined to emphasise a point or opinion previously made; ........

Another problem arises as soon as one attempts to indicate in a meaningful way the frequency of any one response; the significance to be attached to any particular number or frequency. (1969 p8)

Transcripts would be reviewed to obtain comments which could provide a correlation (or not) between the position of an individual as stated in the interview situation, as described by the printed conception statement and as confirmed by them as being correctly recorded in their conception statement.
3.2.5 Document search

In attempting to undertake a comparison of conceptions held by various groups, this study assumes that it is feasible for the institution of ‘the school’ to hold a conception of technology to which staff and students aspire. Although in opposition to this notion Hoyle (1989) might extend his argument regarding institutional goals to include the notion of concepts. He notes that:

The point would be that only individuals can have goals. The phenomenologist would concede that groups of individuals have common interests, and in confronting common problems can, through their interaction, come to recognise these mutual concerns and construct a set of shared goals [..........................] but the point would be that these would be the constructed goals of a group of people and not goals which could be objectively ascribed to the organisation as an abstract entity. (1989 p128)

Although it may be argued that the institutional conception is in reality the aggregation of those conceptions held by individuals; staff, governors (and in some instances students) the school as an institution with changing populations of staff and students should be considered in terms of its published statements of how technology is viewed and described. In the context of this study the documents reviewed set or support the curricular requirements which school staff are working to fulfil. It can be argued that as new staff join the school these documents provide an indication of the direction or expectation of the school. Whilst new staff might successfully challenge the published documents and a process of review and revision may follow, the use of school documents is valid in that it provides a ‘snap shot’ of the institutional position at time which this investigation took place. In considering the examination of documents Clift et al note that:
Documents can be a key source for identifying an institution’s values or an innovations’ intentions. (1988 p55)

However, this examination of documents has an intrinsic difficulty in that the documents were produced for purposes other than this study. The institutional conception is unlikely to be provided in any single document in a reasoned form but can be framed from information obtained from a number of school documents.

The development of a secure methodology for capturing and comparing students conceptions formed one of the chief questions. Since an evaluation of the effectiveness of this methodology forms one of the findings from this research project aspects of reliability and validity are reported with other major findings in Chapter 7 (section 7.1.3).

3.3 Pilot study investigation

The remainder of this section reports the organisation and key findings of a pilot study which was conducted to evaluate the proposed case study methodology.

3.3.1 Context of pilot study

The intention of the pilot study was to establish whether any difficulties existed concerning the administration of the questionnaire or the subsequent processing of the data gathered. It was necessary to evaluate which of the outcomes generated by the methodology would be useful in investigating the conceptions of technology which the students held and to establish if the methodology could be applied to
a school about which the author had little or no prior knowledge.

Using data obtained during the development and trialling of the questionnaire it had been established that the views held by individuals could be captured and articulated sufficiently well to allow comparisons to be made between individuals and groups. The pilot study would provide an indication as to the viability of a larger comparative study of two institutions. A review of the outcomes of the methodology would also inform decisions regarding the viability of exploring what role (if any) the influence of particular curriculum experiences, or particular members of staff had in the development of a student's conception; also the extent to which the corporate vision of the school was reflected in the conceptions held by its students.

3.3.2 Description of the school

The pilot study school was an LEA maintained mixed comprehensive school having approximately 400 students on roll aged 11 to 16 years. Its catchment is predominantly rural with the majority of students travelling into the school by bus. The school is located in a large village. Despite its rural location many students come from 'professional families', the surrounding villages providing dormitory housing for two market towns (about 10 miles away), the county town (about 25 miles away) and another large town with considerable industrial and port sectors (also about 25 miles away).

3.3.3 Student sample and administration of the methodology

The administration of the instrument was organised by school staff,
students completed the instrument during a timetabled tutorial lesson on 12 July 96. The sample was an opportunity sample containing all those students who attended the tutorial lesson which the school had scheduled for completion of the questionnaire by that form group.

The sample of students who completed the questionnaire is summarised in Table 3.2

<table>
<thead>
<tr>
<th>Year</th>
<th>Male</th>
<th>Female</th>
<th>Year Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>34</td>
<td>24</td>
<td>58</td>
</tr>
<tr>
<td>8</td>
<td>35</td>
<td>36</td>
<td>71</td>
</tr>
<tr>
<td>9</td>
<td>24</td>
<td>28</td>
<td>52</td>
</tr>
</tbody>
</table>

Table 3.2 The breakdown of the student sample for the Pilot Study (sample total 181)

The author provided the school with instruction sheets for the department staff who administered the instrument so that, in the same manner as schools obtain a consistent application of conduct for examinations, all students in the sample were given the same instructions for the completion of the questionnaire.

Interviews with panels of students were conducted on 23 July 96. The interview panels were formed (as outlined in Section 3.2.4) from a 'long list' of students which was sent to the school a few days in advance of the interview date.
3.3.4 Analysis of responses to instrument questions

The responses provided by students to the questions in the instrument were processed, and the 'statement bank' codes for their conceptions of technology were recorded. All students in Years 7, 8 and 9 were allocated a personal number; the statement bank codes were recorded against each student number so that the listing for any student could be identified and a description of their conception of technology generated in a text or graphic format.

A detailed question by question analysis of the instrument was undertaken. The frequency with which each response option was used was plotted. The number of responses in each category: agree, disagree and don't understand were plotted. Two pages of plots were produced for each question firstly by form (10 forms in all) as the total number of students and again a plot for each form, but showing the number of responses in each response category by gender (Figures 3.7 and 3.8). The cumulative total for each year group was calculated. This data was also plotted as the total response by year. Again this total figure was broken down and plotted by gender. The year totals were calculated as a percentage to allow comparisons to be made between groups of students. These frequency plots identified interesting trends or particular groups (year, form or gender) which were at odds with the sample as a whole. They also identified questions which had a high 'U' - don't understand response rate, which would require further editing or replacing.

Once the questionnaire responses had been processed through the transcription matrix to produce the listing of statement bank codes a second series of plots were produced. For each of the sections in the statement bank (29 in all) the frequency of use of each comment option was plotted (Figure 3.9).
### Responses by Form

<table>
<thead>
<tr>
<th>Form</th>
<th>A</th>
<th>D</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>7B</td>
<td>2</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>8B</td>
<td>6</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>9B</td>
<td>1</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>7S</td>
<td>2</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>8C</td>
<td>5</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>9C</td>
<td>4</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>7W</td>
<td>1</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>8S</td>
<td>3</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>8W</td>
<td>2</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

### Responses by Year Group as %

<table>
<thead>
<tr>
<th>Year Group</th>
<th>A</th>
<th>D</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>9</td>
<td>84</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>23</td>
<td>73</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>14</td>
<td>82</td>
<td>4</td>
</tr>
</tbody>
</table>

**Figure 3.7 Frequency of A, D, U responses to question 47**
Figure 3.8 Frequency of A,D,U responses (by gender) to question 47
Figure 3.9 Statement section ‘BA’. Frequency that statement options were generated
This was done in the same manner as the responses to the questionnaire, by form and year group.

When drawn the plots were filed firstly into the six areas of interest. Within each of the six areas of interest the plots were ordered by statement section together with the plots of all the questions which were used to generate that statement section via the transcription matrix. Thus each area of interest could be reviewed by reference to the associated statement sections, in turn supported by the question responses which generated it. Consideration of each area of interest was also supported by reference to the comments made by students during interview.

The situation in the school 'on the day' was such that two interviews were conducted, a Year 7 and 8 combined panel and a Year 9 panel. Students for the interview panels were selected by the school; having been provided with a long list of names of 9 or 10 possible candidates from which to form the panels. The school selected students for the interview panel by availability - students in school (and the co-operation of other teaching staff to release students from lessons). The only restriction placed on the school for the construction of the panels was that there should be an equal number of boys and girls on each panel. The Year 7 and 8 panel contained six students - three from each Year group. The Year 9 panel contained 4 students.

The time scale of the pilot study provided little opportunity for detailed analysis of student conceptions between the completion of the instrument by students and conducting group interviews. The long list of students names supplied to the school, from which the interview panels were drawn had to be compiled without the opportunity to undertake a detailed analysis of the questionnaire
responses. Students were included on the long list on the basis of providing comments in the first and final 'open' sections of the questionnaire and a low count of responses in the 'U' - don't understand column. It was considered that these students were most likely to be willing to communicate their views during an interview.

Students on the interview long list held a number of different conceptions of technology, and this range was evident in the makeup of the final panels. However, the conceptions held by the students did not form any aspect of the selection criteria onto the long list. The primary intention of the interviews was to check the reliability of the questionnaire and 'conception statement' process; this was assumed to be possible whatever the conceptual make up of final interview panels.

Before the recorded interview proceedings were closed the students were asked if there was any area they thought they should have been asked about or comments they would like to make. They were then invited to comment on the conception statement which had been prepared for them.

One of the intentions in undertaking the pilot study was to establish the viability of investigating the influence on students of curricular experience or the views of staff. To this end the pilot study also involved the capture of the conceptions of technology held by staff. In this case rather than insist all teachers were involved in the inquiry, participation was limited to the teachers in the Design and Technology department, which had agreed to support the study. At the end of the initial meeting in school, and having agreed to take part in the investigation, the two members of staff were asked to provide a short statement of what they thought technology to be before they had the opportunity for reflection. This methodology has
been used by a number of other researchers to capture conceptions from both staff and students. Rennie notes that:

The teachers were given no more than five minutes to write down their personal definition of technology. Five minutes does not give teachers time to write out a long reasoned argument, but is time enough to elicit those issues which teachers believe are central to the nature of technology. (1987 p124)

This method of data collection was used by Thomson and Householder (1995) to record information from staff and students. The rationale behind data collection at the preliminary stage of the study was to obtain a 'bench-mark' in case the conceptions of staff developed during the course of the investigation and against which any change in conception could be compared. During the investigation into students conceptions at Wayland High School (Hine 1990) it was noted that student conceptions developed as they reflected on the concept of technology. In reality the concepts which staff held of technology were consistent throughout the stages of this investigation. Any developments of thinking were in the way their conception was justified rather than in the conception as such.

The department staff completed the same questionnaire as the students at the same time. As was the case for the students they did not see the questionnaire paper until they were invited to complete it. Their responses to the questionnaire were processed and presented in the same way as that used for student responses. Interviews were held with staff on a one to one basis. The interview procedure was not recorded but; with the agreement of the member of staff, notes were made of the responses given to questions. The pattern of questioning followed the same structure as that used during the student interviews.
3.3.5 Major pilot study findings

The analysis of the pilot study investigation was undertaken with two distinct purposes in mind. Firstly to establish the viability of the operational aspects - the administration and processing of the research methodology; and secondly to establish if the results produced represented a viable basis for a further comparative study. In operational terms the proposed methodology was sufficiently developed such that:

- bar charts could be plotted by interest group (form, year or gender) to display the frequency of responses (A,D and U) to each question;

- responses to questions in the instrument could be processed via the matrix to produce a coding which in turn could be used to generate a printed ‘conception statement’, or a graphic profile;

- bar charts could be plotted to show the frequency that each statements was generated from the statement bank;

- the recording and transcribing of data associated with the instrument was manageable;

- comments obtained during the student interviews and regarding their ‘conception statements’ supported the data gathered by the instrument.

The value of plotting the frequency charts was questionable. Whilst it was possible to draw plots which provided a powerful method of identifying shifts in student responses, the plotting process involved a considerable amount of the author’s time (in the region of 47 hours). The data was in fact already available, albeit in a less obvious form, as tables of response from which the graphs had been plotted. The same shifts could be identified by careful consideration of these tables. The frequency plots showing the use of the statements were of no value in the analysis process since they were linked (via the
matrix) to the response options which had already been plotted.

The methodology did capture and record a range of different conceptions of technology. The comparison of the conceptions held by two individuals could be compared easily either by plotting their graphic profiles or by reading down the statement bank 'option codings'. However students conception codings were listed in columns - twenty per page. It was not possible to work across the page of listings to compare twenty conceptions simultaneously in order to find identical or close conceptions, let alone to carry this comparison across the ten pages of listings to consider the sample as a whole. In any subsequent studies 'data processing' would have to be undertaken on a computer database. The data from the pilot study was subsequently processed in this way to enable a search for identical conceptions to be undertaken. No students in the pilot study school held identical conceptions.

3.3.6 Corporate vision and students' conceptions

No concise account of 'what technology is' was available from the school's documentation. The Design and Technology department handbook contains references to the orders for Technology in the National Curriculum (NC). Some of the teaching materials used in the lower school (Years 7 to 9) are published schemes which are written to cover NC requirements. It may be argued then, that technology in Key Stage 3 is seen in terms of the description provided in the then current non-statutory guidance provide by the National Curriculum Council:

Technology is a new subject, which requires pupils to apply knowledge and skills to solve practical problems.

(1990 p4)
The department report card for students in Key Stage 4 contains a short descriptor of the course:

**Technology:** the course enables students to develop their application of knowledge, skills and understanding of technology through the specific focus within an overall ‘design and make’ approach. All students complete a course in construction and an option of their choice.

All Key Stage 4 courses deliver the syllabus requirements for MEG Design and Technology. The documented vision of technology which the school has adopted is that which is framed by the requirements for Technology in the National Curriculum since the published materials, other lower school schemes and the Examination Board syllabus all fulfil its requirements.

The document search revealed an unclear position regarding the title of the subject. The prospectus which is issued to new students and the upper school ‘course booklet’ which is available to Year 9 students use both the titles ‘Technology’ and ‘Design Technology’ in relation to the same subject. The two titles are interchangeable within these publications and suggests that no differentiation is made between aspects of design or aspects of technology activity.

The student conceptions of technology which were evident within the pilot study school are presented here by ‘area of interest’:

**Recognising technology activity**

Three issues were explored within this area: when am I involved in
technology activity?, what is a technology outcome?, technology in different times and cultures.

The majority of students were unclear whether they could be involved in technology activity by accident or if involvement in technology activity required some intention to carry out that particular course of activity (79% in Year 7 falling to 54% in Year 9). Of those students who held a clear conception of this issue the majority thought that technology activity required some intention to act.

Less students were unclear when considering the issue of what is a technology outcome? From the responses to the instrument questions the most frequently generated statement (at a rate of 46% Year 7, 56% Year 8, 63% Year 9) was Be:

Be You feel you have been involved in a technology activity even if the outcome was only to produce proposals which others could manufacture or propose changes to systems which others will effect.

For these students technology is not linked exclusively with the manufacturing of an outcome. This conception may be linked to the notion of teamwork (Naughton 1986 p8) or be a reflection of the curricular activities for delivery of NC technology.

The final issue in this area concerned recognising technology in different ‘times and cultures’. Of these two factors time appeared to present most problems with 34% of Year 7 students (compared with 15% in Year 9) indicating that technology has developed within the last 100 years. Of the sample of 181 students; 15 felt that other cultures did not have technology, only three students saw technology as being limited to factories which use robot machines.
Participating in technology activity

This area was explored by considering four issues. The first concerned working in stages to participate in technology. Students overwhelmingly thought that technology has a number of stages. Only 8 of the 181 did not agree with this assertion and 4 of those marked the ‘U’ response box. Agreement with this assertion reflects the way in which students are encouraged to manage their own technology work in schools. Exploring the issue of ‘starting technology activity’ students were asked questions related to the desirability of knowing a process for undertaking technology before starting an activity. The majority of students were in agreement with this assertion increasing from 59% in Year 7, 72% in Year 8 to 73% for students in Year 9.

In considering the issue ‘is technology like problem solving?’ only one of three questions on the instrument generated a significant distribution towards one of the response options. This mode of response was a little surprising since the notion of ‘problem solving’ formed part of the conceptions given by staff at the first meeting.

The final issue in this area concerned ‘finding and knowing information’. The most frequently generated option was Fc:

Fc In addition to being able to find information. You feel that you need to have some knowledge of the field in which the activity takes place so you can understand and use the information which you find.

This approach reflects the pattern of teaching within the school’s subject Technology. Students are introduced to a new area of work. They learn some information about that field which is then supported
and extended with project, practical work. This conception parallels the pattern of technology teaching and learning in the school.

**Which subjects teach technology?**

Of the total sample 13% of students thought that technology was taught exclusively by the subject technology. Students in Years 7 and 8 (9% and 7%) were more likely to hold this view than students in Year 9 (2%). During the interview process students explained that each summer term all students are set science project work. This involves problem-solving, research, design of experiments and practical work, and evaluation. This aspect of science teaching in the school appears to be encouraging the notion of science teaching technology. The response rate in agreement to Q25 'Science subjects can teach how to do technology': is 78% in Year 7 (who were undertaking the projects for the first time when the instrument was presented), 94% in Year 8 (doing the project activity for the second time) and 90% for Year 9. There was an even stronger agreement that science and technology project work has a commonality of stages.

During interviews with students technology work was linked to art. This like technology, involved designing and making activities.

**Living with technology**

Student responses supported the assertion that they were often in contact with the results of technology. Contact with technology was not seen as being limited to those individuals concerned with the manufacture of products. Students identified that technology
products influenced their actions. The premise that 'technology is changing people's jobs' drew a high level of agreement from students in Years 8 and 9 (92% and 94%). Interestingly a gender difference was noted in the responses from Year 7 students. Approximately twice the rate of girls in comparison with boys disagreed with the premise - 41% of girls and 21% of boys. Although a gender difference was apparent in the response to this question it is striking that in other questions no gender difference was apparent. When considering the intrinsic good/bad value of technology development, students viewed the development or product as having an intrinsically neutral value. Any value judgment associated with a product was a result of its use.

Influence on conceptions of technology from outside school

The construction of the matrix for this section of the instrument analysis does not deliver secure processing of the responses. In essence the matrix tends to cut out the responses of students who claim to have been influenced by factors outside school, (for example television programmes) but who did not disagree with the previous question:

38 My ideas about technology have not been influenced by my experiences at home.

Given that the matrix required revision for this cluster of questions the support for the following influences could be higher than stated. Between 75% and 80% of students in each year group felt that watching television had influenced their ideas, 70% to 80% of each year group by using home computers and about 80% by using home workshop equipment (no gender difference noted) and between 83% and 92% by conversations about technology. Although the students
who formed the interview groups did not support the notion of discussing technology to the same extent.

Products of technology

The notion that technology had results other than products was widely supported by students of all year groups (88% of Year 7, 77% of Year 8, and 85% of Year 9). The year group least happy with limiting their conception of technology products to electrical equipment was Year 7. In considering all other issues this had been the year group who most readily adopted a narrow focus of technology, this conception was unexpected. A majority of students in each year group felt that all manufactured products were products of technology. This was also the case for Years 8 and 9 considering 'new medicines and drugs are products of technology' but Year 7 opinion was split - 48% agree and 47% disagree.

The notion that 'new strains of plants are examples of technology' was not as readily accepted as the other two propositions, although the rate of those agreeing was higher than those disagreeing. Year 7, 55% agree, 40% disagree. Year 8, 48% agree, 41% disagree and Year 9, 52% agree, 33% disagree. Students were more likely to identify manufactured products as being technology even though new strains of plants are a result of human activity.

Staff conceptions

The most striking aspect of the staff conceptions is their similarity to each other. The comment listing generated from the instrument responses shows a difference in only three statement sections. The probability of obtaining this match (in pure number terms) is 1:9.33
x $10^6$. This tends to suggest that as joint Heads of Department they have discussed issues relating to the nature of technology and that students can expect to receive a conception which is consistent across the department.

Although in this pilot study it was not possible to match the conceptions held by staff to those held by students - just as it was not possible to match students to other students, a comparison can be made of staff conceptions against the conception of the 'modal student' (Figure 3.10).

In the area of interest - 'recognising technology activity'; the majority of students were 'unclear' about their conceptual position, as might be expected the staff were not, although this was one of only three areas where they held differing views. Considering 'participating in technology activity'; the staff conceptions were identical but differed from the modal student. In the second area of interest the difference between modal student and staff concerned the knowledge base for technology. Whilst the student conception indicated the desirability to know how to manage the process the responses of staff to questions in the instrument generated a blank comment. Exploring this in interview it does not suggest an unclear conception. Rather a flexibility of approach which would allow them to start an activity in a variety of ways but still exercise control over its direction.

In area of interest three, 'which subjects teach technology?' - the conceptions of the modal student and one member of staff are identical. The second member of staff matches in four of the five
Figure 3.10 Pilot Study conception profiles:
Staff and 'Modal Student'
sections in this area. The mismatch concerns 'science subjects can teach how to do technology'. The second member of staff thinks that it does not, although it is possible that like the author this member was unaware of the project work which students undertake during the summer term. Considering 'living with technology' both staff conceptions were the same and differed from the modal student in one section. Staff did not believe that you needed to understand why a technology product worked before you could use it, the modal student did. Both staff and the modal student held the same conception regarding 'conceptions of technology from outside school'. Considering 'the products of technology', both staff and the modal student match in the first two of three sections. One member of staff can extend 'products of technology' to include 'new strains of plants', the other cannot. 30% of students also included new strains of plants but the modal conception (42%) was undecided.

Staff conceptions and the modal student conception show a correlation in 22 of the 29 sections. The differences are apparent in sections concerned with identification and management of knowledge and technology activity, staff have more experience in these fields.

The conceptions held by staff and modal student in part reflect the corporate vision of the school. In consideration of the second area of interest 'participating in technology activity' students and staff identified stages of technology activity. This notion of stages is evident in the NC documentation (adopted as the school's corporate vision) particularly in the first two attainment targets: 'Identifying needs and opportunities' and 'Generating a design'. Whilst the delivery of the schemes of work may identify matches in other areas of interest this was not evident from the documentation.
The document search identified the use of two titles 'Technology' and 'Design Technology' to describe the same subject. The notion of this twin title was supported by Year 7 and 8 students during the interview:

Robert      Sometimes we call it Technology.

Stacey      Sometimes we call it Design Technology.

_Yea are those names. Are they two different names for the same thing?_

Group       Yes.

_So we're not talking about two different subjects are we?_

Group       No.

_So those two names mean the same thing._

Group       Yea.

