Mapping Reform in Scotland's Technology Education Curriculum: Change and Curriculum Policy in the Compulsory Sector

Robert A. Doherty and Brian Canavan

University of Glasgow Scotland

In this paper we attempt to critically explore the changing technology education curriculum of Scotland's compulsory sector in the preceding twenty years. The first section of the paper sets out a framework for analysing such change drawing on the insights of policy studies. This analytical frame is developed with respect to such dimensions as historical antecedents, sociological perspectives, structural contexts and institutional and group actors. It also attempts to identify useful markers in analysing change within the technology education curriculum. The paper has a focus on 'technical education' as the main provider, in the Scottish context, of courses within the secondary technology curriculum. The paper gives a broad picture of what has changed, and using the framework above, seeks to examine the drivers and agents of change over this period. The final section of the paper sets out a critical appraisal of the status of technology education in Scotland's school curriculum and makes an attempt to look toward its future. In looking to the near and medium term future the paper considers tensions, opportunities and threats to technology education as it develops through the opening decade of the 21st century.

Introduction

The compulsory sector of Scottish education has, over the past twenty years, witnessed a process of curriculum drafting that has resulted in the establishment of a framework that covers the 3-18 age range. Within this framework, the sector has adopted a 'capability' stance in attempting to articulate the place of technology education in its curricular structures. Across all ages and stages, technology education has as its declared goal the development of technological capability defined in terms of: "...understanding appropriate concepts and processes; the ability to apply knowledge and skills by thinking and acting confidently, imaginatively, creatively and with sensitivity; the ability to evaluate technological activities, artefacts and systems critically and constructively" (SCCC, 1996).

In this paper we attempt to critically explore the changing technology education curriculum of Scotland's compulsory sector in the preceding twenty years. In using the term 'curriculum' we assume not just the content of official syllabuses of instructional subject matter, but embrace approaches to assessment, pedagogy and organisation. We must also differentiate our exploration of technology education through the evolution of technical education, formerly technical subjects, from other aspects of technology education provided