3.3.7 Implications for the main case study and revision of methodology

Some questions required reworking to reduce the tendency for students to respond using the 'U' - don't understand option. Some criticism had been made by students of the conception statements which had been presented to them. This criticism was not in terms of the capture of their conception but in the language used to articulate it. Three factors were noted concerning language.

- In some statements the way in which options had been combined from successive sections left the language flow a little 'wooden'.

- Some terms were felt by some students to be critical of their position.

- In spite of the 'wooden' feel for some students the language structure was too formal.
The wooden feel is perhaps an inevitable criticism of this method of generating statements. The statement bank contained 29 sections with between two and five possible options in each. Given the total range of over 2.3 million combinations it was not possible to check all combinations of statements, the most feasible course of action was to read back through the statements which the students had examined and adjust the wording to improve the flow between sections.

In the phrasing of statement options the terms 'unclear', 'undecided' and 'uncertain' had been used. These were felt by some students to be critical of their position. The tradition of statement bank reporting in schools has generally been to comment on positive aspects of student performance. The instruction to schools constructing their statement bank for the NROA (National Record of Achievement) document carried forward by Year 11 leavers, has been to produce a statement bank which is non-negative. It was against this type of document that the students judged their 'conception statement'.Whilst the statement bank could have been reworked to contain only comments which the students judged to be positive this would have reduced the clarity of the articulation. An observer would be required to 'read between the lines' to interpret the intended meaning. This concern of students was overcome by explaining that being 'unclear' was an entirely honourable and honest position. Also reading through the statement with students allowed them to question any language construction which they found difficult.

The inclusion of the conceptions held by staff in the pilot study school was interesting. However considering the proposed case study investigation of a City Technology College and a Rural Comprehensive School the methodology was modified. The proposal was to undertake a comparison between the corporate vision (based
on institutional documents) and student conceptions; and a comparison of the conceptions held by the student populations of the two schools. Teacher participation was omitted since they should deliver the corporate vision of the school as set out in its documentation (though it may be argued that since staff act as agents for the school their conceptions may be taken as part of the corporate vision). The absence of staff involvement beyond the administration of the instrument provided a strong position when negotiating access into the school.

References


A Bame and W Dugger, ‘Pupils attitudes and concepts of technology’, *The Technology Teacher*. Volume 49 Number 8 1990 pp10-11


P Freire, ‘The Polices of Education’ P Murphy and B Moon (eds), Developments in Learning and Assessment. London: Hodder and Stoughton 1989

E Glaserfeld, ‘Learning as a constructive activity’, P Murphy and B Moon (eds), Developments in Learning and Assessment, London: Hodder and Stoughton 1989


P Murphy, ‘Gender and Assessment in Science’, P Murphy and B Moon (eds), Developments in Learning and Assessment. London: Hodder and Stoughton 1989

J Naughton, 'What is 'technology' anyway?', A Cross and R McCormick (eds), *Technology in schools*, Milton Keynes: Open University Press 1986

J Raat and M de Vries (eds), *Pupils attitude towards technology*, Eindhoven: Eindhoven University of Technology 1986

L Rennie, 'Teachers' and pupils' perceptions of technology and the Implications for Curriculum', *Research in Science and Technological Education*. Volume 5 Number 2 1987


C Thomson and D Householder, 'Perceptions of Technological competences in elementary technological education', [Paper for IDATER 95] Loughborough University of Technology 1995

E Wragg, *Rediguide 11: Conducting and Analysing Interviews*, TRC-Rediguides Ltd
CHAPTER FOUR

Case study investigation - City Technology College

4. Introduction

The presentation of the case study materials for the City Technology College (CTC) is presented in three sections.

Section 1 provides an overview of the school and the case study methodology. Section 2 provides a detailed analysis and discussion of the corporate vision of the school in comparison to the conceptions of technology which were held by its students. The corporate vision was based on school documentation and schemes of work, the syllabus requirements of examination boards and the Orders for Design and Technology in the National Curriculum. A summary of the comparison of the corporate vision and student conceptions is presented as Section 3 of this chapter.

4.1 Details of school and case study methodology

This section provides details of the school and the administration of the methodology in the following subsections:

4.1.1 Description of the school;
4.1.2 Student sample and administration of the methodology;
4.1.3 Use of school and public domain documents.
4.1.1 Description of the school

The CTC has Grant Maintained status and opened in the early 1990s. Although it occupies the site of a school which had closed a few years earlier only the shell of the buildings from the original school remain, the interior having been gutted and redeveloped. In this respect the CTC can be considered as being purpose built and equipped. An observer who has visited a number of Local Education Authority schools would no doubt be aware of the commercial atmosphere when entering this school; its strong corporate identity, use of building materials, interior design and colour set this school apart from many others. Walking round the school perhaps the most striking aspect is the availability of ICT equipment both in teaching rooms and in the seven ICT bases. In Key Stage 3 Technology is taught for 15% of curriculum time; in terms of the Orders for Technology in the National Curriculum 12.5% is for Design and Technology and 2.5% for Information Technology. In Key Stage 4 all students must follow a course in Design and Technology, which takes 10% of curriculum time, and may also opt to undertake a further 7.5% of curriculum time as Design and Technology or Information Technology. The nature of the curriculum is outlined by the CTC in the second broad aim of its curriculum policy:

The School delivers the full National Curriculum in KS3 and KS4, with a particular emphasis on exceptionally deep and valued understanding of Science, Technology and Mathematics for all pupils. We promote the specific teaching of Information Technology, and use it in all curriculum areas to help achieve for each pupil their full academic potential. (1996a p5)

Some observers may draw comparisons between this CTC atmosphere and the atmosphere created for the ‘Tec Lab’ investigation undertaken by Householder and Bolin (1993). This study was concerned with determining the effects of immersing
students in a ‘technology rich’ learning environment on their achievement in technology lessons and their attitude towards technology.

The school does not have a selection policy for students and as such welcomes a comprehensive intake. As one of a number of schools in the city, students select the school in the year preceding transfer. Competition for students between secondary phase schools in the locality works in favour of this study as the CTC has produced prospectus materials for prospective students which are focused towards explaining the policies driving the educational experiences it provides. The school made a number of documents available in addition to their prospectus; with the exception of the ‘Technology’ department handbook all were available to the public.

4.1.2 Student sample and administration of the methodology

The administration of the instrument was organised by the school’s technology teaching staff. Students completed the instrument during ‘technology’ lessons some time during late April and early May 1997 at a time convenient to the technology department. The sample was an opportunity sample containing all those students who attended the technology lesson which the school had scheduled for completion of the questionnaire by that group.

The sample of students who completed the questionnaire is summarised in Table 4.1. The author provided the school with instruction sheets for the department staff who administered the instrument so that, in the same manner as schools obtain a consistent application of conduct for examinations, all students in the sample
were given the same instructions for the completion of the questionnaire.

<table>
<thead>
<tr>
<th>Year</th>
<th>Male</th>
<th>Female</th>
<th>Year Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>44</td>
<td>38</td>
<td>82</td>
</tr>
<tr>
<td>8</td>
<td>17</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td>10</td>
<td>64</td>
<td>54</td>
<td>118</td>
</tr>
</tbody>
</table>

Table 4.1 The breakdown of student sample CTC  
(sample total 232)

Interviews with panels of students were conducted on 21 July 1997. The interview panels were formed by the school (as outlined in section 3.2.4) from a 'long list' of students which was provided by the author a few days in advance of the interview date.

4.1.3 Use of school and public domain documents

In undertaking a review of the documents which were available consideration has been made of the manner in which 'interesting' material is collated for presentation. Statements about technology (which are contained in the school documents) have been categorised in relation to the six areas of interest. Where an extract has a bearing on more than one area it is repeated. This method of categorising statements has been used by a number of other researchers and it should be noted that this approach relies on a subjective evaluation of the statement by the author. In an attempt to make this process as transparent as possible the extracts are provided with the author's
commentary.

Given that the school follows the orders for Design and Technology and Information Technology in the National Curriculum consideration has also been made of this documentation as the school’s own documents were reviewed. The National Curriculum (NC) Orders which are current at the time of this case study carry the following guidance at the head of the Programme of Study for each Key Stage.

Pupils should be taught to develop their design & technology capability through combining their Designing and Making skills [...] with Knowledge and Understanding [...] in order to design and make products. (DFE 1995 p2)

In terms of the theoretic framework for this research inquiry this emphasis in the current Design and Technology orders places the majority of the intended experience for students into two of the areas of interest; ‘Participating in technology activity’ (area 2), and ‘The products of technology’ (area 6). Some of the requirements of the programmes of study for Key Stages 3 and 4 are related to other ‘areas of interest’ where this occurs the links are noted. However, designing and making skills, and knowledge and understanding which relate to the two areas of interest above reproduced. Where consideration of a particular prescribed skill or body of knowledge is pertinent, details are provided in the commentary. The schemes of work for students following technology courses in KS4 fulfil the requirements of the syllabuses for the Midland Examination Group.
4.2 Corporate vision and students conceptions

The comparison of the corporate vision and students conceptions is undertaken in relation to each of the areas of interest (which were outlined in theoretic framework for this research inquiry) and these areas form the following subsections:

4.2.1 Recognising technology activity;
4.2.2 Participating in technology activity;
4.2.3 Which subjects teach technology?;
4.2.4 Living with technology;
4.2.5 Influence on conceptions from outside school;
4.2.6 The products of technology.

In considering these areas of interest a common pattern of presentation has been adopted for the comparative commentary; a review of the school documentation, followed by a review of student conceptions.

It should be noted in making a consideration of the corporate vision and student statements that some bias is inherent in the construction of the statements. This does not invalidate the comparison but the following three factors should be considered in making judgments. The fundamental focus of the corporate vision is concerned with technology in school. The framework for the student conception is provided by the research methodology which makes inquiries across a broad range of aspects of technology. The student conception is in truth an amalgamation of a number of conceptual standpoints. However, in considering the student conception most emphasis is placed on the most frequent combination of statement options within the area of interest - the modal conception. If this modal conception did not include the most frequently generated option within a statement section (the modal option for that comment section) this was also considered and is noted in the commentary.
4.2.1 Recognising technology activity

In its documentation the CTC includes statements about the end results of technology. It is reasonable to suppose that if these are recognised outcomes of technology activity, then the activity which produced them is also to do with technology.

In the ‘Aims’ section of the Technology Department Handbook it is stated that the subject should aim:

1. To provide both boys and girls with the confidence, knowledge and skills to design and make quality products fit for their intended purpose.

5. To develop pupils’ understanding of ways in which products, systems and environments may be controlled .... 

(1996b p1)

Technology activity is recognisable by virtue of the designing and making of quality products and by the ability to control products or systems. This corporate vision is supported by the NC Technology documentation. The CTC documentation makes no note of the status of proposals to manufacture or change the control of a system as being an outcome of technology activity. It may be the case that acceptance of proposals is subsumed into the designing aspects. The NC documentation notes in section 3. Designing Skills:

- generate design proposals that match stated design criteria and modify proposals to improve them; (op cit p6)

In their ‘aims’ of technology the CTC has a corporate vision of how students should come to an understanding of technology in other times and cultures:

4. To encourage respect for the ways in which people of
other cultural backgrounds past and present, have demonstrated their ability to enrich their lives through the application of technology. (op cit 1996 p1)

also,

17. Show an awareness of the effect of design and technological development on human activity, resources and the environment.

18. Show an awareness of the effects of, and the contribution made by the design and technological activities of other times and cultures. (ibid, p3)

The corporate vision of the school has been summarised by this author as follows:

Involvement in technology activity can be recognised by the manufacture of products or change effected in systems (or proposals to manufacture or change), the effects of technology can be recognised in other cultures and at other times in their and our past.

The starting point for considering the conceptions of students is the 'modal conception statement'. The 'conception statement' is generated from a statement bank; 'statement options' are determined from the responses to questions in the research instrument via a transcription matrix. The 'modal conception' for this area of interest is reproduced below. Unlike the printed statement which was produced for students as a continuous text, the 'print' of the statement options below contains additional information concerning its location in the statement bank and how frequently it was generated by students in the sample. For example considering the following comment:

Ac. (145 62%) You are undecided whether doing technology involves participation in an activity (which others may confirm is technology) or if doing technology requires an intention to take that course of action.
This is option ‘c’ of statement ‘A’. It was generated by 145 students which was 62% of the students in the CTC sample.

When a complete ‘conception statement’ was printed for a student the comments were not collected into areas of interest as reproduced here, the comment options were drawn from the statement bank in alphabetic order; the focus of the comments mirroring the focus of the instrument sections.

The ‘conception statement’ for this first area of interest is constructed from six statement sections, 16 students (7%) generated this modal conception and two other groups (15 students in each) also matched the options in the first five statements shown below.

A c.(145 62%) You are undecided whether doing technology involves participation in an activity (which others may confirm is technology) or if doing technology requires an intention to take that course of action.

B e.(144 62%) You feel that you have been involved in a technology activity even if the outcome was only to produce proposals which others could manufacture or propose changes to systems which others will effect.

X a.(151 65%) You recognise that technology has always been related to human activity

Y a.(200 86%) You recognise that technology activity occurs in other countries and cultures not just our own.

Z b.(222 96%) BLANK

B D a.(65 28%) You do not associate using the products of technology activity as doing technology.

Statement ‘A’ relates to ‘intention to take action’; this notion is drawn from outside the field of education and is an area which was not evident in the school documentation. The option printed is the one most frequently generated by students’ responses. Statement ‘B’ concerns the outcome of technology activity. The option printed (again the most commonly generated option) reflects the corporate vision and extends it to include the production of proposals which
could be manufactured or proposals to effect changes to systems. The corporate vision is also reflected in the options for statements 'X' and 'Y' which concern times and cultures. The printing of the 'Blank' option in statement 'Z' (which was edited out when continuous text was formed for students) indicates a disagreement with option Za:

Za You see technology being associated with modern industrial practices.

The option contained in the modal conception for statement BD was not the most frequently generated. Option BDc, which was a 'Blank' comment, was generated by 67 (29%) of students. Statement BD concerned the use of technology products being recognised as doing technology. An examination of the response rates to the questions linked to this statement indicates that younger students are more likely to associate the use of products as 'doing technology', and the more these products tend towards 'intelligent' products the more likely that view is. Given their access to ICT equipment to support technology teaching this is perhaps unsurprising. The statement bank comments which were generated in the modal conception can be edited to produce the following short statement.

Students are undecided whether technology activity occurs only when they have the intention to do technology or if they follow an activity others consider to be technology. Identifiable outcomes from technology are the manufacture of products or changes to systems or proposal to do these. Using technology products is not the same as doing technology. Technology activity can be recognised in other times and in other cultures.
4.2.2 Participating in technology activity

Investigation of this area of interest concerns the extent to which school and student consider knowledge of the management of technology, or knowledge of the specific field of activity in which they are operating as being a prerequisite for technology activity.

In the context of this thesis ‘management knowledge’ (which McCormick (1997 p145) would identify as procedural knowledge) concerns strategies for undertaking technology activity; for example working through a prescribed series of stages, problem solving, trial and error and the knowledge of how to evaluate progress identifying the next organisational stage accordingly. The other knowledge ‘operational knowledge’ concerns knowledge (theoretical or applied) of a particular field such that; for example, a suitable material could be identified and then worked to the required form. ‘Operational knowledge’ may form part of the stated learning objectives of the subject technology, another school subject or be gained through independent investigation by the student to support their technology activity.

A reasoned argument may be made that knowledge of how to manage technology activity ‘management knowledge’ is subsumed by ‘operational knowledge’ and this view is supported by this author. However it should be remembered that; in the context of this investigation, the focus of differentiation is concerned with why an activity (or information) may be identified as technology. Participation in technology activity may require information which is taught as either ‘management’ or ‘operational’ knowledge or a given amount of both.

Considering the management of technology activity both the school
and NC Technology documentation contain references to a routine sequence of stages. The departmental ‘Initial Statement’ contains detail of how students work through this routine of stages:

... Initially the design process is taught in a very linear way and there is a large degree of teacher autonomy. As pupils develop their knowledge and skills the more open ended, cyclic, nature of design is taught and the pupils’ autonomy developed. (1996b p1)

It may be reasonable to expect that for lower school students the corporate vision is bound by this linear sequence of stages; but that for students in the upper school (following GCSE examination courses) the corporate vision is one of awareness of the different stages which can be undertaken as appropriate. Thus the corporate vision changes with the students’ experience of technology. For students in Key Stage 3 their experience is governed by the routine ‘stages’ and this may be mirrored in their conception. Students in Key Stage 4 are less bound by the set routine and their conception may place less emphasis on the routine of stages than on the knowledge with which they are operating. The issue of starting technology activity is linked to the issue of stages in technology. In order to undertake technology activity does a participant require knowledge of how to manage the activity? The teaching scheme of the CTC indicates that the provision of a linear sequence of stages enables the students to manage the technology activity. This supports the ‘designing skills’ requirements of the NC Technology documentation and the Assessment Objectives set out in the Midland Examining Group (MEG) syllabuses (for GCSE Technology 1457, CDT: Technology 1451 and Design and Technology 1455 MEG (1994). The corporate vision of the school would include the need for students to know how to manage technology activity before they start.
The Key Stage 3 Curriculum Guide for Technology which the school publishes contains references to problem solving in the description of activities within technology courses:

Pupils will be encouraged to be flexible and seek their own solutions to a broad range of problems.

Towards the end of the year a block of time will be allocated to allow the pupils to participate in a more open problem solving activity. (1996c p12)

The pupils will identify items which satisfy the problem set. (1996d p6)

In terms of the corporate vision of the CTC, problem solving is a way of describing technology activity. The expression ‘problem solving’ is used to denote an open ended task in which students are expected to apply knowledge of a particular field to a given design task. As such the expression problem solving has been adopted as the descriptor for a particular pattern of technology activity.

Concerning operational knowledge, the programme of study for each NC Key Stage contains a section which outlines the ‘Knowledge and Understanding’ which should form part of a students operational knowledge of technology. In addition to this Section 2 of both the Key Stage 3 and Key Stage 4 programme of study states that pupils should be given the opportunity to:

b apply skills, knowledge and understanding from the programmes of study of other subjects, where appropriate, including art, mathematics and science. (DFE 1995 p6)

In the section ‘Technology Objectives’ of the CTC department handbook, two of the specific objectives note that students should be
able to:

6. gather, order and assess relevant information.  
   (1996b p2)

and that tasks should

8. encourage pupils to apply knowledge, already gained through learning and experience in the wider curriculum, to assist in the successful solution to design activities.  
   (ibid p1)

The corporate vision can be thought of as: students should be taught a core of operational knowledge and understanding which enables them to undertake the activities most commonly associated with the subject Technology. They should also be able to gather information from other fields of knowledge as required to undertake technology activity. The corporate vision of the CTC concerning participating in technology activity can be thought of as:

Technology experience will change for students as they progress through the Key Stages. KS3 students will participate in technology activity through a routine sequence of stages, whilst in KS4 less emphasis is placed on sequence and students might identify participation in technology by virtue of the knowledge with which they operate. Students need to be taught how to manage technology activity. Problem solving is a way of describing technology activity. Students should know a core of operational knowledge but should be able to find additional information from other fields as required.

The student conception statement for this second ‘area of interest’ is constructed from four statement sections, 34 students (15%) generated this modal conception. One other group of 32 students (14%) matched the first three statements but generated a ‘Blank’ option in statement ‘F’.
C. (197 85%) You identify technology as having a routine sequence of stages; however, neither this fact, or the knowledge base of the activity can on their own make the activity technology.

D. (161 70%) You are unclear about linking technology to problem solving.

E. (164 71%) You feel that before you start technology activity you need to be aware of the steps or stages which will help you control the activity.

F. (70 30%) In addition to being able to find information you feel that you need to have some knowledge of the field in which the activity takes place so you can understand and use the information which you find.

In each of the four statements the most frequently generated option (modal option) was included in the modal conception. Whilst there was strong agreement that technology can be considered as a number of stages (never less than 97% for any year group) the responses of students in Year 10 were at odds with those of students in Years 7 and 8 when responding to question 10:

10. All technology is about following the stages you have been taught.

This change reflects the corporate vision drawn from the CTC documentation. The notion of problem solving being linked to technology was less clear. Students in Years 7, 71% and 8, 75% agreed with the assertion that some aspects of technology and problem solving are the same. However the assertion that solving problems and technology are the same had disagreement rates of in Year 7, 54% and in Year 8, 53%. These two year groups agreed that an activity is more likely to be technology because of its field of knowledge than because problems were solved. The response rate was less polarised for students in Year 10 who agreed with both assertions but had an agree - disagree difference of 11% and 3% respectively. This suggests that they believe problem solving in ‘Technology’ is technology but that problem solving is a technique used by other subjects and may not be technology as such.
There was strong agreement that you should know how to manage technology activity before starting, in Year 7, 95%; 8, 88% and 10, 83%. This reduction through the years supports the corporate vision. The last statement in this ‘area of interest’ ‘F’ had the greatest number of options. The least generated option concerned the need to have studied a topic extensively before a technology activity could be undertaken. The limited generation of this option (4%) suggests that students feel their technology experience is not restricted to topics which they have studied extensively. Agreement with the assertion that you can undertake more technology activity if you know how to find out, had the support of 78% of students in Years 7 and 10, and 88% of students in Year 8. The statement option Fc reflects the corporate position on knowing and finding knowledge. For students:

Technology has a routine sequence of stages, although this becomes less important in identifying an activity as technology as students progress through the school when technology activity is also judged on its knowledge base. Technology activity involves problem solving (but problem solving as such is not always technology). Before starting technology activity you need to know how to manage it (procedural knowledge) and to have some knowledge of the topic area. A wider range of activity could be undertaken if you know how to find information.

4.2.3 Which subjects teach technology?

The documentation provided by the CTC makes note of applying knowledge from other subject areas in the department aims;

8. to encourage pupils to apply knowledge, already gained through learning and experience in the wider curriculum, to assist in the successful solution to design activities.

(ibid p1)
and, from the NC document, Section 2 in both the Key Stage 3 and Key Stage 4 programme of study states that pupils should be given the opportunity to:

b apply skills, knowledge and understanding from the programmes of study of other subjects, where appropriate, including art, mathematics and science. (op cit p6)

which is incorporated into the MEG examination syllabus for GCSE and Design Technology (1457 and 1455) as:

2.2 understand that technology requires the application of knowledge, understanding and skills drawn from various areas of human activity and enquiry; (1994 p2)

but makes no direct reference to technology being taught in subjects other than the Technology focus areas of: Resistant materials, Electronic Design and Communication, Textiles, Food, ICT - CAD/CAM, Mechanisms. In terms of a corporate vision:

Although operational knowledge from other subjects is sought as a resource for technology activity only, Technology subjects teach procedural (management knowledge) aspects of technology.

The student 'conception statement' for this area of interest is constructed from five statement sections, 180 (78%) of students held this modal conception. The most frequently generated option within each statement was included in the modal conception.

Gc.(214 93%) BLANK
Ha.(218 94%) In order to undertake technology activities information / knowledge from other subjects is sometimes required.
Ja.(205 88%) You feel subjects other than 'Technology' may also teach you how to do technology.
Ka.(214 92%) You identify that technology is also taught in science. Technology
and science lessons both teach aspects of investigation, producing proposals, testing and problem solving.

I.a.(225 97%) You believe that technology is the application of science or science in action.

The statement option Gc which is ‘Blank’ is generated as a result of students disagreeing with the following two questions:

21 Only a subject called technology teaches you how to do technology.

22 Only the information you learn in ‘technology’ lessons is to do with technology.

Year 7 girls were the group most likely to see the teaching of technology and its content being limited to the subject Technology. Girls in Year 10 were most likely to view technology involving knowledge from other subjects. This group was also in agreement that other subjects teach technology (94%) along with both boys and girls in Year 9 (94% and 93%). With the exception of seven students (who agreed with both sides of the argument) all students who disagreed with the assertion; ‘only the information you learn in ‘technology’ lessons is to do with technology’, provided responses to question 23 which generated statement option Ha shown on the previous page.

More than 90% of students in each year group were in agreement that science subjects could teach how to do technology, and that science teaches investigating, testing and problem solving. In identifying technology through problem solving it should be noted that in the second area of interest - ‘participating in technology activity’, students did not recognise all problem solving as technology, it may be more accurate to state that as a working skill problem solving does link technology to science. It should also be noted that the questions relating to this third area of interest were
less abstract than in the previous section. When questioning in this section the prompts: investigation, testing and solve problems were used. Unclear thinking evident in the responses to questions in the previous area of interest may be a result of the term 'problem solving' being familiar to students. For students:

'Technology' subjects teach technology but students can identify Science teaching technology procedures. Theoretical knowledge from other subject fields is needed for technology activity.

4.2.4 Living with technology

The corporate vision of the school is one of preparing students for society. The prospectus notes:

We welcome enquiries from all parents who seek a school, which emphasises science, technology and enterprise skills. We invite students to join this partnership in order to prepare them to take a full part in our modern technological society. (1996a p2)

The objectives of the technology department include, objectives to:

17 show an awareness of the effect of design and technological development on human activity, resources and the environment.

18 show an awareness of, and the contributions made by the design and technological activities of other times and cultures. (1996b p3)

This awareness is however focused by the fourth departmental aim from the handbook:

4 To encourage respect for the ways in which people of other cultural backgrounds, past and present, have demonstrated their ability to enrich their lives through the application of technology. (ibid p1)
Whilst the corporate vision might encourage an awareness of the influence of technology the fourth departmental aim would tend to encourage a positive approach which focused towards the benefits of technology development and away from potential problems.

NC documentation makes requirements to consider 'users and manufacturers' in analysing products but in terms of considering the effects of technology the broadest requirement is given as item 'd' in the quality section of the programmes of study:

\[ d \quad \text{its impact beyond the purpose for which it was designed,} \]
\[ \text{\emph{eg. on the environment}.} \quad \text{(DFE 1995 p9)} \]

The MEG documentation provides more guidance:

1.4 to expand the candidates awareness of the nature and significance of Technology and its importance in a society dependent on technology and manufactured goods;

2.1 understand that technology changes the environment and affects society and circumstances in which people find themselves; \quad \text{(1994 p2)}

The corporate vision of the CTC can be considered as:

\begin{quote}
\text{to prepare students for a modern technological society. That they should develop an awareness of the impact on themselves and in both other times and cultures and hold an awareness of the impact of technology developments.}
\end{quote}

The student 'conception statement' for this fourth area of interest is constructed from six statement sections, 54 students (23%) generated the modal conception below.

\text{Ma.}(199 86\%) \text{ You understand that the development of technology has created situations which influence your daily life.}
Qa. (212 91%) You believe technology is affecting employment patterns.

Na. (207 89%) You have identified that technology can create problems as well as provide solutions.

Oa. (205 88%) You see the products of technology as having a neutral effect, they are good or bad depending on the way they are used.

Pb. (78 43%) You do not feel that it is necessary to understand how technology products work to be able to use them.

Rb. (146 63%) Issues to do with technology are evident in many subjects other than technology. You are able to observe them in areas such as RE and History.

With the exception of statement ‘P’ all the options which form part of the modal conception were the most frequently generated option within each statement.

There was strong support for the assertions that technology products can save work, and that we come into contact every day even if we don’t undertake technology activities (questions 27, 28 and 29). In any of the three questions support for the assertions was never less than 84% for any year group. These questions generated statement ‘M’. In addition to identifying contact with technology 91% of students felt that technology was changing people’s jobs, (statement ‘Q’).

Student conceptions support the corporate vision of the school. The school documentation tended to lean towards the positive achievements of technology. The response rates to questions 31 and 32 which generated statement ‘O’ tend not to bear out this bias with 87% of Year 7, 100% of Year 8 and 94% of Year 10 disagreeing that the results of technology are always good and 91% of Year 7, 84% of Year 8 and 96% of Year 10 agreeing that technology developments can be used for good or bad purposes. It is beyond the scope of this study to attribute how students formed this conception, but the beneficial nature of the corporate vision may be challenged by experiences outside school.
The response patterns provided by Year 10 students to the questions concerning knowing how technology products work were at odds with those from the other two years. Year 10 are less concerned with why technology products work only that they do and can be used. Statement section ‘R’ reports the extent to which students feel developments or effects of technology are evident in the school subjects RE and History. These two subject areas were included in the questioning because in pilot study investigations they were found to be the most likely curriculum areas to be named which examined a range of cultures and periods of human activity. It would be unlikely that any student completing the research instrument would not have some knowledge of another culture or time period. Agreement with both assertions; that you might talk about the effects of technology in RE and that you might study the effects of technology in History, became stronger from Year 7 to Year 10. For RE from 51% to 90%, and for History from 68% to 87%. This increase in support through the Key Stages could prompt further investigation concerning curriculum opportunities in RE and History or the way in which students thinking matures through their school career.

The recognition of technology in other times and cultures was addressed in the first area of interest; however, it is in part reconsidered here since the corporate vision of the CTC included awareness of technology in other times and cultures. In this area of interest 89% of students recognised that technology can create problems as well as providing solutions and 88% identified that this is a result of the manner in which products of technology are used. If the statement options which these students generated for statements ‘X’ and ‘Y’ (time and culture) are considered with the options for statements ‘N’ and ‘O’ 54% of students generate the following conception:

X a. You recognise that technology has always been related to human activity
You recognise that technology activity occurs in other countries and cultures not just our own.

You have identified that technology can create problems as well as providing solutions.

You see the products of technology as having a neutral effect, they are good or bad depending on the way they are used.

The conception of students is:

That we all come into contact with technology and this influences our lives and is changing people's jobs. The products of technology can be used for good or bad purposes and technology can cause problems as well as solving them.

The influence of technology can be identified in other cultures and its effects noted in other times.

4.2.5 Influence on conceptions from outside school

This area of interest is concerned with influences from outside school and, as such, no corporate vision is considered.

The student 'conception statement' for this fifth area of interest is constructed from five statement sections, 95 students (41%) held the modal conception.

You feel that you may have been influenced at home by:

- watching programmes about technology on television, 184 (72%)
- using home computers, 169 (73%)
- using tools or home workshop equipment, 189 (89%)
- Your view has also been developed by discussing the effects of technology in conversations with members of your family, 191 (82%)

In inquiring where their ideas about technology might have been influenced 94% of students identified their experiences either at
home (65%) or in some other context outside school (29%), and had involved one, some or all of the following: using home computers, television programmes, home workshop equipment and tools and by discussions with family members. For the remainder of the sample an analysis of their responses to the group of questions in this section identified a group of students (5%) who felt they had not been influenced and 2 students (just under 1%) who had provided 'U' responses.

The majority of students believe that their conception of technology has been influenced outside school by some or all of the following experiences: using home computers, television programmes, home workshop equipment and tools and by discussions with family members.

4.2.6 The products of technology

The school's documentation contains a number of references to the production of products in the Technology department aims:

1. to provide both boys and girls with the confidence, knowledge and skills to design and make quality products fit for their intended purpose.

5. to develop pupils understanding of ways in which products, systems and environments may be controlled ...

(1996b p1)

The corporate vision of the school includes the manufacture of products as the outcome of technology activity. The production of products is supported by the requirements in the NC Technology documentation and as noted in the first area of interest extends the corporate vision to include producing proposals to manufacture or change systems.
The teaching schemes contain reference to the use of ICT equipment and the corporate vision also includes the use of ICT in Technology activity, in so much as it is seen in all teaching and learning activity. The curriculum policy notes:

We promote the specific teaching of Information Technology, and use it in all curriculum areas to help achieve for each pupil their full academic potential. (1996e p2)

However the main emphasis of the corporate vision of technology concerns the production of products rather than their use as being technology, the only exception being those products whose use form part of the core knowledge and understanding of the NC Programmes of Study. Students work through a number of focused Technology areas in Key Stage 3 only ICT and electronics are related to 'intelligent' products. The corporate vision for this area of interest can be seen as:

The outcome of technology activity is the manufacture of quality products although effecting change in a system or proposing to manufacture or to effect change in systems, is also recognised.

The student ‘conception statement’ for this final area of interest is formed from three statement sections, 69 students (29%) generated the modal conception below. The options generated in statements ‘BA’ and ‘BB’ of the modal conception were also the most frequently generated option in each statement section.

BAb.(181 78%) You see that technology activity can have a number of types of outcome one of which is the manufacture of products.

BBc.(203 87%) BLANK

BCb.(80 34%) You can see that whilst some products may themselves be used in further technology activity all manufactured products (products made by man) are products of technology also you see that 'soft products' such as new strains of plants can be included.
Statement ‘BA’ concerns the identification of products as the end result of technology activity, 97% of students generated an option which related products and technology activity. The remaining 3%, (eight Year 7 students) provided a ‘U’ response to the question which triggered the statement ‘BCc’. The identification of products supports the school’s corporate vision; however, 78% of students held a conception which identified products as one of a number of outcomes. The student conception extends beyond the vision which the school provides in its documentation. Their conception is in line with the outcomes identified in the NC Technology documentation and by MEG.

The second statement in this area of interest ‘BB’ concerned the type of product which was considered to be related to technology. For 13% of students electrical products were to do with technology, for 62% of these students (8% of the sample) this was particularly so for those products which involved some form of ‘intelligence’ or processing capability. The majority of students (87%) did not associate electronic or electrical products as being the only type of technology products (hence the ‘blank’ option comment ‘BBc’) in spite of their exposure to ICT equipment and ICT based learning activities.

The final statement in this area reflects the range of manufactured products which students were prepared to identify as being an outcome of technology. The following three questions explored the conception which students held.

50 All manufactured (man-made) things are products of technology

51 New medicines and drugs are products of technology

52 New strains of plants are examples of technology products
Students who agreed with all three assertions generated the statement option ‘BCb’, 34% of the sample. Year 10 students were most likely to agree with these statements. For each year group in each question the majority of students were in agreement with the assertion with one exception. The majority of Year 7 students were unable to identify new strains of plants as products of technology activity, although the agreement rate was 40%. Year 7 were the group most likely to produce a ‘U’ response; and in considering plants as products of technology 14% of Year 7 provided a ‘U’ response.

The most frequently generated option in this statement section was ‘BCc Blank’. This was generated by 102 students (43%). The response to question 50 ‘set’ the matrix. Only an ‘agree’ response would produce a statement comment (‘D’ and ‘U’ produced ‘blanks’ regardless of the following responses). Of the students who generated the option ‘BCc - blank’ 4 students provided a ‘U’ response to question 50, 73 students disagreed with the assertion of question 50 outright, the remaining 23 agreed with the assertion but not with the two following questions. Students who identified all manufactured products as products of technology were the majority of the sample 56% although only 34% of the sample could extend that identification to include new strains of plants. The majority of students hold a conception which reflects the corporate vision of the school as stated below.

The manufacture of products as being one type of outcome of technology activity but their conception also extends to include other outcomes. Students do not associate technology products as being exclusively electronic or electrical in nature. The majority of students consider any manufactured product to be an outcome of technology activity, some students can extend this to include ‘soft’ products.
4.3 Summary of findings

This section provides a summary of the comparison between corporate vision of the CTC and the conceptions of its students. The intention of this section is to provide a summary of the key findings within each of the six areas of interest outlined in the theoretic framework of this research inquiry.

Recognising technology activity.

The student conception is consistent with the corporate vision, however, the structure of the instrument enabled students to generate comments concerning the notion of ‘intention to act’ and the use of technology products. Recognition of technology by the use of products is not explicit in the school documentation; although a somewhat tenuous but reasoned argument may be made that the corporate vision does recognise ‘technology through products’ (tools and equipment) which are used to practice ‘making skills’.

Participating in technology activity.

The corporate vision and the student conceptions are consistent except for the notion of problem solving. Students do not view all problem solving activities as technology. However the instrument provided the opportunity to challenge student thinking against different assertions, this was not possible using documents.

Which subjects teach technology ?.

In terms of operational knowledge both corporate and student
conceptions are consistent. Students however, can identify the teaching of technology procedures (management knowledge) in Science.

Living with technology.

The conception held by students is common with the vision of the school. The student conception also reflects changes in: employment and daily contact with technology (although as was the case in other areas of interest this broader conception is in part a product of the way in which the instrument was constructed). Students identify that problems are also associated with technology developments, not just the 'enriching' aspects.

Influences from outside school.

The majority of students believe that their conception of technology has been influenced outside school by some or all of the following experiences: using home computers, television programmes, home workshop equipment and tools and by discussions with family members.

The products of technology.

The conception held by students reflects that of the corporate vision. Again the construction of the instrument enabled details of the limits or conditions that students place on 'what a technology product is' to be explored.
References

The publisher of the CTC documents is not stated in order to protect their anonymity. Copies of the documents examined are held by the author.

CTC, Prospectus, 1996a

CTC, Department Handbook, 1996b

CTC, Year 7 Parents Handbook, 1996c

CTC, Curriculum Guide for parents, Year 8, 1996d

CTC, Curriculum Policy, 1996e

DFE, Design and Technology in the National Curriculum, HMSO London 1995


MEG, Technology Syllabus A (syllabus code 1457), Cambridge: Midland Examining Group 1994
5. Introduction

The presentation of the case study materials for the Rural Comprehensive School (RC) follows the same structure as that adopted for the reporting of the CTC case study investigation.

5.1 Details of school and case study methodology

This section provides details of the school and the administration of the methodology in the following subsections:

5.1.1 Description of the school;
5.1.2 Student sample and administration of the methodology;
5.1.3 Use of school and public domain documents.

5.1.1 Description of school

The Rural Comprehensive is a Local Education Authority school which opened as a County Modern School. This is one of two schools in a small rural market town. The other school has a selective entry, drawing students from a catchment far wider than the local
community. The student entry to the 'study' school is comprehensive in nature although many students in the top 20% of the ability range take places at the selective school.

The Technology teaching areas have been developed from rooms which were originally designed and equipped for the teaching of homecraft and handicrafts. They contain a good range of equipment for technology teaching but have been adapted to their current use rather than being purpose built. Some ICT equipment is available within the department and one workshop has a CNC machine centre.

In Key Stage 3 Technology is taught for 12.5% of curriculum time; in terms of the Orders for Technology in the National Curriculum 10% is for Design Technology and 2.5% for Information Technology in Year 7. In Key Stage 4 all students must follow a course in Design Technology - 10% curriculum time. Information Technology is available as two lunch time sessions per week.

The school is not in direct competition with other institutions for students, and, as such has produced prospectus materials which are more focused towards managing the transfer of students between partner feeder schools and itself. The school provided other details in addition to their prospectus but these were concerned with the themes and rotation of Technology teaching groups. No documentation was provided which sought to inform parents of the schools' vision of technology. Students at the school follow National Curriculum Technology. Key Stage 4 examinations in Technology follow the Midland Examining Group syllabuses. The corporate vision of the school is taken as being that which can be derived from the National Curriculum and examination board documentation.
5.1.2 Student sample and administration of the methodology

The administration of the instrument was organised by the school's technology teaching staff. Students completed the instrument during 'technology' lessons some time during late April and early May 1997 at a time convenient to the technology department. The sample was an opportunity sample containing all those students who attended their technology lesson which the school had scheduled for completion of the questionnaire by that group.

The sample of students who completed the questionnaire is summarised in Table 5.1

<table>
<thead>
<tr>
<th>Year</th>
<th>Male</th>
<th>Female</th>
<th>Year Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>45</td>
<td>36</td>
<td>81</td>
</tr>
<tr>
<td>8</td>
<td>32</td>
<td>24</td>
<td>56</td>
</tr>
<tr>
<td>9</td>
<td>45</td>
<td>43</td>
<td>88</td>
</tr>
</tbody>
</table>

Table 5.1 The breakdown of student sample RC (sample total 225)

The same procedure was used for the administration of the questionnaire at the RC as was used at the CTC.

Interviews with panels of students were conducted on 10 July 1997. The interview panels were formed (as outlined in section 3.2.4) from a 'long list' of students which was sent to the school a few days in advance of the interview date.
5.1.3 Use of school and public domain documents

The review of RC documents was undertaken in the same manner as those of the CTC. In common with the CTC the schemes of work for RC students following technology courses in Key Stage 4 fulfil the requirements of the syllabuses for the Midland Examination Group.

5.2 Corporate vision and students conceptions

The comparison of the corporate vision and students conceptions is considered in the same arrangement of subsections as the previous CTC case study.

5.2.1 Recognising technology activity;
5.2.2 Participating in technology activity;
5.2.3 Which subjects teach technology?;
5.2.4 Living with technology;
5.2.5 Influence on conceptions from outside school;
5.2.6 The products of technology.

The documentation produced by the RC was focused towards managing the transfer of students between its partner feeder schools and itself. No documentation was provided which sought to inform parents of the school's vision of technology. In constructing the corporate vision more reliance is made on the documentation for NC Technology and the Key Stage 4 examination course.

5.2.1 Recognising technology activity

The starting point for the construction of a corporate conception is a consideration of the NC and MEG documentation. The guidance note
at the head of each of the NC programmes of study concludes with the following phrase:

... in order to design and make products. (DFE 1995 p2)

It is reasonable to suppose that if these are recognised outcomes of technology activity, and if the same outcomes are identified on a subsequent occasion then that activity which produced them is also to do with technology. The NC documentation also makes note of control of systems in both Key Stage 3 and Key Stage 4 Programmes of Study. For Key Stage 3 students:

a assignments in which they design and make products, [.....] these assignments should include work with control systems... (ibid p6)

Technology activity is recognisable by virtue of the design and making of quality products and by the ability to control systems. The NC documentation also notes proposals to manufacture or change the control of a system as being an outcome of technology activity. In section 3 of the Key Stage 3 Programme of Study ‘Designing Skills’:

e generate design proposals that match stated design criteria and modify proposals to improve them; (ibid p6)

The following guidance is available in NC documentation regarding the effects of technology. From the ‘quality’ section in both Key Stage 3 and Key Stage 4 Programmes of Study. Judging the quality of a product:

d its impact beyond the purpose for which it was designed eg. on the environment. (ibid p9)

and from the MEG documentation for GCSE Technology 1457 and
Design and Technology 1455:

2.1 understand that technology changes the environment and affects the society and circumstances in which people find themselves. (MEG 1994 p2)

This would enable an investigation of technology in other times and cultures to be undertaken, no specific reference to other times and cultures is made in the school documentation. However the Year 9 topic based on the context of windmills may provide some consideration of technology in other times.

The corporate vision of the school has been summarised by this author as:

involvement in technology activity can be recognised by the manufacture of products or change effected in systems (or proposals to manufacture or change).

The conception statement for this area of interest is constructed from six statement areas, the modal conception was generated by 8 students (4%).

Ac.171 (76%) You are undecided whether doing technology involves participation in an activity (which others may confirm is technology) or if doing technology requires an intention to take that course of action.

Be.82 (36%) You feel that you have been involved in a technology activity even if the outcome was only to produce proposals which others could manufacture or propose changes to systems which others will effect.

Xc.107 (47%) BLANK

Ya.182 (81%) You recognise that technology activity occurs in other countries and cultures not just our own.

Zh.210 (93%) BLANK

BDb.36 (16%) You feel that you are doing technology when you use technology products.
Although the comment printed in five of these six statement sections was the most frequently generated option for that section, when considering all six statement sections together the largest group holding a common conception was 8 students (4%). Statement ‘A’ relates to ‘intention to take action’; this notion is drawn from outside the field of education and is an area which was not evident in the school’s documentation. The comment option ‘Ac’ printed in the modal conception statement was the most frequently generated option in this statement section.

Statement ‘B’ concerns the recognition of technology activity by its outcome. The notion of linking the recognition of technology activity exclusively to making products was supported by 5% of students, a further 9% linked technology to making a product or changing a system. Whilst this second group identify the inclusion of systems, for 52% of students the activity which produces proposals as an outcome is a technology activity. This final group of students support the corporate vision drawn from NC and MEG documentation.

Statement ‘X’ concerned technology in other times. The question:

43 Humans have always been involved in technology activities.

was well supported with 65% of Year 7, 66% Year 8 and 86% of Year 9 being in agreement. The response to the assertion of the next question was less certain:

44 Technology is a recent idea in human history - within the last 100 years.

Although the majority of student responses was ‘disagree’ (Year 7 47%, Year 8 57% and Year 9 55%); the ‘U’ response rate was high (16%). The number of students who agreed with both the assertions of questions 43 and 44 above was also high. At least 80% of students in each year group recognised technology in other cultures.
Although 57% of the student sample did not recognise technology in other times their conception is still consistent with the corporate vision. The recognition of technology in other cultures extends beyond the vision of the school documentation.

The printing of the 'Blank' option in statement 'Z' (which was edited out when continuous text was formed) indicates a disagreement with option 'Za':

\[
Za \quad \text{You see technology being associated with modern industrial practices.}
\]

Only 41 students generated the comment 'Za' (17 of these were Year 7 girls and 13 Year 9 boys), 4 students used the 'U' response the other students disagreed and generated the option 'Zb'

The modal conception for this area contains statement option 'BDb'. This was not the most frequently generated option, 33% of students generated 'BDd. Blank' by the inclusion of 'U' responses. The second most frequent option was 'BDc':

\[
BDc \quad \text{You are undecided whether using the products of technology is the same as doing technology.}
\]

Although 52% of students did not think using a product is the same as doing technology, and 56% thought using electrical products did not mean you were doing technology 67% of students thought:

\[
53 \quad \text{When you use electronic or computer products you are doing technology.}
\]

The most frequently generated statement comments and those comments generated in the modal conception can be edited to form the following short statement.

\[
\text{Students are undecided whether technology activity occurs only when they have the intention to do technology or if}
\]

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they follow an activity others consider to be technology. Identifiable outcomes from technology are the manufacture of products or changes to systems or proposal to do these. Using technology products may be the same as doing technology dependent on the nature of the product. Technology activity can be recognised in other cultures by the majority of students but in other times by only 43%.

5.2.2 Participating in technology activity

Investigation of this area of interest concerns the extent to which school and student consider knowledge of the management of technology, or knowledge of the specific field of activity in which they are operating to be a prerequisite for technology activity to be undertaken.

NC Technology documentation and the assessment objectives for the MEG examination provide identifiable stages in the designing and making of a product. The issue of starting technology activity is linked to the issue of stages in technology. In order to undertake technology activity does a participant require knowledge of how to manage the activity? Guidance from the NC documentation is not clear, however before the sections outlining designing and making skills the instruction.

Pupils should be taught to: (op cit p6)

is included in the text. The corporate vision of the school would include the need for students to know how to manage technology activity.

NC documentation only contains two references to problems and these are both in Key Stage 4 and are concerned with the
management of designing and making activity. Pupils should be taught to:

3i ... produce and use detailed working schedules that will achieve the desired objectives and provide alternatives to possible problems;

4h ... produce and use detailed working schedules that will achieve the desired objectives, setting realistic deadlines for the various stages of manufacture, identifying critical points in the making process and providing alternatives to possible problems; (ibid p10)

A reader with a background of technology teaching at Key Stage 3 and Key Stage 4 might make an argument for the following requirements being accepted as direction for problem solving at Key Stage 3.

3b use design briefs to guide thinking.  

(ibid p6)

and at Key Stage 4.

3a to develop and use design briefs and detailed specifications.  

(ibid p10)

Although some readers may hold a common conception of ‘design briefs’ and ‘problem solving’ for the purpose of this review specific reference to the term problem solving is sought. The expression problem solving is not evident in the MEG documentation.

Concerning operational knowledge, the programme of study for each NC Key Stage contains a section which outlines the ‘Knowledge and Understanding’ which should form part of a student’s operational knowledge of technology. In addition to this Section 2 of both the
Key Stage 3 and Key Stage 4 programmes of study state that pupils should be given the opportunity to:

b apply skills, knowledge and understanding from the programmes of study of other subjects, where appropriate, including art, mathematics and science. (ibid p6)

The second of the aims in the MEG documentation notes the course should enable candidates to:

2.2 understand that technology requires the application of knowledge, understanding and skills drawn from various areas of human activity and enquiry. (op cit p2)

The corporate vision can be thought of as requiring students to be taught a core of operational knowledge and understanding which enables them to undertake the activities most commonly associated with the subject. The corporate vision for this area of interest can be considered as the following.

Technology has procedural stages and students should be taught these to manage technology activity, they should also be taught a core of operational knowledge and understanding which enables them to undertake the activities most commonly associated with the subject Technology and they should be able to gather information from other fields of knowledge when required.

The student conception for this area of interest is constructed from four statement areas, 35 students (16%) generated this modal conception. One other group of 30 students (13%) matched the first three statements.

Ch.185 (82%) You identify technology as having a routine sequence of stages; however, neither this fact, or the knowledge base of the activity can on their own
make the activity technology.

Dd.169 (75%) You are unclear about linking technology to problem solving.

Ea.152 (68%) You feel that before you start technology activity you need to be aware of the steps or stages which will help you control the activity.

Fe.90 (40%) BLANK

In each of the four statements the most frequently generated option was included in the modal conception. There was strong support for the notion that technology can be considered as a number of stages (89% Year 7, 89% Year 8 and 92% Year 9), however this support did not extend to the view that:

10. All technology is about following the stages you have been taught.

The views of Year 7 girls and boys differed; girls agree 47% (disagree 50%), boys agree 69% (disagree 29%). Students were uncertain whether to accept an activity as technology on the basis that it could be broken down into stages, or because of the field of knowledge within which the activity was undertaken. The majority of students (Year 7 78%, Year 8 69% and Year 9 85%) were in agreement with question 11.

11. Developing a new coat is technology because the process can be broken down into stages.

However they were less decisive about the next question. This explored the assertion that; even though the designing and making of a coat or a new electric circuit are both technology (because they can be broken into stages) one is more to do with technology than the other, because of its field of operational knowledge. The field of operational knowledge will determine if an activity is technology. No year group had a response rate which had more than a 6% difference between agree and disagree. Of particular concern was the ‘U’ response rate. In Year 7 this was 35%, in Year 8, 26% falling in
Year 9 to 10%. Putting 'U' responses aside Year 7 were the only year group who disagreed with this assertion. The statement option 'Ca' was generated by 17% of students.

Ca You identify stages within technology activity. Technology has a routine sequence of stages. You would suggest an activity is to do with technology because of its sequence of stages rather than the content of its activity.

Since this comment also identifies 'stages' a total of 99% of the sample identified stages in technology activity. This supports the corporate vision of the school. The link between technology and problem solving was identified by 5% of the sample. Whilst students tended to agree that some aspects of technology and problem solving were the same; solving problems and being involved in technology were not. The response was mixed when considering if the problem solving or the operational knowledge were more likely to make an activity technology. Given that the corporate vision of the school did not include problem solving the mixed responses are perhaps understandable.

The notion of knowing how to manage a technology activity before starting it (as distinct from knowing about the field in which the activity was set) was identified by 68% of students. Some 90% of students were in agreement with question 16.

16 I think that before you start an activity in technology you need to know how to work through it in stages.

This supports the corporate vision concerning knowing how to manage technology activity. In considering the relationship between finding and knowing operational knowledge students were most clear when asked:
19 You can undertake more technology activities if you know how to find the information (knowledge) you need as you go along.

Most students were in agreement, Year 7 (65%), Year 8 (79%) and Year 9 (76%). The relative importance of knowing how to find out, compared with knowledge of a particular field, was less polarised. The largest difference between agree and disagree was 10% and again Year 7 had a high 'U' response rate (30%). At least 63% in each of the three year groups indicated that you should have learnt about a topic before you undertake technology activity in that area.

The final statement section in this area of interest is 'F'. The responses to questions 18, 19 and 20 produced a range of options when applied to the transcription matrix. Option 'Fe'-‘blank’ was triggered by ‘U’ responses from 40% of the student population; 44% of students generated an option which placed the emphasis on knowing before starting and being able to find out later, 44% were uncertain or generated a blank response. This second group did not match the corporate vision. Hence the students’ conception of technology can be summarised as follows.

Technology has a routine sequence of stages.
Technology activity might involve problem solving, but it is not technology. Before starting technology activity you need to know how to manage it and to have some knowledge of the topic area. More activity can be undertaken if you know how to find information.

5.2.3 Which subjects teach technology?

The NC Programmes of Study note the use of knowledge from other subject areas. Section 2b from both Key Stages 3 and 4 notes:
apply skills, knowledge and understanding from the
programmes of study of other subjects, where
appropriate, including art, mathematics and science.
(op cit p6)

The MEG examination syllabus for GCSE and Design Technology
(1457 and 1455) states:

2.2 understand that technology requires the application of
knowledge, understanding and skills drawn from
various areas of human activity and enquiry;
(op cit p2)

The school documentation makes no reference to technology being
taught in subjects other than the Technology focus areas of: Food,
Graphics, Resilient Materials, ICT - CAD/CAM, Electronics and
Textiles. In terms of a corporate vision,

Although operational knowledge is sought from other
subjects to undertake technology activity only Technology
subjects teach procedural aspects of technology.

The student conception for this area of interest is constructed from
five statement sections, 114 (51%) of students held the modal
conception. The most frequently generated option within each
statement was included in the conception held by the modal group.

Gc.177 (79%) BLANK
Ha.189 (84%) In order to undertake technology activities information / knowledge
from other subjects is sometimes required.
Ja.170 (76%) You feel subjects other than ‘Technology’ may also teach you how
to do technology.
Ka.184 (82%) You identify that technology is also taught in science. Technology
and science lessons both teach aspects of investigation, producing proposals,
testing problem solving.
La.191 (85%) You believe that technology is the application of science or science
in action.
The statement option Gc which is 'Blank' is generated by the responses to the following two questions:

21 Only a subject called technology teaches you how to do technology.

22 Only the information you learn in 'technology' lessons is to do with technology.

Although the majority of students in each year group disagreed with question 21, the difference in student numbers between agree and disagree increased from 2% in Year 7 (47% agree - 49% disagree), 22% in Year 8 (39% agree - 61% disagree) to 37% in Year 9 (39% agree - 61% disagree). The tendency to disagree with question 22 was clearer, 65% disagree in Year 7, 64% in Year 8 and 74% in Year 9.

Option 'Gc' was generated by 79% of students who felt that techniques and knowledge from other subjects were to do with technology. This was reflected by students generating statement 'Ha' which supported technology not being limited to the subject Technology. Option comments 'Gc' and 'Ha' could be thought of as positive and negative assertions of the same argument, that other subjects teach technology. This combination of options was generated by 72% of students. The assertion that other subjects teach technology was extended by option 'Ja' generated by 76% of students. The combination of the three options 'Gc', 'Ha' and 'Ja' was generated by 138 students (61%). There was strong agreement that science subjects can teach technology, as shown by the finding that 71% of students generated both options 'Ka' and 'La'. For students:

operational knowledge for technology activity is drawn from other subjects. Some subjects other than technology (for example science) can teach some procedural aspects of technology.
5.2.4 Living with technology

NC documentation makes requirements to consider users and manufactures in analysing products, but in terms of considering the effects of technology the broadest requirement is given as item ‘d’ in the quality section of the programmes of study:

\[ \text{d} \quad \text{its impact beyond the purpose for which it was designed,} \quad \text{eg. on the environment.} \quad \text{(op cit p9)} \]

The MEG documentation provided more guidance:

1.4 to expand the candidates’ awareness of the nature and significance of Technology and its importance in a society dependent on technology and manufactured goods;

2.1 understand that technology changes the environment and affects society and circumstances in which people find themselves; \quad \text{(op cit p2)}

The corporate vision of the Rural Comprehensive can be considered as:

students should develop an awareness and understanding of the influence of technology (and technology products) which change the environment and circumstances around them.

The student conception for this area of interest is constructed from six statement areas, 23 students (10%) generated the modal conception below.

Ma.152 (68%) You understand that the development of technology has created situations which influence your daily life.

Qa.151 (67%) You believe technology is affecting employment patterns.

Na.173 (77%) You have identified that technology can create problems as well as providing solutions.
Oa.171 (76%) You see the products of technology as having a neutral effect, they are good or bad depending on the way they are used.

Pa.94 (42%) You feel that you should understand how these products work.

Rb.79 (35%) Issues to do with technology are evident in many subjects other than technology. You are able to observe them in areas such as RE and History.

There was strong agreement that all people come into contact with aspects of technology daily. All year groups were in agreement with question 35:

35 Technology is changing people’s jobs.

The agreement was more pronounced in student groups towards the end of the Key Stage. For students in Year 7, 56% agree - 36% disagree; Year 8, 71% agree -25% disagree and Year 9, 74% agree - 22% disagree. Both options ‘Ma’ and ‘Qa’ were generated by 50% of students and this conceptions is in line with the corporate vision based on the MEG documentation. This argument is strengthened by the generating of options ‘Na’ and ‘Oa’ (listed in the modal conception above).

Considering ‘knowing how’ technology products work, 42% of students generated option ‘Pa’, 43% of the sample gave contradictory or ‘U’ responses (10%) and option ‘Pc’ was generated. Knowing how to obtain the desired performance was considered more important by 15% of students than understanding why the product worked.

Statement section ‘R’ concerns the extent to which students feel developments or effects of technology are evident in the school subjects RE and History. Year 7 were least likely to identify aspects of technology in RE and History. Identification of technology in RE and History did increase with age but no clear pattern was evident. The most frequently generated option by 146 students (65%) was ‘Rc. Blank’, these students (with the exception of 11 students (5%
who provided a 'U' response) disagreed with the assertion in the first or both questions about technology in RE or History. The conception of students is:

That everyone is in contact with technology which influences lives and is changing jobs. The products of technology can be used for good or bad purposes and technology can cause problems as well as solving them. Students feel they should understand how these products work.

5.2.5 Influence on conceptions from outside school

This area of interest is concerned with influences from outside school and as such, no corporate vision is constructed.

The conception for this area of interest is constructed from five statement areas, 43 students (19%) held the modal conception.

Sa.107 (48%) You feel that you may have been influenced at home by:
Ta.128 (57%) watching programmes about technology on television,
Ua.137 (61%) using home computers,
Va.154 (68%) using tools or home workshop equipment.
Wa.148 (66%) Your view has also been developed by discussing the effects of technology in conversations with members of your family.

In considering where their ideas about technology had been influenced 89% of students identified their experiences either at home (48%) or in some other context outside school (41%), and had involved one, some or all of the following: using home computers, television programmes, home workshop equipment and tools and discussions with family members. For the remainder of the sample an analysis of their responses to the questions in this section identified a group of students (3%) who indicated they had not been
influenced, and another 3 students (just over 1%) who had provided 'U' responses.

The majority of students believe that their conception of technology has been influenced outside school by some or all of the following experiences: using home computers, television programmes, home workshop equipment and tools and by discussions with family members.

5.2.6 The products of technology

The header to each of the programmes of study in the NC Technology documentation requires that design and technology capability should be taught:

... in order to design and make products.

(op cit p2)

It was noted in the first area of interest that the manufacture of products was one of a number of possible outcomes from technology activity. The school encourages the use of intelligent products through the Electronic and CAD/CAM Technology teaching areas and in the optional Key Stage 4 ICT examination course. However the relationship between the use of technology products and being involved in technology activity is not made explicit in any documentation. No information is provided regarding which products are or are not to do with technology.

The corporate vision for this area of interest can be seen as.

The outcome of technology activity is the manufacture of quality products although effecting change in a system or proposing to manufacture, or to effect change in systems is also recognised.
The student conception for this area of interest is formed from three statement areas, 36 students (16%) generated the modal conception below.

**BA**

b.118 (52%) You see that technology activity can have a number of types of outcome one of which is the manufacture of products.

**BBc.176 (78%) BLANK**

**BCb.90 (40%) BLANK**

Statement 'BA' concerns the identification as products as the end result of technology activity, 86% of students generated an option which related products and technology activity. For 52% of the sample their conception was extended to include other types of outcome in addition to products.

The production of products was also considered in section 'B' in the first area of interest. The questions generating the option from statement 'B' had a high 'U' response (32%). The students who noted production of proposal to manufacture or change systems as being technology in section 'B' also noted that products were not the only outcome in this area. Year 7 had a high 'U' response rate (26%) which suggests some students are unclear or undecided about this aspect.

The second statement in this area 'BB' concerned the use of technology products. For 22% of students electrical products were products of technology and for 57% of these students (12% of the sample) this was particularly so if they involved some intelligence or processing capability. The majority of students (78%) did not identify electronic or electrical products as being the only type of technology product, hence the 'blank' option comment 'BBc' in the modal conception above.
The final statement of this area reflects the range of manufactured products which students were prepared to identify as outcomes of technology. The following three questions challenged students conceptions

50 All manufactured (man-made) things are products of technology

51 New medicines and drugs are products of technology

52 New strains of plants are examples of technology products

There was strong agreement with the assertion in question 50, (63% in Year 7, 64% in Year 8 and 73% in Year 9). The difference in frequency between agree and disagree responses for question 51 increased as students were older, but decreased for question 52. The most frequently generated statement option was ‘BCa’:

BCa You can see that whilst some products may themselves be used in further technology activity all manufactured products (products made by man) are products of technology.

This option was generated by 42% of the sample and supports the corporate vision. During the sequence of questions relating to statement ‘BC’ the ‘U’ response rate increased amongst Year 7 students from 5% in question 50, to 10% in question 51 and rose to 16% in question 52. For students:

the manufacture of products is one type of outcome of technology activity, but students’ conceptions include other types of outcomes. Technology products are not exclusively electronic or electric in nature. Students support the notion that all manufactured products are products of technology but are undecided what factors differentiate ‘manufactured products’ from ‘natural products’ when considering ‘soft’ technology products.
5.3 Summary of findings

This section provides a summary of the comparison between the corporate vision of the RC and the conceptions of its students. The intention of this section is to provide a summary of the key findings within each of the six areas of interest outlined in the theoretic framework of this research inquiry.

Recognising technology activity.

The conception of the modal student is consistent with the corporate vision, but is extended by the structure of the instrument to contain comment on the notion of 'intention to act', the use of technology products and technology in other times and cultures. Recognition of technology by the use of products is not explicit in the school documentation. However a reasoned argument might be made that the corporate vision recognised technology by some products, for example those used to practice 'making skills' which are set in the 'knowledge and understanding' section of the NC documentation.

Participating in technology activity.

The corporate vision and the student conceptions are consistent except for the notion of problem solving. In considering problem solving the students' position extends the corporate vision of the school as it is made explicit by their documentation.
Which subjects teach technology.

In terms of operational knowledge the corporate vision and students conceptions are consistent. Students however, can identify the teaching of technology procedure in other subjects.

Living with technology.

The conception held by students subsumes the vision of the school and is extended to reflect changes in: employment and daily influence (these aspects were included by virtue of the instrument design). Technology products can be used for good or bad purposes, students feel that they need to understand how technology products work.

The products of technology.

The conception held by students reflects that of the corporate vision. The construction of the instrument explored details of the limits or conditions students place on 'what a technology product is' which was not possible through the document search.

References


CHAPTER SIX

Comparison of student conceptions

The comparison of the conceptions of students from the two schools is presented in a similar pattern to that of the previous two chapters. Comparative analysis of students' conceptions is considered within each of the six areas of interest.

6.1 Recognising technology activity;
6.2 Participating in technology activity;
6.3 Which subjects teach technology?;
6.4 Living with technology;
6.5 Influence on conceptions from outside school;
6.6 The products of technology.

A common pattern of presentation has been adopted within each subsection, in addition to the author's commentary, data is presented using the following graphics:

- a scatter graph (plotted by school) to show the number of students holding a common conception and the frequency with which that size of group occurred;
- a table showing the frequency of generation of each conception statement option for students in both schools;
- a 'graphic profile' of the modal conception and the most frequently generated statement options (modal options) for students in both schools;

Explanatory notes accompanying these presentation methods are provided in Figures 6.1 & 6.2.
ents have • 20 groups of one student ~ all students have differing conceptions

5 groups each having 4 students with same conception

All students have same conception

Group size. Number of students holding same conception forming each group

Figure 6.1 Scatter graph: explanatory notes

The scatter graphs also contain a graphic to indicate the range of conceptions which were identified in that area of interest.

The numbers in the box indicate the number of conceptions for that subset: conceptions exclusive to RC students, those shared by students of both schools and those conceptions exclusive to CTC students. The figures above the boxes indicate the percentage of CTC students whose conceptions form that subset. The figures below the box indicate the percentage of RC students.

In the example below; of 168 different conceptions identified in this 'area of interest' 57 were common to both populations of students - 73% of CTC students and 59% of RC students. 64 conceptions were exclusive to RC students (41% of their sample) and 47 conceptions were exclusive to CTC students (27% of their sample).

Conception range

Total number of conceptions 168 of which 57 are common

Figure 6.2 Range of conceptions: explanatory notes
A plot of the 'agree' (A), 'disagree' (D) and 'don’t understand' (U) responses for each instrument question have been included as Appendix AII. These are plotted by gender and year group for each school, providing detailed support for the commentary in this chapter.

6.1 Recognising technology activity

This area of interest is investigated through 15 questions. With the exception of the six questions (identified below) the plots of students’ ‘A’, ‘D’ and ‘U’ responses tend to present the same pattern for both school populations. Students at the RC use the ‘U’ response more frequently. Whilst it was not possible to differentiate one school population from the other by their pattern of ‘A’, ‘D’ and ‘U’ responses, the response of the CTC students tended to be more polarised than those of students at the RC.

The responses to questions in the instrument transcribe to 6 statements; A, BD, B, X, Y, Z. Each statement contains between 2 and 6 options which provide for 864 possible combinations of which 168 were generated. CTC students generated a smaller range of different conceptions (104), than students at the RC (121 different conceptions). CTC students formed larger groups of students holding single conceptions. This is evident in the distribution of points in the scatter graph (Figure 6.3). Of the 168 different conceptions generated 57 were common to both school populations. The number of conceptions which were common to students of both schools was obtained by searching the database of ‘conception codes’ of one school for those codes generated by the other school. If a coding was not found in the database of the first school then it was exclusive to the second school and vice versa.

195
Area of Interest 1. Recognising Technology Activity

- Rural Comprehensive School - 225 students
- City Technology College - 232 students
- Both schools

Conception range

- Rural Comprehensive School: 73%, 27%
- City Technology College: 41%, 59%

Total number of conceptions 168 of which 57 are common

Figure 6.3 Scatter graph: 'Area of Interest' 1 - Recognising technology activity
Considering conceptions which are held exclusively by students in one of the schools, individual (not grouped) CTC students hold 62% of their 'exclusive CTC' conceptions, 53% of the RC 'exclusive conceptions' are held by individuals. This is reflected in the scatter graph by the frequency with which groups of 1 occur. In examining the scatter graph, it should be noted that the plot is by sample (rather than %). The CTC has a larger sample than the RC (7 additional students), but has 7 fewer students who hold individual conceptions and 6 fewer pairs of students holding the same conception. Whilst the RC had more groups where 3, 4 or 5 students held the same conception, the CTC had larger groupings of students holding the same conception.

The scatter graph provides no indication as to the nature of the conceptions. Since it is not practical to print all the variations, or develop a working knowledge of them for comparative purposes Figure 6.4 provides a graphic profile of both the 'modal conception' and 'modal options' of both schools for this area of interest. The most frequently held conception is the modal conception and the most frequently generated option within each statement section the 'modal options'.

The modal conceptions differ in sections 'BD' and 'X' as described below. Section 'BD' concerns the use of technology products being identified as doing technology. In the modal conceptions CTC students did not make this association, but the RC students did.

Considering the most frequently generated options (modal options) for this statement section. CTC students were 'undecided' (option BDc) about technology products being identified as doing technology; RC students generated a 'blank' comment (option BDd).
Note: To aid comparison the modal conception profile for each school has been plotted adjacent to the bold centre line. The plots of modal options are placed outside the modal conception for each school.

**Figure 6.4 Conception profiles: area of interest 1**

Table showing the frequency of generation of each conception statement option as a % of the sample.

<table>
<thead>
<tr>
<th>City Technology College</th>
<th>Rural Comprehensive School</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>option:</strong> a b c d e g</td>
<td>a b c d e g</td>
</tr>
<tr>
<td>A 24 14 62</td>
<td>21 3 76</td>
</tr>
<tr>
<td>BD 28 17 29 26</td>
<td>20 16 31 33</td>
</tr>
<tr>
<td>B 3 4 12 10 62 9</td>
<td>5 9 21 16 36 13</td>
</tr>
<tr>
<td>X 65 9 26</td>
<td>43 10 47</td>
</tr>
<tr>
<td>Y 86 14</td>
<td>81 19</td>
</tr>
<tr>
<td>Z 4 96</td>
<td>7 93</td>
</tr>
</tbody>
</table>

**Table 6.1 Frequency of statement options:**
**Area of Interest 1**
A detailed examination of the percentage of students generating each option (Table 6.1) reveals little difference between the two student populations in terms of 'undecided' (option BDc) or 'blank' (option BDd) with only 8% more CTC students disassociating use of products from doing technology than RC students (option BDa).

Statement 'X' concerned viewing technology as a recent development. Within both student populations the modal conception and modal option were the same. The statement generated by the two schools were different. CTC students generated option 'Xa':

You recognise that technology has always been related to human activity.

RC students generated option 'Xc' 'blank'. An analysis of the responses to the questions in the instrument show that the RC students were three times more likely to provide a 'don’t understand 'U'' response to questions in this section than were CTC students. This 'U' response generated a 'blank' comment through the transcription matrix (Figure AI.5).

Six questions gathered responses from either gender and/or year groups which might raise interesting issues for further investigation. These questions, and questions identified from other 'areas of interest' are noted at the end of this chapter.
6.2 Participating in technology activity

This area of interest is investigated through 12 questions. With the exception of three questions the plots of students' 'A', 'D' and 'U' responses tend to present the same pattern. The responses to the questions in the instrument transcribe to 4 statements; C, D, E, F. Each statement contains between 3 and 5 options which provide for 180 possible combinations of which 75 were generated. CTC students generated a larger range of conceptions (60), than the RC students (55). CTC students tended to form larger groups (Figure 6.5). As a percentage of their school population the CTC and RC both had 12% of students holding different individual conceptions.

Of the 75 conceptions which were generated 40 were common to both school populations. Individual (not grouped) CTC students hold 41% of their 'exclusive' CTC conceptions, 67% of the RC 'exclusive' conceptions were held by individuals. In both school populations the largest group holding the same conception contained 35 students, however the conceptions were not identical. The conceptions held by these two groups of 35 students are considered first. In the four statement sections in this 'area of interest' both student populations generated the same options in the first three sections (Figure 6.6). The difference between these two conceptions is the statement option generated in statement 'F'. The option comment generated by the group of CTC students was 'Fc':

In addition to being able to find information. You feel that you need to have some knowledge of the field in which the activity takes place so that you can understand and use the information you find.

The option comment which was generated by the group of RC students was 'Fe' 'Blank'. This option was generated by the matrix (Figure A1.11) if the response to any question in the matrix was 'U'.
Area of Interest 2. Participating in technology activity

- Rural Comprehensive School - 225 students
- City Technology College - 232 students
- Both schools

Conception range

Total number of conceptions 75 of which 40 are common

Group size. Number of students holding same conception forming each group
Figure 6.6 Conception profiles: area of interest 2

<table>
<thead>
<tr>
<th>Modal options</th>
<th>Modal conception</th>
<th>Rural Comprehensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 C</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
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<tr>
<td></td>
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</tr>
</tbody>
</table>

Table showing the frequency of generation of each conception statement option as a % of the sample.

City Technology College | Rural Comprehensive School

<table>
<thead>
<tr>
<th>option</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
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<tbody>
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<td>C</td>
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<td>0</td>
<td></td>
<td></td>
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<td>70</td>
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<td>6</td>
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</tr>
<tr>
<td>E</td>
<td>71</td>
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<td>9</td>
<td></td>
<td></td>
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<td>30</td>
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<td>11</td>
<td>5</td>
<td>28</td>
<td>16</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 6.2 Frequency of statement options: area of interest 2
Students from the RC had a higher rate of 'U' responses to these questions than did the CTC students. When considering the frequency that options were generated in section F (Table 6.2) option 'Fc' was in fact, almost the same for both student populations. CTC students were twice as likely to identify with knowing how to find information before starting technology activity (option 'Fa') than were RC students.

The case study analysis of both schools identified some differences between the corporate vision and the conception of students regarding the issue of 'problem solving'. No clear distinction can be made between the conceptions of the two student populations. An examination of the frequency with which statement options were generated in this statement section 'D' (Table 6.2) shows the majority of students in each school were unclear (including responding 'U') about linking technology and problem solving.
6.3 Which subjects teach technology?

This area of interest was investigated through 6 questions. The plots of students' 'A', 'D' and 'U' responses to the instrument questions show that as a group CTC students tended to be more polarised towards agree or disagree than students from the RC.

The responses to the questions in the instrument transcribe to five statements; G, H, J, K, L. Each statement contains 2 or 3 options which provide for 48 possible combinations of which 33 were generated. CTC students generated a smaller range of different conceptions (17), than did students of the RC (33). All the conceptions which were generated by the CTC students are also common to students from the RC. Of the 16 which are exclusive to RC students, 10 were held by individuals, the remaining exclusive conceptions were held by 6 groups of students. The distribution of points on the scatter graph (Figure 6.7) indicates that the population of CTC students generate fewer different conceptions. CTC students tended towards a single common conception with fewer individual conceptions, and fewer groups containing small numbers of students.

CTC students are more likely to view technology activity and learning as not being restricted to the subject or lesson 'Technology' (93% compared with 79% for RC students). This is supported by the tendency of CTC students to generate options ‘Ha’, ‘Ja’, ‘Ka’ and ‘La’ in the other statement sections in this 'area of interest' (Table 6.3). These statement options identify possible areas in school where technology may be experienced.

The construction of the matrix for section 'G' produced a 'blank' comment for students who considered that technology was not limited to the lesson 'Technology'. However, it should be noted that
Area of Interest 3. Which subjects teach technology

- Rural Comprehensive School - 225 students
- City Technology College - 232 students
- Both schools

Conception range

Total number of conceptions 33 of which 17 are common

Group size. Number of students holding same conception forming each group.
Table showing the frequency of generation of each conception statement option as a % of the sample.

<table>
<thead>
<tr>
<th>Modal options</th>
<th>Modal conception</th>
<th>Modal conception</th>
<th>Modal options</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>G</td>
<td>H</td>
<td>3</td>
</tr>
<tr>
<td>G</td>
<td>J</td>
<td>K</td>
<td>G</td>
</tr>
<tr>
<td>H</td>
<td>J</td>
<td>K</td>
<td>H</td>
</tr>
<tr>
<td>J</td>
<td>K</td>
<td>L</td>
<td>J</td>
</tr>
<tr>
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<td>L</td>
<td></td>
<td>K</td>
</tr>
<tr>
<td>L</td>
<td></td>
<td></td>
<td>L</td>
</tr>
</tbody>
</table>

**Table 6.3 Frequency of statement options: area of interest 3**
the matrix also generated a 'blank' comment if a student provided a 'U' response. A detailed examination of responses was made. A total of 9 students made a 'U' response to questions in this matrix. 4 students from the RC and 5 from the CTC. The examination of the option coding for these students reveals that none of the 4 RC students are in their modal group. Of the 5 CTC students 2 are in the modal group.

The matrix construction did not differentiate between a 'blank' generated by students who considered that technology was not limited to the lesson 'Technology', and a 'blank' by students who provided 'U' responses. Two CTC students in this model group provided 'U' responses but, because of the matrix construction were included in the modal conception group. Whilst in the context of this analysis all 180 CTC students held the same conception coding ('blank' for section 'G'), in truth 178 held one conception and the other 2 'U' response students held a differing one.

6.4 Living with technology

This area of interest is investigated through 11 questions. The plots of 'A', 'D' and 'U' responses to questions in this 'area of interest' followed the same pattern for both school populations with the exception of three questions. As in other areas of 'interest' CTC students tended to form more polarised groups. This is most evident in the plots for question 35 (Figure AII.35).

The responses to the questions in the instrument transcribe to 6 statements M, Q, N, O, P, R. Each statement contains 2 or 3 options which provide for 144 possible combinations, of which 65 were generated. CTC students generated a smaller range of different conceptions (43), compared with RC students (55).
Area of Interest 4. Living with technology

- Rural Comprehensive School - 225 students
- City Technology College - 232 students
- Both schools

Conception range

Total number of conceptions 65 of which 33 are common

Group size. Number of students holding same conception forming each group
Figure 6.10 Conception profiles: area of interest 4

Table showing the frequency of generation of each conception statement option as a % of the sample.

<table>
<thead>
<tr>
<th></th>
<th>City Technology College</th>
<th>Rural Comprehensive School</th>
</tr>
</thead>
<tbody>
<tr>
<td>option</td>
<td>a  b   c</td>
<td>a  b   c</td>
</tr>
<tr>
<td>M</td>
<td>86  14</td>
<td>68  32</td>
</tr>
<tr>
<td>Q</td>
<td>91    9</td>
<td>67  33</td>
</tr>
<tr>
<td>N</td>
<td>89    11</td>
<td>77  23</td>
</tr>
<tr>
<td>O</td>
<td>88    12</td>
<td>76  24</td>
</tr>
<tr>
<td>P</td>
<td>28    34  38</td>
<td>42  15  43</td>
</tr>
<tr>
<td>R</td>
<td>1     63  36</td>
<td>0    35  65</td>
</tr>
</tbody>
</table>

Table 6.4 Frequency of statement options: area of interest 4
Of the 65 different conceptions generated, 33 were common to the students of both schools. It is evident from the distribution of points on the scatter graph (Figure 6.9) that CTC students, despite having 20 individual student conceptions (19 for RC students) were more likely to form larger groups which held the same conception than were the RC students. The group holding the modal CTC conception was more than twice as large as the modal group for the RC. The conceptions of these modal groups are not identical.

Both RC and CTC students had the same modal conception for the first four statement options although it was generated far more frequently by CTC students (67%) than by RC students (40%). Considering the fifth statement section ‘P’, some 42% of RC students feel they need to understand why technology products work before they use them (15% did not) for CTC students 28% did (34% did not). Questions in this statement section generated a high rate of ‘blank’ comment options (38% CTC, 43% RC). This may have been a combination of two factors both relating to the processing of students’ responses to the questions through this matrix (Figure A1.21). Firstly the rate of ‘U’ response for RC students was more than twice the rate for CTC students (RC, 13%, CTC, 5.6%). This ‘U’ response was transcribed by the matrix as ‘Pc blank’. The second factor also concerns the construction of the matrix and the combination of ‘A’ and ‘D’ responses. The difference in frequency of options for section ‘P’ in Table 6.4 is not identifiable in the trends of ‘A’, ‘D’ and ‘U’ responses which were plotted for each question.

The final statement section in this ‘area of interest’ is R. The modal conception for each student population contained statement option ‘Rb’ (this was also the modal option for CTC students). However, two thirds of RC students generated option ‘Re’ ‘blank’. Over half of the RC student population (57%) did not recognise issues to do with
technology in Religious Education or History lessons. The 'U' response rate was 3.8% for CTC students and 6.2% for RC students (less than for section 'P' above) In this case the matrix (Figure A1.22) accommodated 'U' responses to question 34, the second of the pair of questions for this statement section.

6.5 Influence on conceptions from outside school

This area of interest was investigated through 5 questions. The plots of the 'A', 'D' and 'U' response rates all follow the same pattern for both school populations. The responses for CTC students tend to be more polarised 'agree' or 'disagree' and display a lower 'U' rate than the students from the RC. The responses to the questions in the instrument transcribe to 5 statements S, T, U, V, W. Each statement contains between 2 and 4 options which provide for 64 possible combinations, of which 42 were generated. CTC students generated a smaller range of different conceptions (30); than did students of the RC (42). All the conceptions which were generated by the CTC students were held by students from the RC. 24 RC students held 12 exclusive conceptions. Of these exclusive conceptions 7 were held by individuals and 5 were held by 17 students in 5 groups (1 group of 2, 1 group of 3, and 3 groups of 4).

The largest group of students in each school, 95 in the CTC (41%) and 43 in the RC (19%), held identical conceptions (Figure 6.11), and generated the statement:

You feel that you may have been influenced at home by:
watching programmes about technology on television, using
home computers, using tools or home workshop equipment.
Your view has also been developed by discussing the effects of
technology in conversations with members of your family.

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Area of Interest 5. Influence from outside school

- Rural Comprehensive School - 225 students
- City Technology College - 232 students
- Both schools

Conception range

Total number of conceptions 42 of which 30 are common

Group size, Number of students holding same conception forming each group
Table showing the frequency of generation of each conception statement option as a % of the sample.

<table>
<thead>
<tr>
<th>City Technology College</th>
<th>Rural Comprehensive School</th>
</tr>
</thead>
<tbody>
<tr>
<td>option: a b c d</td>
<td>a b c d</td>
</tr>
<tr>
<td>S 65 6 28 1</td>
<td>48 8 41 3</td>
</tr>
<tr>
<td>T 79 21</td>
<td>57 43</td>
</tr>
<tr>
<td>U 73 27</td>
<td>61 39</td>
</tr>
<tr>
<td>V 81 19</td>
<td>68 32</td>
</tr>
<tr>
<td>W 82 18</td>
<td>66 34</td>
</tr>
</tbody>
</table>

Table 6.5 Frequency of statement options: area of interest 5
The difference in the frequency of generation of this conception was striking, as the rate for the CTC was twice that of the RC. To generate the first option of the modal conception ‘Sa’ students had to identify that they had been influenced at home. This was not the case with the second largest RC group (18 students), or their fourth largest group (12 students) which raises issues about recognising technology. For these students who apparently contradicted themselves by agreeing with the assertion in question 38:

My ideas about technology have not been influenced by experiences at home

but subsequently disagreeing with a later question about not being influenced by certain factors the statement option ‘Sc’ was generated:

You feel your ideas about technology have not been influenced by technology but you have been influenced by: ....

All the conception profiles which were produced (Figure 6.12) are identical, as in the analysis of the other ‘areas of interest’ Table 6.5 provides details of the statement section options which were generated. The conceptions which are exclusive to RC students tend to identify an unusual combination of factors or a single factor which has influenced them; or as outlined above, students felt they had not been influenced, and then noted an influencing factor.
6.6 The products of technology

This area of interest was investigated through six questions. The ‘A, D and U’ responses tended towards the same pattern for both student populations. In previous ‘areas of interest’ it has been noted that the responses of CTC students as a group had polarised towards agree or disagree. This is not evident for questions 50, 51 and 52 which relate to the final statement section ‘BC’.

Responses to questions in the instrument transcribe to three statements BA, BB, BC. Each statement contains 3 possible options which provide for 27 possible combinations, of which 23 were generated. CTC students generated a smaller range of different conceptions (18), compared with students of the RC (22). Both student populations had individuals holding different conceptions, CTC (4), RC (3); however in comparison to other ‘areas of interest’ this was a small number. Of the 23 different conceptions generated 17 were common to both school populations.

The single conception which was exclusive to the CTC was held by an individual student. The 5 conceptions which were exclusive to the RC were held by 14 students; 2 conceptions were held by individuals, and the remaining 3 conceptions by groups (1 group of 3, 1 group of 7 and 1 group of 2). The distribution of points on the scatter graph (Figure 6.13) indicates that the sample of students from the CTC held conceptions which were common to more students. The 3 largest groups from the CTC generated identical options for the first 2 statements. The concept which differentiated these 159 students (69%) into 3 groups was the extent to which they viewed all manufactured products as products of technology.
Area of Interest 6. The products of technology

- Rural Comprehensive School - 225 students
- City Technology College - 232 students
- Both schools

Conception range

95.5% 0.5%

Total number of conceptions: 23, of which 17 are common.

Group size. Number of students holding same conception forming each group.
Table showing the frequency of generation of each conception statement option as a % of the sample.

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<th>Rural Comprehensive School</th>
</tr>
</thead>
<tbody>
<tr>
<td>option: a b c</td>
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<td>BA 22 75 3</td>
<td>34 52 14</td>
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<tr>
<td>BB 8 5 87</td>
<td>12 10 78</td>
</tr>
<tr>
<td>BC 22 34 44</td>
<td>42 18 40</td>
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</table>

Table 6.6 Frequency of statement options: area of interest 6
The conception profiles for this ‘area of interest’ (Figure 6.14) differed between schools, and for both schools between the ‘modal conception’ and their ‘modal options’. The first two statement sections of the modal conceptions contain the same options for both student populations. CTC students are more likely to identify that ‘technology activity can have a number of outcomes’ than are RC students (Table 6.6) and are less likely to agree with the assertion:

Only products or objects are the end result of technology activity.

Statement ‘BB’ investigated the extent to which students viewed technology products exclusively as electrical and/or electronic in nature. CTC students are more likely to disagree with this view than are RC students.

The final statement concerned the extent to which all manufactured products were seen as products of technology. A total of 56% of CTC students and 60% of RC students identified all manufactured things as products of technology. When considering the extent to which ‘soft’ products (for example new strains of plants) could be identified as technology products the difference between the two student populations was more pronounced; 34% of CTC students identified with this assertion compared with 18% of RC students. Whilst this wider view of products was included in the ‘modal conception’ for the CTC, the RC ‘modal conception’ generated ‘BCc’ ‘blank’. Although RC students had a higher ‘U’ response rate (24%) than CTC students (13%), 44% of CTC students generated ‘BCc’ compared with 40% of RC students. Whilst RC students generated option ‘BCc’ as a result of a high ‘U’ response rate; CTC students tended to present a mixed pattern of ‘A and D’ responses, in this situation the transcription matrix (Figure A1.30) produces a ‘blank’ comment.
The instrument contained 55 questions of these 12 questions gathered responses from either gender and/or year groups which might raise interesting issues for further investigation. Table 6.7 forms a summary of these by ‘area of interest’ and provides the location of the plot of students responses for that question in Appendix II.

<table>
<thead>
<tr>
<th>Area of interest 1 - Recognising technology activity</th>
<th>Question</th>
<th>Comment</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>Year 10 CTC girls and Year 7 girls at odds with all other subgroups.</td>
<td>Fig. All.1</td>
</tr>
<tr>
<td></td>
<td>2 and 4</td>
<td>Year 10 CTC students agree with assertion of question all other groups disagree.</td>
<td>Fig. All.2, Fig. All.4</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Year 7 CTC girls agree with assertion of question all other groups disagree.</td>
<td>Fig. All.7</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Year 8 CTC boys disagree with assertion of question all other subgroups tend to agree.</td>
<td>Fig. All.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area of interest 2 - Participating in technology activity</th>
<th>Question</th>
<th>Comment</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>Year 10 CTC response was at odds with all other subgroups.</td>
<td>Fig. All.10</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Year 8 RC girls split ‘agree - disagree’ all other groups had a clear majority agreeing.</td>
<td>Fig. All.11</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Boys in all years at the RC are less clear relationship of problem solving with technology.</td>
<td>Fig. All.14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area of interest 4 - Living with technology</th>
<th>Question</th>
<th>Comment</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>36 and 37</td>
<td>The response of Year 10 CTC students is at odds with other subgroups.</td>
<td>Fig. All.36, Fig. All.37</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>There was a marked difference in the of students at the RC Year 7 tend to disagree Year 8 to agree.</td>
<td>Fig. All.33</td>
</tr>
</tbody>
</table>

Table 6.7 Questions having interesting ‘A’, ‘D’ and ‘U’ responses
CHAPTER SEVEN

Findings and discussion

This chapter is presented in three major sections.

7.1 Methodological issues
7.2 Student conceptions
7.3 Opportunities for further research

It is intended that the detail and discussion of the research findings considered in this chapter will address the two remaining chief questions.

• What findings are evident from a comparison of the conceptions held by the two student populations?

• Are the conceptions of technology which students display dependent on the technology which their school offers?

7.1 Methodological issues

7.1.1 Differentiating between student populations

It would be incorrect to suggest that the conceptions of the two samples of students represent opposing views or that they can be easily differentiated from each other.

The two student populations cannot be differentiated by virtue of the
range of conceptions which one group holds being distinct from those of the other. It is apparent from an examination of the ‘Frequency of statement options’ (Tables 6.1 to 6.6) that in all but two cases (‘Cc’ for CTC and ‘Ra’ for the RC) the responses to the instrument questions have generated a complete set of option comments for each population. It could therefore be argued that taken statement by statement (in all but two instances) any conception evident in one population is also evident in the other. In undertaking a comparison of the conception held by the two student populations in the previous section the term ‘exclusive conception’ was used. This referred to an exclusive combination of a number of statement sections. For example when a number of statements are taken together; as in the first ‘area of interest’ recognising technology activity, the modal conceptions differ only in the issues of ‘recognising technology in other times’. Although not a majority view at the RC, 43% recognise technology in other times, and as such both populations contain that conception.

If the two student populations are not distinguishable by virtue of their holding unique conceptual positions; a comparison can be made of the two based on the extent to which the students in that sample tend towards a common position. Students in the CTC population tend to have a more common conception about technology issues. They form fewer, larger groups of students holding the same conception, and the frequency of individual conceptions is lower than that for RC students. This is supported by the distribution of points on the scatter graphs and the range of conceptions evident in each area of interest.

CTC students have a reduced number of ‘undecided’ statement option comments. Six statement options contain ‘undecided’, ‘unclear’ or ‘uncertain’. In five of these instances the frequency of
generation was lower for CTC students (on average by 6%) and in the sixth instance it was the same as the rate for RC students. A further argument can be made in support of the assertion that CTC students are less likely to be uncertain about their position towards a given aspect of technology than their peers at the RC. CTC students are less likely to respond to questions by using the ‘don’t understand ‘U’’ option. CTC students used the ‘U’ response for 3% of their total responses compared with RC students who used ‘U’ for 7.8% of total responses (2.6 times more than CTC students). During the development of the instrument the title and use of the ‘U’ response option was investigated. The final title and position were determined to reduce the percentage of respondents who used ‘U’ response as an ‘easy’ solution to challenging questions. Hence from a lower ‘U’ rate it may be reasoned that CTC students had a clearer understanding of the aspects raised in the instrument questions.

The construction of the transcription matrix does not enable the response rates generating ‘unclear’ comments to be directly compared to the ‘U’ response rates. The six options which include the terms ‘undecided’, ‘unclear’ or ‘uncertain’ are generated where, for example, a student agrees with a negative assertion and a positive assertion concerning the same technology aspect. Where a student uses a ‘U’ response, 26 of the 29 statement matrices produce a ‘blank’ option (the other 3 having graded comments). The high ‘U’ response rate is masked because 23 of the matrices also produce a blank comment if unlisted combinations of ‘A’ and ‘D’ are used. Or in some cases only produce a comment if an ‘A’ is produced, a ‘D’ response generating the ‘blank’ comment or vice versa.

The tendency for CTC students to polarise towards a smaller range of conceptions which are common to larger groupings of students is a recurring theme across the ‘areas of interest’. In addition to this
subtle differences were noted when a comparison of the two student populations was made. The term subtle is used because (as outlined above) no clearly distinguishable difference has been identified. Although individuals or small groups hold exclusive conceptions in both populations. The majority of one population does not hold a conception which is exclusive to that school.

CTC students are more likely not to associate the use of products of technology as doing technology (CTC 28%, RC 20%). They are more likely to disagree with the notion that technology is a recent idea (CTC 77%, RC 52%); and that technology has always been related to human activity (CTC 78%, RC 73%). CTC students are twice as likely as RC students to view knowing how to gather information as being more important than knowing information about a specific field before starting a technology activity (CTC 22%, RC 11%). CTC students are more likely to view school subjects other than ‘Technology’ as also teaching aspects of technology (CTC 93%, RC 79%). RC students are less likely to recognise technology issues in subjects such as RE or History (RC 43%, CTC 68%). CTC students are less likely to see only products as the end result of technology activity (CTC 22%, RC 34%). Both populations are as likely to identify all manufactured products as being products of technology (CTC 56%, RC 60%) but CTC students are more likely to include ‘soft’ products (CTC 34%, RC 18%).

7.1.2 Students holding identical conceptions

In the previous sections the ‘conception statements’ which students generated were considered by ‘area of interest’ and details were presented of the number of students who held identical ‘conception statements’ within each specific ‘area of interest’. The comment database was also searched for identical conceptions based on all 29
statement sections. With each statement section having between 2 and 6 options the complete transcription matrix provided for $1.8575 \times 10^{12}$ possible combinations. However not all possible options were generated, the total possible combination for options generated by the student samples for this investigation provide for $2.6108 \times 10^{10}$ possible conceptions. No students in the sample from the RC had identical conception statement codings, however 2 groups of students (2 students in each group) were found to have identical conceptions in the student sample from the CTC.

The search for identical conception statements had also been undertaken on the database which was compiled for the analysis of the pilot study responses. No identical conceptions were found in the sample of 181 students. It was not practicable to conduct a ‘part match’ search of the students’ sample. However in the pilot study investigation Technology department teaching staff had agreed to complete the instrument. The conception statements of two of the department staff differed in only 3 of the 29 statement sections. The probability of obtaining this match is $1.9.33 \times 10^{6}$. This match tends to suggest that in their roles as joint Head of Department they had discussed issues relating to the nature of technology.

In the final stages of analysis a search was conducted across the three student samples (CTC, RC and pilot study) for individuals who held identical conceptions statements. No matches were found in addition to the two pairs of CTC students who held identical conceptions. This finding might appear to support further discussion about the influence of environment, curriculum or teaching styles. An attractive assertion would be that this influence was evident in the matching of students with common conceptions, particularly given the situation of the two staff in the pilot study school. However it must be noted that further investigation would be required before
claims could be made that this matching of conception codes was significant.

7.1.3 Reliability and validity of the methodology

In adopting the research methodology detailed above consideration was given to the related aspects of reliability and validity. For the purposes of this investigation reliability is taken to be the measure of the ‘repeatability’ of the investigation technique in different institutions. Validity is taken to be a measure of the extent to which the methodology actually reports the factors which it claims to.

Both reliability and validity are tested and supported by ‘triangulation’. The notion of triangulation is borrowed from surveying and mapping techniques in which a third position is used to confirm the relationship between two other positions. In this study triangulation is established by comparing the following: the data obtained from the questionnaire (in the form of the ‘conception statement’), the comments made by the respondent during interview, and the opinion of the respondent regarding the validity of the ‘conception statement’ in reflecting their views.

The reliability of the methodology is particularly strong. The limited response options of the instrument and the processing of the responses using a predetermined matrix make for consistent and repeatable application. In one development stage a sample of respondents (PGCE Design and Technology students) were provided with a transcription matrix, and after completing the questionnaire they processed their responses to obtain their own conception statement. In these and other cases where respondents have been invited to review their conception statement, it has been agreed to be
a valid articulation of their position. On some occasions respondents have questioned certain sections but this has been on the basis of the language construction. The conception statement is obtained by printing different sections of the statement bank together. Given the large number of possible statement option combinations it was not practical to refine the language construction to take account of the possible combinations. Some students questioned sections as no longer being the conception which they held; because they had reflected on the questionnaire or issues raised during the interview their position had developed and the articulation in the conception statement was out of date, despite being valid at the time the questionnaire was undertaken.

As was noted earlier in considering the key aspects for inclusion in this investigation, the conception which is captured may be invalid in that it does not adequately reflect an individual's total construct. However if the conception statement is in reality a limited view; any subsequent comparison is valid and reliable in that the study reports a comparison based on the same key aspects for all respondents.

The interviews conducted during the pilot study provided a degree of triangulation between the responses provided by a student to the questions in the instrument, their conception statement and their articulated position. Interviews were retained in the methodology for the comparative case study, although (having secured the research methodology through the pilot study) the focus of their purpose was further developed. Interview panels were formed by the school from a 'long list' of students identified by the author. The long list was compiled on the basis of the written responses provided by students to the open questions at the start and end of the instrument. Students who had been prepared to articulate their conception (no matter what that conception was) were long listed. The school identified about six
students from this list of between ten and twenty names. The interview panels were not representative of a range of differing conceptions of technology. In the comparative study, rather than using the interview transcripts to illustrate the analysis of trends in responses to questions in the instrument students comments in the interview were matched to statement sections in their ‘conception statement’.

The interview panels contained four or five students and as the discussions moved through the question scenarios in the timetable periods made available by the schools (questioning normally lasting for about forty minutes) it was not possible to elicit comments from each student which covered all twenty nine statement sections. During the transcription of the interview tapes the comments made by a student were matched with sections of their conception statement. The following vignette is included as an example of the matches which became evident.

Laura; a Year 9 student at the Rural Comprehensive

Comments made by Laura during the interview support seven (of the twenty nine) sections of her conception statement. These matches are presented below as an extract from the interview transcript followed by the ‘statement section option’ which was generated from her responses to the questions in the instrument.

Concerning the school subjects which teach technology:

46 Is there anything that you do, any sort of things you learn in Technology which you learn in other subjects as well.

do you do levers in technology and levers in...
Laura You do it in Science as well.

So now I've sort of nudged you a bit you would say yes that certain things in tech are like certain things in Science. What is it that makes doing it in 'Technology' technology, and what is it that makes doing it in Science science?

Laura because its Technology lesson and you just think that's technology.

Again that's fine.

Laura Science has always got a sort of scientific thing... a different way of wording the thing as well and it goes into more detail as well.

So in a way it's purely because that's what the lesson's called you happen to be sat in at the time..

John & Laura Yes.

... if you do it in a Science lesson it's science and if you do it in a Technology lesson it's technology

Statement Ka You identify that technology is also taught in Science. Technology and Science lessons both teach aspects of investigation, producing proposals, testing and problem solving.

Concerning differing situations in which students believe they recognise or participate in technology activity:

I want to think about lawn movers. I want you to imagine the old fashioned lawn mower have you got a picture of it in your mind, the sort you push - there's no motor on it you just get the blades on the bottom and two wheels and then you get a wooden handle with a 't' piece across the top it's the sort your granny might have. You just push it to mow the lawn. If I go out and cut the grass with one of those am I doing technology?

Laura Yea. well yes you are it's sort of a technology object.

Statement BDb You feel you are doing technology when you use technology products.

also;

Let's try you with this one imagine that I'm going to go and develop something, I'm going to go and develop a new drug - not speed or anything like that. Say we're going to go and look for a cure for AIDS and if you imagine hard - a large room full of chemicals. I walk into the large room full of chemicals and with a beaker in one hand I just start pouring odds and ends out of bottles and shaking it and mixing it around. Every now and again I stop and give it to someone to test it. Is that doing technology?

Laura What you making the drug?

John If you're making something I think that's technology.
You keep having to test it - yes that's technology. Because you keep trying.

You're making something.

Yea I keep testing it and I'm making something.

Oh that's more to do with science actually I think.

The chemical part is but the making part's technology.

How about before I went in there and I sat down and thought about it, and I'd got a plan of action all out what I was going to do, you know I'd worked it all out then I went in and did it. so I've thought about it.

Its science.

Yes that's it, in technology you plan things first anyway.

In science you test more.

Yea

In science you test more, in technology you plan it out.

You identify stages within technology activity. Technology has a routine sequence of stages. You would suggest that an activity is to do with technology because of its sequence of stages rather than the content of its activity.

You feel an activity is to do with technology if you started the activity intending to carry out that course of activity. You cannot do technology by accident or by copying others.

What about technology outside school because so far you've given me your view of technology based on the lesson in school haven't you. What do you think has been technology influence outside of school.

What do you mean things you do at home?

Yea.

Well you do loads of technology things at home don't you, but you just don't know it until you think about it - like opening a can of beans or something.

Yes. So you think you can do technology outside of school.

Yes.

You feel you may have been influenced at home by:

using tools or home workshop equipment.
The final match concerns statement section R. This does not appear printed in Laura's statement since the option which was generated was ‘Rc’ - blank. The transcription matrix for statement R (figure A1.22) concerns the extent to which students feel technology is evident in the subjects Religious Education (RE) or History. Although Laura responded ‘A’-agree to question 34 (concerning History) her response to question 33 (concerning RE) was ‘D’-disagree, and according to the matrix option ‘Rc’ was produced. That Laura believes technology is evident in History is supported by her interview comments below and in her response to the last open question of the instrument (Figure 7.1).

Which question or questions have helped you change your view of what technology is?

25 and 26 which made me realise that science does teach about technology. And question 34, because otherwise I didn't realise it, but we do talk about the results of tech in history.

Figure 7.1 Questionnaire extract: Laura, Rural Comprehensive School

What about History and RE do you see anything for technology in those?

60 Joanne Not in RE.

61 John Could in History.

62 Does that mean you might in History you don't in RE.
Laura: No I don’t know

Joanne: Easier in History, usually it’s just about dates and things

Laura: Ah actually yes you do! In textiles we’re going to be doing the GNVQ about industry and going back through the years. That’s history I suppose

The interviews were retained in the methodology for two further reasons; they provided an opportunity to meet students and discuss their conception statement. Had this discussion been based on a shorter meeting it is questionable whether students would have been as open, or as articulate about their position. The interview allowed data to be collected which, although the analysis is beyond the scope of this study, placed the organisation of technology teaching in context.

Two further tests were applied to the methodology to establish the validity of the findings, a double-blind test and a statistical analysis of the instrument responses. One sample of twenty students in the author’s home institution conducted a double-blind test. Having completed a portion of the instrument, students continued to work through a second document; this was in fact the complete listing of all the conception statement section options relating to the questions they had attempted. The responses to the questions were processed through the transcription matrix and the correlation between the options generated from the instrument, and those selected from the full listing were considered. The correlation was not secure; and given the confirmation of the conception statements by previous groups somewhat unexpected.

However, on closer reflection the format of the test was itself considered to be insecure. The methodology had been developed to
enable a conception of technology to be captured which in many cases the student did not know they had; could not articulate; or which tended to change or develop as they experienced the instrument. The act of reading through the various statement section options became in its-self an experience which challenged and developed the students’ conception beyond that held when they responded to the questions in the instrument.

A chi-squared analysis was conducted of the A, D and U responses provided by students (in both schools) to each of the 55 questions in the instrument (a sample calculation is presented as Appendix AIII). With the exception of 12 questions the probability values obtained from the ‘percentage points of the \( \chi^2 \) distribution’ were never greater than 0.01 that is 1% probability of any difference between the responses of the two schools being a chance result. For 39 questions a value of 0.001 that is 0.1% was obtained (Figure 7.2). For the twelve questions which provided values above 1% probability of a chance result the chi-squared analysis provides a useful focus for further consideration, in particular of three possibilities.

Firstly that the results were obtained by chance. For the 12 questions identified above (being between 0.70 - 70% and 0.025 - 2.5%), 10 transcribe to statements which include an ‘undecided, unclear or blank’ option. Students may not be clear about their thinking and this is reflected in a more uncertain approach to selecting ‘A, D or U’. Secondly the conceptions held by the students may tend towards common conceptions of the issues raised in some questions. Of the twelve questions identified, the remaining questions (31 and 50) have response rates which were similar for both school populations. The difference in any category (A, D, U) between the two student populations being no greater than 2%, when considering responses as
Figure 7.2 Chi-squared analysis: Probability values for instrument questions.
a percentage of each school sample. The final possibility is that the construction or content of the questions is unclear. For the purposes of this study further investigation of the chi-squared analysis was considered to be beyond the scope of the study since if any constructional shortcomings in the design of the instrument were to become evident the methodology ensured that any influence was applied to the conceptions generated for all students.

7.2.1 Student conceptions and corporate visions

The corporate vision of both institutions is supported by the conceptions of its students. In a number of instances student conceptions extend beyond the vision of the school and include additional aspects. Consideration has been made in the previous sections concerning the tendency of the instrument to provide a framework for students to construct their conceptions by seeking views in areas which students may not have identified for themselves. Students of both schools have a more uncertain view of problem solving than is displayed in their schools' corporate visions. Both populations of students identify more subjects which teach technology than is provided for by their school’s documentation. Although the students from the RC did not recognise technology in other times as frequently as CTC students this aspect was not included in their school’s corporate vision.

7.2.2 Might corporate vision influence student conception?

The research findings suggest that CTC students have an increased awareness of technology. The type of learning atmosphere in the CTC and the reliance of its teaching schemes on the use of ICT. The
emphasis of its ‘mission statement’.

We welcome enquiries from all parents who seek a school, which emphasises science, technology and enterprise skills. We invite students to join this partnership in order to prepare them to take a full part in our modern technological society. (CTC 1996a p2)

and the facilities of the CTC.

Special features of the school include a campus wide network of computers with over 150 workstations and an output enhanced opportunities for study and research. Computer Aided Design and Manufacturing equipment is housed in a purpose-built area within the Technology Department. The science laboratories are of the latest design and are fully equipped for the best in modern science teaching. (ibid p4)

suggest a technology rich environment. Householder and Bolin, in studying the response of students to the ‘technology rich’ teaching environment detail the atmosphere created by ‘Tec Lab’:

The TEC-Lab incorporated a wide range of technologies, including computers, audio and video equipment, computer numerically controlled (CNC) machine tools, and satellite communication equipment. (1993 p6)

Direct parallels can be drawn between this environment and the provision for students in the CTC. The TEC-Lab project had dual aims, the second was to:

(b) determine the effect of immersion in a technology - rich environment on the attitude towards technology as displayed by the students in those groups. (ibid p5)

The summary of their report notes:

The changes in student attitudes towards technology during the academic year are particularly provocative. Participation in the TEC - Lab project, whether in one of the TEC -Lab classes or in one of the comparison classes taught by TEC -
Lab teachers, resulted in positive changes in attitude towards technology. (ibid p16)

If this increased attitude towards technology which was identified in the TEC - Lab project occurs in other 'technology rich' environments then it may be reasonable to suppose that a positive attitude toward technology may be accompanied by an increased awareness. If this heightened awareness is enjoyed by CTC students then this may be a factor which is evidenced by a more certain response to questions about technology and a common experience which provides a strong base for common conceptions.

Where CTC students may be revising issues as they provide responses to questions on the instrument, RC students may be considering these issues for the first time. It should be noted that this is only one of a number of arguments which might seek to explain the difference between the two student populations. One school serves an urban community the other a rural market town, the aspirations of these two groups of students may be significantly different and may influence their interest in, and conceptions of technology.

7.2.3 Other influences on student conception

In responding to questions in the instrument students from both schools identified activities outside school which had influenced their conception of technology. Both student populations had a common 'modal conception' and as was noted in the comparison section the difference in the frequency of generation of this conception is striking, the rate for the CTC being twice that of the RC.

In reviewing the interview transcripts a common theme emerged from students of both schools. Although students may be involved in
technology activity outside school this may not influence their conception. Firstly because until these activities are linked to the notion of technology, by experience of technology at school, they do not identify any activity as technology. Students do not seek to identify, or do not identify technology outside school. The finding that CTC students are more likely to identify technology activity outside school than are RC students also supports the notion of heightened awareness derived from a ‘technology rich’ environment.

7.2.4 Implications for a school’s Technology policy

Although the findings of this research might promote much discussion regarding possible changes to the nature of Design and Technology education to further develop the requirements of the National Curriculum, comment in this section is restricted to implications for school policy within the current guidance. One of the chief questions for this research inquiry was: can the conceptions of students in schools be captured? Given that it has been demonstrated that this research methodology has fulfilled this requirement, school policy may be influenced in any situation in which a development or change of student conception is a measure of the effectiveness of a policy, or of its implementation. For example:

- curriculum models are revised or new teaching modules are evaluated;
- a ‘value added’ analysis is made of students development over a period of time;
- the consistency of a teaching team is investigated.

This methodology would enable a student’s conception of technology to be captured before and also after a module of work. A comparison of the two conceptions would provide an indication of the effectiveness of the module (or of the teaching) to be made.
Particularly if a stated aim of the module was to challenge and develop a student's understanding of a specified aspect of technology.

7.3. Opportunities for further research

The development of a methodology which enables student conceptions to be captured provides a working 'tool' with which to investigate issues in design and technology education which relate to the nature of the subject as distinct from monitoring the effectiveness of its delivery, by virtue of its development of students conceptions. For example remaining within the current Design and Technology subject guidance, issues of pedagogy could be explored:

- how do students construct their conceptions of technology?
- can the development of a student's conception of technology be considered in terms of readiness - like reading readiness?
- what would be the implications for the development of effective curriculum models for delivering technology?
- can an international comparison of students conceptions of technology be made?

This research inquiry has been based on two schools which display a differing emphasis on technology in their curriculum. Much comparative study remains to be undertaken between schools in this and other countries, the methodology outlined in this study would provide a basis for that comparison.

References

CTC, School prospectus, 1996

D Householder and B Bolin, 'Technology: its influence in the secondary school upon achievement in academic subjects and upon students' attitude toward technology'. International Journal of Technology and Design Education, Vol. 3 No 2 1993, pp5 - 18

238


APU, *Understanding Design and Technology*, Assessment of Performance Unit 1982


A Bame and W Dugger, 'Pupils attitudes and concepts of technology', *The Technology Teacher*. Volume 49 Number 8 1990, pp10-11


J Beynon and H Mackay (eds), Technological Literacy and the Curriculum, London: The Falmer Press 1992


A Clegg, P Medway and D Yeomans, Planning for Technology within the Curriculum - Module 4 ET887/897, Milton Keynes: The Open University Press 1987


DES, Design and Technology for ages 5 to 16: Proposals of the Secretary of State for Education and Science and the Secretary of State for Wales, HMSO 1989

DFE, Technology for ages 5 to 16 (1992): Proposals of the Secretary of State for Education and the Secretary of State for Wales, York: HMSO 1992

DFE, Design and Technology in the National Curriculum, London HMSO 1995


E Glaserfeld, 'Learning as a constructive activity’, P Murphy and B Moon (eds), *Developments in Learning and Assessment*, London: Hodder and Stoughton 1989


HMI, *CDT: A curriculum statement for the 11-16 age group*, HMI 1983


A Jones and M Carr, 'Teachers Perceptions of Technology', Learning in Technology Education Project, Hamilton: University of Waikato 1992

P Jones, Cultural constructs of technology: a different paradigm for technological literacy, Paper for IDATER 97 Department of Design and Technology, Loughborough University 1997


D Lee, TVEI and curriculum theory, Bishop Norton: David Lee & Humberside Education Services, 1996


MEG, Technology Syllabus A (syllabus code 1457), Cambridge: Midland Examining Group 1994


H Mackay, M Young and J Beynon (eds), Understanding Technology in Education, London: The Falmer Press 1991

C Mitcham, Thinking through technology: the path between Engineering and philosophy, Chicago: The University of Chicago Press 1994

C Mitcham and R Mackay (eds), Introduction: Technology as a Philosophical Problem, Philosophy and Technology, London: The Free Press 1983

P Murphy, ‘Gender and Assessment in Science’, P Murphy and B Moon (eds), Developments in Learning and Assessment. London: Hodder and Stoughton 1989


J Naughton, ‘What is ‘technology’ anyway?’, Introduction to T101, Milton Keynes: Open University Press 1979

J Naughton, ‘What is ‘technology’ anyway?’, A Cross and R McCormick (eds), Technology in schools, Milton Keynes: Open University Press 1986

NCC, Technology 5-16 in the national curriculum: a report to the Secretary of State for Education and Science on the statutory consultation for attainment targets and programmes of study in technology, York: NCC 1989

NCC, Non-statutory guidance - Design & Technology Capability, York: NCC 1990

NCC, Non-statutory Guidance: Information Technology Capability, York: NCC 1990

NCC, Issues in Design and Technology: Technology in the National Curriculum in Key Stages 1 to 4, York: NCC 1991
NCC, Technology programmes of study and attainment targets: recommendations of the national curriculum council, York: NCC 1993


A Pacey, The culture of technology, Oxford: Blackwell 1983

L Parker and L Rennie, ‘Attitude towards technology: Administration of the questionnaire in Western Australia’, J Raat and M de Vries (eds), Pupils’ attitude towards technology, Eindhoven: Eindhoven University of Technology 1986

M Parkes, Letter to the Secretary of State for Education and Science and the Secretary of State for Wales, In DES, Design and Technology for ages 5 to 16: Proposals of the Secretary of State for Education and Science and the Secretary of State for Wales, HMSO 1989


J Raat and M de Vries (eds), Pupils’ attitude towards technology, Eindhoven: Eindhoven University of Technology 1986


School Science Curriculum Review and Further Education Unit, School Technology is Changing: Implications for schools and colleges. [undated but post 1988]


St Williams Foundation, 'Our future needs technology' [manifesto document], York: St Williams Foundation 1985


C Thomson and D Householder, 'Perceptions of Technological competences in elementary technological education' Paper for IDATER 95, Department of Design and Technology, Loughborough University of Technology 1995

M J de Vries, 'What is technology?', J Raat and M de Vries (eds), *Pupils’ attitude towards technology*, Eindhoven: Eindhoven University of Technology 1986


B Woolnough, 'The place of Technology in Schools', *School science review*, Volume 56: 443-448 1975

E Wragg, *Rediguide 11: Conducting and Analysing Interviews*, TRC-Rediguides Ltd
Transcription matrices

The responses provided to questions in the instrument are used to generate a 'conception statement' which has twenty nine sections. Between one and four questions are used to generate each statement section via a 'transcription matrix'. Each statement section has a number of different options dependent on the combination of responses provided to questions in the instrument. This appendix contains the twenty nine matrices, and details the instrument questions, statement bank comments and the way they are linked. The matrices are grouped by area of interest as reported in the main text.

Figure AI.1 shows an example of the matrix format.

Option 'a' is only produced when the respondent agrees - 'A' to both questions.

Disagreement with the first question produces option 'b', regardless of the response to the second (indicated by the shaded box).

Option 'c' is generated by any don't understand - 'U' response.

Response options A D U

<table>
<thead>
<tr>
<th>Question</th>
<th>A</th>
<th>D</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
</tbody>
</table>

Statement option a
Statement option b
Statement option c
TRANSCRIPTION DETAILS FOR STATEMENT SECTION ‘A’
- QUESTIONS 1, 2, 3 AND 4

Questions

1. You cannot do technology by accident - an activity is only technology if you do it for a purpose - to get the result you wanted.

2. You copy someone who is doing technology, even if you don’t understand what you are doing you are still doing technology.

3. I worked out how to make a system to open my garage doors without getting out of the car. I made all the electronics myself. I have been involved in technology.

4. I work for a firm which makes garage doors. I fit the bits where I’m told or I copy the other workers. I think I am doing technology.

Response options A D U

Statement options

Aa. You feel an activity is to do with technology if you started the activity intending to carry out that course of activity. You cannot do technology by accident or by copying others.

Ab. You feel that if you undertake an activity which is recognised by others as technology (even if you did not at the time) you are still doing technology.

Ac. You are undecided whether doing technology involves participation in an activity (which others may confirm as technology) or if doing technology requires an intention to take that course of action.
Questions

53. When you use electronic or computer products you are doing technology.

54. Using electrical appliances is not technology.

55. Using a product of technology is the same as doing technology.

Response options A D U

Statement options

BDa. You do not associate using the products of technology activity as doing technology.

BDb. You feel you are doing technology when you use technology products.

BDC. You are undecided whether using the products of technology is the same as doing technology.

BDd. BLANK
Questions

5. You can only be involved in technology activity if you make things.

6. An example of the end result of technology activity could be changing the way a system works.

7. You have not been involved in technology activity if you only suggest proposals for what could be made.

8. Ideas or proposals about how to change a system are not results of technology activity.

Response options: A D U

Statement options

A. You feel that in order to have been involved in technology activity, that activity must have resulted in a proposal being manufactured.

B. You feel that in order to have been involved in technology activity, that activity must have resulted in a proposal being manufactured or effected change in the case of a system.

C. BLANK

D. You feel that you have been involved in technology activity if the outcome was only to produce proposals which others could manufacture.

E. You feel that you have been involved in technology activity if the outcome was only to produce proposals which others could manufacture or propose changes to systems which others will effect.

F. You are unclear as to the extent to which an activity is technology based on the production of an object.
### TRANSCRIPTION DETAILS FOR STATEMENT SECTION ‘X’
- QUESTIONS 43 AND 44

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response options A</th>
<th>D</th>
<th>U</th>
<th>any other combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>43. Humans have always been involved in technology activities.</td>
<td>A</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44. Technology is a recent idea in human history - within the last 100 yrs</td>
<td>D</td>
<td>A</td>
<td></td>
<td>Xa Xb Xc</td>
</tr>
</tbody>
</table>

**Statement options**

- **Xa. You recognise that technology has always been related to human activity**
- **Xb. You see technology as a recent development**
- **Xc. Blank.**
Question
45. Other countries and cultures *don't* have technology.

Response options A D U

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>A</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ya</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yb</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statement options

Ya. You recognise that technology activity occurs in other countries and cultures not just our own.

Yb. BLANK.
### Question

46. Technology is only to do with factories which use robot machines.

### Response options A D U

- A
- D
- U

### Statement options

- Za. You see technology as being associated with modern industrial practices.
- Zb. BLANK.
Questions

9. Technology can be thought of as a number of stages. For example: ideas, proposals, testing and evaluation.

10. All technology activity is about following the stages you have been taught.

11. Any activity which can be broken into stages can be classed as technology.

12. An activity is more likely to be technology because of what it is than because it can be broken into stages.

Statement options

Ca. You identify stages within technology activity. Technology has a routine sequence of stages. You would suggest that an activity is to do with technology because of its sequence of stages rather than the content of its activity.

Cb. You identify technology as having a routine sequence of stages: however, neither this fact, or the knowledge base of the activity can on their own make the activity technology.

Cc. You believe the nature of the activity has more to do with it being technology than the fact that it can be broken down into a number of routine stages.
Transcription Details for Statement Section 'D'
- Questions 13, 14 and 15

Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Response options A D U</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Solving problems and being involved in technology activity are the same.</td>
<td>A D D</td>
</tr>
<tr>
<td>14. Only some aspects of technology and solving problems are the same</td>
<td>D A D</td>
</tr>
<tr>
<td>15. An activity is more likely to be classed as technology because of the knowledge or information it uses, than because it solves problems.</td>
<td>D D A</td>
</tr>
</tbody>
</table>

Statement options

Da. You view technology and problem solving as the same activity. You would probably agree with the following. That if technology is to do with fulfilling human needs, any activity which requires humans to make decisions (solve problems) is technology.

Db. You feel that technology and problem solving have a common pattern of stages. However, the knowledge or information used to solve problems has more to do with making an activity technology than does the fact that it can be broken down into stages.

Dc. You feel an activity is technology because of the type of knowledge it is based on.

Dd. You are unclear about linking technology exclusively to problem solving.
TRANSCRIPTION DETAILS FOR STATEMENT SECTION ‘E’
- QUESTIONS 16 AND 17

Questions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Response options A D U</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. I think that before you start an activity in technology you need to <strong>know how to</strong> work through it in stages.</td>
<td>A A D D</td>
<td>any ‘U’ combination</td>
</tr>
<tr>
<td>17. You <strong>can</strong> start a technology activity without knowing about investigating, developing ideas, making testing or evaluating.</td>
<td>D A A D</td>
<td></td>
</tr>
</tbody>
</table>

Statement options

**Ea.** You feel that before you start technology activity you need to be aware of the steps or stages which will help you control the activity.

**Eb.** You are undecided whether you need to be aware of the steps or stages which will help you manage technology activity before you start.

**Ec.** BLANK
Questions | Response options A D U
---|---
18. Being able to find information is not as important for doing technology as knowing the information in the area you are working in. | D A [ ] D A
19. You can undertake more technology activities if you know how to find the information (knowledge) you need. | A D A D A
20. You need have learnt about a topic before you can do a technology activity based in that area. | D A A D A

Statement options

Fa. You feel that in order to undertake a technology activity you need to know how to find and organise information and knowledge before you start rather than knowing the information before you start.

Fb. You feel that in order to undertake a technology activity you need to know the facts and information about the area on which the activity is based - rather than being able to find the information during the progress of the activity.

Fc. In addition to being able to find information. You feel that you need to have some knowledge of the field in which the activity takes place so that you can understand and use the information which you find.

Fd. You are uncertain about the value of knowing about a topic compared with being able to find out about a topic when undertaking technology activity.

Fe. BLANK.
TRANSCRIPTION DETAILS FOR STATEMENT SECTION ‘G’
- QUESTIONS 21 AND 22

Questions

21. *Only* a subject called ‘technology’ teaches you how to do technology.

22. Only the information you learn in ‘technology’ lessons is to with technology.

Response options A D U

Statement options

Ga. You feel that the only subject in school which teaches technology is the subject which has that title in its name.

Gb. You feel that the only subject in school which teaches technology is the subject which has that title in its name and only the work covered in these lessons is technology.

Bc. BLANK
Question

23. Some knowledge learnt in other subjects is to do with technology.

Response options A D U

Statement options

Ha. In order to undertake technology activities information/knowledge from other subjects is sometimes required.

Hb. BLANK.
TRANSCRIPTION DETAILS FOR STATEMENT SECTION 'J' - QUESTIONS 24

Question:

24. Subjects other than 'technology' can also teach you how to do technology activity.

Response options A, D, U

Ja, Jb, Jb

Statement options:

Ja. You feel subjects other than 'Technology' may also teach you how to do technology.

Jb. BLANK.
25. Science subjects can teach how to do technology.

Statement options

Ka. You identify that technology is also taught in science. Technology and science lessons both teach aspects of investigation, producing proposals, testing, problem solving.

Kb. BLANK.
26. Science subjects can teach you how to investigate, test and solve problems.

**Response options A D U**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>D</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>La</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lb</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Statement options**

La. You believe that technology is the application of science or science in action.

Lb. BLANK.
**TRANSCRIPTION DETAILS FOR STATEMENT SECTION 'M’**
- QUESTIONS 27, 28, AND 29

**Questions**

<table>
<thead>
<tr>
<th>Question</th>
<th>Response options A D U</th>
</tr>
</thead>
<tbody>
<tr>
<td>27. Technology products <em>can</em> save work around the house.</td>
<td>A</td>
</tr>
<tr>
<td>28. We come into contact with the results of technology every day.</td>
<td>A</td>
</tr>
<tr>
<td>29. Only people who undertake technology activity come into contact with technology.</td>
<td>D</td>
</tr>
</tbody>
</table>

**Statement options**

- **Ma.** You understand that the development of technology has created situations which influence your daily life.

- **Mb.** BLANK
TRANSCRIPTION DETAILS FOR STATEMENT SECTION 'Q'
- QUESTIONS 35

Question
35. Technology is changing people’s jobs.

Response options A D U
A  D  U

Statement options
Qa. You believe technology is affecting employment patterns.
Qb. BLANK.
**Question**

30. Technology can produce developments which cause problems as well as solving problems

**Response options A D U**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>D</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Statement options**

Na. You have identified that technology can create problems as well as providing solutions

Nb. Blank.
Questions

31. The results of technology *are* always good.

32. Technology developments *can* be used for good or bad purposes.

Response options A D U

Statement options

Oa. You see the products of technology as having a neutral effect, they are good or bad depending on the way they are used.

Ob. BLANK
**TRANSCRIPTION DETAILS FOR STATEMENT SECTION ‘P’**
- **QUESTIONS 36 AND 37**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response options A D U</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>36. You need</strong> to know how technology products work.</td>
<td>A</td>
</tr>
<tr>
<td><strong>37. You don’t need</strong> to know how household appliances work to use them.</td>
<td>D</td>
</tr>
</tbody>
</table>

**Statement options**

- **Pa.** You feel you should understand how these products work.
- **Pb.** You do not feel that it is necessary for you to know how technology products work to be able to use them.
- **Pc.** BLANK
**TRANSCRIPTION DETAILS FOR STATEMENT SECTION ‘R’
- QUESTIONS 33 AND 34**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response options A D U</th>
</tr>
</thead>
<tbody>
<tr>
<td>33. You might study the effects of technology in RE or PSE lessons.</td>
<td>A</td>
</tr>
<tr>
<td>34. You might study the results of technology in History lessons.</td>
<td>U   A</td>
</tr>
<tr>
<td></td>
<td>any other combination</td>
</tr>
</tbody>
</table>

Statement options

- **Ra.** Issues to do with technology are evident in many subjects other than technology. You are able to observe them in areas such as RE.
- **Rb.** Issues to do with technology are evident in many subjects other than technology. You are able to observe them in areas such as RE and History.
- **Rc.** BLANK
### Question

38. My ideas about technology have *not* been influenced by experiences at home.

### Response options A D U

<table>
<thead>
<tr>
<th>A</th>
<th>D</th>
<th>U</th>
<th>A*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### Statement options

<table>
<thead>
<tr>
<th>Sa</th>
<th>You feel you may have been influenced at home by:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Sb</th>
<th>You feel your ideas about technology have not been influenced by experiences at home.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sc</th>
<th>BLANK.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sd</th>
<th>You are uncertain if you have been influenced by experiences at home but you may have been influenced by:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE.** If response to question 38 is A but any response to questions 39 - 42 is D use A*
39. Programmes I have watched on television at home have **not** influenced my ideas about what technology is.

**Statement options**

- Ta. watching programmes about technology on television.
- Tb. BLANK.
40. Using home computers has not influenced my ideas about what technology is.
41. Using tools or workshop equipment at home has not influenced my ideas about what technology is.

<table>
<thead>
<tr>
<th>Statement options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Va. using tools or home workshop equipment.</td>
</tr>
<tr>
<td>Vb. BLANK.</td>
</tr>
</tbody>
</table>

Response options A D U

D  A  U

V_a  V_b  V_b
42. At home my family *never* discusses anything to do with technology.

**Statement options**

Wa. Your view has also been developed by discussing the effects of technology with members of your family.

Wb. BLANK.
### TRANSCRIPTION DETAILS FOR STATEMENT SECTION 'BA'

- **QUESTIONS 47**

<table>
<thead>
<tr>
<th>Question</th>
<th>Response options A D U</th>
</tr>
</thead>
<tbody>
<tr>
<td>47. Only products or objects are the end results of technology activity.</td>
<td></td>
</tr>
</tbody>
</table>

**BA**

#### Statement options

- **BA a.** You see the manufacture of products as the outcome of technology activity.

- **BA b.** You see that technology activity can have a number of types of outcome one of which is the manufacture of products.

- **BA b.** BLANK.
TRANSCRIPTION DETAILS FOR STATEMENT SECTION ‘BB’
- QUESTIONS 48 AND 49

Questions

48. Only electronic or computer products are products of technology.

49. Only electrical appliances are products of technology.

Response options A D U

BB

Statement options

BBa. You see electrical products as being connected with technology - particularly those which involve some intelligence or processing capability.

BBb. You feel products are to do with technology if they are electrical in nature.

BBc. BLANK
### Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Response Options A D U</th>
</tr>
</thead>
<tbody>
<tr>
<td>50. All manufactured (man made) things <em>are</em> products of technology.</td>
<td></td>
</tr>
<tr>
<td>51. New medicines and drugs <em>are</em> products of technology.</td>
<td></td>
</tr>
<tr>
<td>52. New strains of plants <em>are</em> examples of technology.</td>
<td></td>
</tr>
</tbody>
</table>

### Statement options

- **BCa.** You can see that whilst some products may themselves be used in further technology activity all manufactured products (products made by man) are products of technology.

- **BCb.** You can see that whilst some products may themselves be used in further technology activity all manufactured products (products made by man) are products of technology also you see that 'soft products' such as new strains of plants can be included.

- **BCc.** BLANK
APPENDIX II

Plots of responses to questions in the instrument

The figures reproduced for this appendix contain plots of the ‘agree A’, ‘disagree D’ and ‘don’t understand U’ responses for each question in the instrument. They were drawn to aid the process of comparing the conceptions of technology held by students in each school. The first column contains plots of responses to instrument questions made by Rural Comprehensive School students (by Year Group). The second column of plots show the responses of students at the City Technology College (again by Year Group). In both columns the plots were drawn to differentiate the response patterns of boys from girls.

A third column of plots was included. Again by Year Group but drawn to enable a comparison to be made between the response patterns of the two student populations.

The plots produced indicate the total number of students using that particular response option, as a percentage of that Year Group.
RESPONSE: % OF SCHOOL SAMPLE

Q.1 You cannot do technology by accident - an activity is only technology if you do it for a purpose - to get the result you wanted.
Figure AII.2 Response: % of school sample. Question 2

RESPONSE: % OF SCHOOL SAMPLE

Q.2 You copy someone who is doing technology, even if you don’t understand what you are doing you are still doing technology.

<table>
<thead>
<tr>
<th></th>
<th>CTC</th>
<th>RURAL COMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOYS</td>
<td>GIRLS</td>
<td></td>
</tr>
<tr>
<td>Year 7</td>
<td>27/58/15</td>
<td>36/56/8</td>
</tr>
<tr>
<td>Year 8</td>
<td>34/63/3</td>
<td>29/71/0</td>
</tr>
<tr>
<td>Year 9</td>
<td>31/62/7</td>
<td>47/44/9</td>
</tr>
<tr>
<td>Year 10</td>
<td>53/44/3</td>
<td>54/39/7</td>
</tr>
</tbody>
</table>

278
RESPONSE: % OF SCHOOL SAMPLE

Q. 3 I worked out how to make all the parts of a system to open my garage doors without having to get out of my car. I made all the electronic systems myself. I think that I **have** been involved in technology.
Q. 4 I work for a firm which makes automatic garage doors. I don't know how or why they work. I just fit the bits where I am told to, or I copy the other workers who are doing the same thing. I think that I am doing technology.
Q.5 You can only be involved in technology activity if you make things

RESPONSE: % OF SCHOOL SAMPLE

BOYS GIRLS

RURAL COMP

CTC

RURAL COMP

Year 7

44 51 5
25 72 3

34 64 2
29 68 3

32 65 3
36 60 4

Year 8

38 59 3
21 79 0

12 88 0
7 93 0

9 91 0
30 68 2

Year 9

31 67 2
40 60 0

11 89 0
13 87 0

35 64 1

Year 10
**Figure AII.6 Response: % of school sample. Question 6**

**RESPONSE: % OF SCHOOL SAMPLE**

**Q. 6** An example of the end result of technology activity could be changing the way a system works.

<table>
<thead>
<tr>
<th>Year 7</th>
<th>BOYS</th>
<th>GIRLS</th>
<th>RURAL COMP</th>
<th>CTC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>38</td>
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<table>
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<th>GIRLS</th>
<th>RURAL COMP</th>
<th>CTC</th>
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<td>6</td>
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282
Q.7 You have not been involved in technology activity if you only suggest proposals for what could have been made

RESPOSNE: % OF SCHOOL SAMPLE

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Figure AII.8 Response: % of school sample. Question 8

RESPONSE: % OF SCHOOL SAMPLE

Q. 8 Ideas or proposals about how to change a system are not results of technology activity

BOYS ☐ GIRLS ☐

RURAL COMP

CTC

RURAL COMP

Year 7

36 51 13
28 56 16

23 66 11
16 71 13

20 68 12
32 53 15

Year 8

34 41 25
33 54 13

82 12 6
20 67 13

53 38 9
34 46 20

Year 9

29 58 13
21 65 14

Year 10

13 78 9
26 72 2

17 75 8

284
RESPONSE: % OF SCHOOL SAMPLE

Q. 9 Technology can be thought of as a number of stages. For example: ideas, proposal, testing and evaluation

BOYS ☐ GIRLS ☐

RURAL COMP

CTC

Year 7

82 5 13
97 0 3

Year 8

88 3 9
92 4 4

Year 9

89 7 4
95 0 5

Year 10

100 0 0
98 2 0

CTC

RURAL COMP

97 0 3
89 2 9

97 0 3
89 2 9

92 3 5
99 1 0
Figure AII.10 Response: % of school sample. Question 10

RESPONSE: % OF SCHOOL SAMPLE

Q.10 All technology activity is about following the stages you have been taught

BOYS ☐ GIRLS ☑

RURAL COMP

CTC

RURAL COMP

Year 7

Year 8

Year 9

Year 10

286
Figure AII.11 Response: % of school sample. Question 11

RESPONSE: % OF SCHOOL SAMPLE

Q.11 Developing a new type of coat is technology because the process can be broken into stages.

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Question 12: An activity is more likely to be technology because of what it is, than because it can be broken down into stages. For example: developing a new electronic circuit or developing a new type of child’s coat can both be broken down into the same stages, but one is more to do with technology than the other.
Figure AII.13 Response: % of school sample. Question 13

RESPONSE: % OF SCHOOL SAMPLE

Q.13 Solving problems and being involved in technology are the same

BOYS ☐ GIRLS ☐

RURAL COMP

CTC

CTC RURAL COMP ☐

Year 7

Year 8

Year 9

Year 10

289
Figure AII.14 Response: % of school sample. Question 14

RESPONSE: % OF SCHOOL SAMPLE

Q.14 Only some aspects of technology and solving problems are the same

BOYS ☐ GIRLS ☐

RURAL COMP | CTC

CTC

RURAL COMP

Year 7

Year 8

Year 9

Year 10

290
Q. 15 An activity is more likely to be classed as technology because of the knowledge or information it uses, than because it solves problems.
RESPONSE: % OF SCHOOL SAMPLE

Q. 16 I think that before you start an activity in technology you need to know how to work through it in stages.

BOYS GIRLS

RURAL COMP

Year 7
- Boys: 93, Girls: 94
- Rural Comp: 7, Girls: 6

Year 8
- Boys: 88, Girls: 88
- Rural Comp: 6, Girls: 8

Year 9
- Boys: 87, Girls: 91
- Rural Comp: 13, Girls: 7

Year 10
- Boys: 78, Girls: 89
- Rural Comp: 22, Girls: 11
RESPONSE: % OF SCHOOL SAMPLE

Q.17 You can start a technology activity without knowing about investigating, developing ideas, making, testing or evaluating

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Year 7
- 27% BOYS, 69% GIRLS
- 4% RURAL, 2% CTC

Year 8
- 25% BOYS, 75% GIRLS
- 0% RURAL, 0% CTC

Year 9
- 33% BOYS, 65% GIRLS
- 2% RURAL, 0% CTC

Year 10
- 31% BOYS, 69% GIRLS
- 0% RURAL, 0% CTC
Figure AII.18 Response: % of school sample. Question 18

RESPONSE: % OF SCHOOL SAMPLE

Q.18 Knowing how to find out information about any technology is not as important as knowing about the technology area you are working in

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294
Figure AII.19 Response: % of school sample. Question 19

RESPONSE: % OF SCHOOL SAMPLE

Q.19 You can undertake more technology activities if you know how to find the information (knowledge) you need as you go along.

BOYS ☐ GIRLS ☐

CTC

RURAL COMP

Year 7

Year 8

Year 9

Year 10

CTC

RURAL COMP

295
Figure AII.20 Response: % of school sample. Question 20

RESPONSE: % OF SCHOOL SAMPLE

Q.20 You need to have learnt about a topic before you can do a technology activity based in that area.

BOYS ☐ GIRLS ☐

RURAL COMP CTC

Year 7
- Boys: 67, 58
- Girls: 29, 36
- CTC: 4, 6

Year 8
- Boys: 53, 75
- Girls: 41, 25
- CTC: 6, 0

Year 9
- Boys: 67, 58
- Girls: 31, 42
- CTC: 2, 0

Year 10
- Boys: 61, 59
- Girls: 36, 39
- CTC: 3, 2

CTC RURAL COMP

Year 7
- CTC: 51, 58
- RURAL COMP: 49, 32
- CTC: 0, 0

Year 8
- CTC: 53, 73
- RURAL COMP: 47, 27
- CTC: 0, 0

Year 9
- CTC: 61, 59
- RURAL COMP: 36, 39
- CTC: 3, 2

Year 10
- CTC: 60, 59
- RURAL COMP: 37, 39
- CTC: 3, 2

296
Figure AII.21 Response: % of school sample. Question 21

RESPONSE: % OF SCHOOL SAMPLE

Q.21 Only a subject called 'technology' teaches you how to do technology

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RESPONSE: % OF SCHOOL SAMPLE

Q.22 Only the information you learn in 'technology' lessons is to do with technology

BOYS ☐ GIRLS ☐

RURAL COMP

CTC

Year 7 24 62 14 31 69 0
Year 8 34 66 0 37 63 0
Year 9 27 71 2 21 77 2
Year 10 11 88 1 6 94 0
Figure AII.23 Response: % of school sample. Question 23

RESPONSE: % OF SCHOOL SAMPLE

Q. 23 Some knowledge learnt in other subjects is to do with technology

BOYS ☐ GIRLS ☐

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RESPONSE: % OF SCHOOL SAMPLE

Q. 24 Subjects other than 'technology' can also teach you how to do technology activity

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CTC: RURAL COMP
Figure AII.25 Response: % of school sample. Question 25

RESPONSE: % OF SCHOOL SAMPLE

Q.25 Science subjects can teach how to do technology

BOYS ☑ GIRLS ☐

RURAL COMP  CTC

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RURAL COMP
RESPONSE: % OF SCHOOL SAMPLE

Q. 26 Science subjects can teach you how to investigate, test and solve problems

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Figure AII.27 Response: % of school sample. Question 27

RESPONSE: % OF SCHOOL SAMPLE

Q.27 Products of technology can save work around the house

BOYS ☐ GIRLS ☐

RURAL COMP CTC

Year 7

90 5 5
75 17 8

80 16 4
90 5 5

84 11 5
85 10 5

Year 8

81 16 3
79 21 0

94 6 0
80 20 0

88 12 0
80 18 2

Year 9

94 4 2
88 7 5

96 5 0
95 2 2

91 6 3

Year 10

95 4 1
96 2 2

A D U
Q.28 We come into contact with the results of technology every day.
Figure AII.29 Response: % of school sample. Question 29

RESPONSE: % OF SCHOOL SAMPLE

Q.29 Only people who undertake technology activity come into contact with technology.

BOYS ☑ GIRLS ☐

RURAL COMP

CTC

Year 7

Year 8

Year 9

Year 10

305
RESPONSE: % OF SCHOOL SAMPLE

Q. 30 Technology can produce developments which cause problems as well as solving problems.

BOYS ☐ GIRLS ☐

RURAL COMP

CTC

Year 7

64 9 27

64 11 25

Year 8

75 9 16

96 0 4

Year 9

89 2 9

84 4 12

Year 10

97 3 0

93 2 0

CTC

RURAL COMP

64 10 26

83 10 7

64 10 26

83 10 7

85 9 6

84 5 11

86 4 10

95 5 0

93 2 0
Figure AII.31 Response: % of school sample. Question 31

RESPONSE: % OF SCHOOL SAMPLE

Q.31 The results of technology are always good

BOYS ☐ GIRLS ☐

RURAL COMP

CTC

RURAL COMP

Year 7

Year 8

Year 9

Year 10

307
Figure AII.32 Response: % of school sample. Question 32

RESPONSE: % OF SCHOOL SAMPLE

Q.32 Technology developments can be used for good or bad purposes

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Year 7

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Year 8

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Year 9

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Year 10

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A  D  U
Figure AII.33 Response: % of school sample. Question 33

RESPONSE: % OF SCHOOL SAMPLE

Q.33 You might talk about some of the effects of technology in RE.

Boys: □  Girls: □
Rural Comp:

Year 7
- Boys: 31, 62, 7, 33, 64, 3
- Girls: 33, 64, 3

Year 8
- Boys: 66, 25, 9, 63, 37, 0
- Girls: 63, 37, 0

Year 9
- Boys: 49, 45, 6, 44, 53, 3
- Girls: 44, 53, 3

Year 10
- Boys: 94, 6, 0, 85, 13, 2
- Girls: 90, 9, 1

CTC

Rural Comp:
- Boys: A, D, U
- Girls: □

CTC
- Boys: □
- Girls: □
**Figure AII.34 Response: % of school sample. Question 34**

**RESPONSE: % OF SCHOOL SAMPLE**

**Q.34** You might study the results of technology in History lessons

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Figure AII.35 Response: % of school sample. Question 35

RESPONSE: % OF SCHOOL SAMPLE

Q.35 Technology is changing people's jobs

BOYS □ GIRLS □

RURAL COMP

CTC

RURAL COMP

Year 7

Year 8

Year 9

Year 10

311
Figure AII.36 Response: % of school sample. Question 36

RESPONSE: % OF SCHOOL SAMPLE

Q.36 You need to know how technology products work

BOYS ☐ GIRLS ☐ RURAL COMP ☐

CTC

RURAL COMP ☐

Year 7 67 27 6 78 19 3

Year 8 50 47 3 75 25 0

Year 9 69 31 0 70 26 4

Year 10 41 58 1 39 59 2

Year 11 61 32 7 61 34 5

Year 12 61 33 6 72 23 5

Year 13 50 47 3 61 37 2

Year 14 69 28 3
Figure AII.37 Response: % of school sample. Question 37

RESPONSE: % OF SCHOOL SAMPLE

Q.37 You don't need to know why household appliances work to use them

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RESPONSE: % OF SCHOOL SAMPLE

Q38 My ideas about technology have **never** been influenced by experiences at home

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314
 RESPONSE: % OF SCHOOL SAMPLE

Q.39 Programmes I have watched on television at home have *not* influenced my ideas about what technology is

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Figure A11.40 Response: % of school sample. Question 40

RESPONSE: % OF SCHOOL SAMPLE

Q.40 Using home computers has not influenced my idea about what technology is

BOYS [Diagram] GIRLS [Diagram]

RURAL COMP [Diagram] CTC

Year 7

Year 8

Year 9

Year 10
Figure AII.41 Response: % of school sample. Question 41

RESPONSE: % OF SCHOOL SAMPLE

Q.41 Using tools or workshop equipment at home has not influenced my idea about what technology is

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Figure AII.42 Response: % of school sample. Question 42

RESPONSE: % OF SCHOOL SAMPLE

Q.42 At home my family *never* discusses anything to do with technology

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Figure AII.43 Response: % of school sample. Question 43

RESPONSE: % OF SCHOOL SAMPLE

Q. 43 Humans have always been involved in technology activities

BOYS □ GIRLS □

RURAL COMP

CTC

Year 7

62 29 9
69 25 6

Year 8

69 28 3
63 37 0

Year 9

93 7 0
79 19 2

Year 10

88 11 1
81 19 0

CTC

RURAL COMP

Year 7

80 18 2
61 37 2

Year 8

76 18 6
66 27 7

Year 9

72 22 6
66 32 2

Year 10

86 31 1
85 14 1
RESPONSE: % OF SCHOOL SAMPLE

Q.44 Technology is a recent idea in human history - within the last 100 yrs

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RESPONSE: % OF SCHOOL SAMPLE

Q. 45 Other countries and cultures don't have technology

BOYS □ GIRLS □
RURAL COMP

CTC

Year 7

Year 8

Year 9

Year 10

RURAL COMP

CTC
RESPONSE: % OF SCHOOL SAMPLE

Q.46 Technology is only to do with factories which use robot machines

BOYS [ ] GIRLS [ ]

RURAL COMP

CTC

RURAL COMP

Year 7

Year 8

Year 9

Year 10

A D U

H H H
Figure AII.47 Response: % of school sample. Question 47

RESPONSE: % OF SCHOOL SAMPLE

Q. 47 Only product or objects are the end result of technology activity

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Year 7
- Boys: 36, 38, 26
- Girls: 19, 56, 25
- CTC: 30, 61, 9

Year 8
- Boys: 28, 66, 6
- Girls: 29, 58, 13
- CTC: 12, 88, 0

Year 9
- Boys: 45, 51, 4
- Girls: 47, 47, 6
- CTC: 45, 49, 6

Year 10
- Boys: 19, 81, 0
- Girls: 19, 81, 0
- CTC: 19, 81, 0
Figure AII.48 Response: % of school sample. Question 48

RESPONSE: % OF SCHOOL SAMPLE

Q.48 Only electronic and computer products are products of technology

BOYS ☐ GIRLS ☐
RURAL COMP

CTC

Year 7

Year 8

Year 9

Year 10

324
RESPONSE: % OF SCHOOL SAMPLE

Q. 49 Only electrical appliances are products of technology

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</tbody>
</table>
RESPONSE: % OF SCHOOL SAMPLE

Q.50 All manufactured (man made) things are products of technology

BOYS □ GIRLS □ RURAL COMP □

CTC □ RURAL COMP □

Year 7 62 31 7 64 33 3

Year 8 62 38 0 67 33 0

Year 9 69 27 4 77 19 4

Year 10 64 33 3 87 13 0

A □ D □ U □

61 37 2 63 32 5

53 47 0 64 36 0

73 23 4

75 24 1

326
RESPONSE: % OF SCHOOL SAMPLE

Q.51 New medicines and drugs are products of technology

<table>
<thead>
<tr>
<th>Year 7</th>
<th>BOYS</th>
<th>GIRLS</th>
<th>RURAL COMP</th>
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<td>Year 10</td>
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</tbody>
</table>

Figure AII.51 Response: % of school sample. Question 51
RESPONSE: % OF SCHOOL SAMPLE

Q. 52 New strains of plants are examples of technology products

BOYS GIRLS

RURAL COMP

CTC

RURAL COMP

Year 7

36 49 15
42 42 16

Year 8

31 50 19
46 50 4

Year 9

42 47 11
42 42 16

Year 10

55 39 6
69 28 3

328
RESPONSE: % OF SCHOOL SAMPLE

Q.53 When you use electronic or computer products you are doing technology.

BOYS □ GIRLS □
RURAL COMP

CTC

RURAL COMP

Year 7
51 40 9
64 25 11

Year 8
56 41 3
75 25 0

Year 9
76 22 2
81 19 0

Year 10
63 36 1
69 31 0

329
Q. 54 Using an electrical appliance does not mean you are doing technology

**RESPONSE: % OF SCHOOL SAMPLE**

**BOYS** □ **GIRLS** □

**RURAL COMP**

**CTC**

**Year 7**

<table>
<thead>
<tr>
<th>Boys</th>
<th>Girls</th>
<th>Rural Comp</th>
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<tbody>
<tr>
<td>64</td>
<td>22</td>
<td>14</td>
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<td>58</td>
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**Year 8**

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<tr>
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**Year 10**

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<tr>
<td>56</td>
<td>43</td>
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</table>
Figure A11.55 Response: % of school sample. Question 55

RESPONSE: % OF SCHOOL SAMPLE

Q.55 Using a product of technology is the same as doing technology

BOYS   GIRLS
RURAL COMP

Year 7
38  38  29
36  61  3

Year 8
38  56  6
33  63  4

Year 9
33  62  4
53  42  5

Year 10
27  70  3
24  72  4

CTC

Year 7
34  64  2
37  55  8

Year 8
18  82  0
33  60  7

Year 9
25  72  3
36  59  5

Year 10
26  71  3

RURAL COMP

C
APPENDIX III

Chi-squared analysis: sample calculation. Question 33

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<td>28.29</td>
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<td>7.13</td>
<td>9.67</td>
<td>0.82</td>
<td>34.72</td>
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From $X^2$ tables value of $P$ is less than $0.001 \sim 0.01\%$ chance
APPENDIX IV

Sample instrument

The following pages are a reproduction of the questionnaire instrument. This has been reduced in size for inclusion as this appendix. When it was presented to students it was printed on two sheets of A3 paper which were folded to form an A4 size booklet. The pages were printed 'back to back' (rather than single pages as presented here).
QUESTIONS ABOUT TECHNOLOGY

These questions are part of my research to find out what students think technology is.

The booklet has 55 statements - you have to decide if you agree with the statements or not.

Read each statement then put a cross in the box to agree or disagree with the statement.

For example:

Read the statement below. If you think that the moon is not made of cream cheese, then you would disagree with the statement and put a cross in box 'D'

The moon is made of cream cheese

If you think this statement is correct (you agree) you would put a cross in the 'A' box.

Only use the box 'U' if you don’t understand the statement.

Remember this is not a test - I would like to know your views, there are no wrong answers, everybody has opinions which are important.

Please give the following information which will help me analyse your answers:

Are you a girl or a boy? [ ] Your register number? [ ] Your year? [ ]

As you are going to look through statements to do with technology you and I will find it useful if you write down what you think technology is. Don’t spend more than 2 minutes doing this.
### When am I involved in technology activity?

1. You cannot do technology by accident - an activity is only technology if you do it for a purpose - to get the result you wanted.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

2. You copy someone who is doing technology, even if you don't understand what you are doing you are still doing technology.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

3. I worked out how to make all the parts of a system to open my garage doors without having to get out of my car. I made all the electronic systems myself. I think that I have been involved in an activity to do with technology.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

4. I work for a firm which makes automatic garage doors. I don't know how or why they work. I just fit the bits where I am told to, or I copy the other workers who are doing the same as I am. I think that I am doing technology.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

### What is the end result of technology activity?

5. You can only be involved in technology activity if you make things.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

6. An example of the end result of technology activity could be changing the way a system works.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

7. You have not been involved in technology activity if you only suggest proposals for what could be made.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

8. Ideas or proposals about how to change a system are not results of technology activity.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

### Does technology have stages?

9. Technology can be thought of as a number of stages. For example: ideas, proposals, testing and evaluation.
   - Agree: A
   - Disagree: D
   - Don't understand: U
   - Don't mark these: 

10. All technology activity is about following the stages you have been taught.
    - Agree: A
    - Disagree: D
    - Don't understand: U
    - Don't mark these: 

335
11. Any activity which can be broken down into stages can be classed as technology.

12. An activity is more likely to be technology because of what it is; than because it can be broken down into stages. For example: the activity of developing a new electronic circuit or a new type of child’s coat can both be broken down into the same stages but one is more to do with technology than the other.

Is technology like problem solving?

13. Solving problems and being involved in technology activity are the same.

14. Only some aspects of technology and solving problems are the same.

15. An activity is more likely to be classed as technology because of the knowledge or information it uses than because it solves problems.

Starting technology activities

16. I think that before you start an activity in technology you need to know how to work through it in stages.

17. You can start a technology activity without knowing about investigating, developing ideas, making, testing or evaluating.

Finding and knowing information

18. Being able to find information is not as important for doing technology as knowing the information about the area you are working in.

19. You can undertake more technology activities if you know how to find out the information (knowledge) you need.

20. You need to have learnt about a topic before you can do a technology activity based in that area.
### Which subjects teach technology?

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<tr>
<td><strong>21.</strong> Only a subject called ‘technology’ teaches you how to do technology.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>22.</strong> Only the information you learn in ‘technology’ lessons <em>is</em> to do with technology.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>23.</strong> Some knowledge learnt in other subjects <em>is</em> to do with technology.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>24.</strong> Subjects other than ‘technology’ <em>can</em> also you teach how to do technology activity.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>25.</strong> Science subjects <em>can</em> teach how to do technology.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>26.</strong> Science subjects <em>can</em> teach you how to investigate, test and solve problems.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
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### Is technology wide-spread?

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<tr>
<td><strong>27.</strong> Technology products <em>can</em> save work around the house.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>28.</strong> We come into contact with the results of technology every day.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>29.</strong> Only people who undertake technology activity come into contact with technology.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>30.</strong> Technology can produce developments which cause problems as well as solving problems.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>31.</strong> The results of technology <em>are</em> always good.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>32.</strong> Technology developments <em>can</em> be used for good or bad purposes.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>33.</strong> You might study the effects of technology in RE or PSE lessons.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>34.</strong> You might study the results of technology in history lessons.</td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
</tbody>
</table>
35. Technology is changing people’s jobs.  

36. You need to know how technology products work.  

37. You don’t need to know how household appliances work to use them.  

What has influenced your ideas about technology?  

38. My ideas about technology have *not* been influenced by experiences at home.  

39. Programmes I have watched on television at home have *not* influenced my ideas about what technology is.  

40. Using home computers has *not* influenced my idea about what technology is.  

41. Using tools or workshop equipment at home has *not* influenced my idea about what technology is.  

42. At home my family never discusses anything to do with technology.  

Technology - ‘times and cultures’  

43. Humans *have* always been involved in technology activities.  

44. Technology *is* a recent idea in human history - within the last 100 yrs.  

45. Other countries and cultures *don’t* have technology.  

46. Technology *is* only to do with factories which use robot machines.
The products of technology

47. Only products or objects are the end result of technology activity.
   Agree Disagree Don't understand
   A    D    U

48. Only electronic and computer products are products of technology.
   Agree Disagree Don't understand
   A    D    U

49. Only electrical appliances are products of technology.
   Agree Disagree Don't understand
   A    D    U

50. All manufactured (man made) things are products of technology.
   Agree Disagree Don't understand
   A    D    U

51. New medicines and drugs are products of technology.
   Agree Disagree Don't understand
   A    D    U

52. New strains of plants are examples of technology products.
   Agree Disagree Don't understand
   A    D    U

53. When you use electronic or computer products you are doing technology.
   Agree Disagree Don't understand
   A    D    U

54. Using electrical appliances is not technology.
   Agree Disagree Don't understand
   A    D    U

55. Using a product of technology is the same as doing technology.
   Agree Disagree Don't understand
   A    D    U
Well done! This is the last page.

In other schools students have told me that they found these statements difficult because they had never been asked to explain their views of technology.

Has thinking about these statements changed your idea of technology? If it has, make a note in the box to explain how your views have changed or what your new view is.

Which question or questions have helped you change your view of what technology is?

Has anything else influenced your view of technology which I have not asked about? If you think there are some other areas, what are they? - How have they influenced your thinking?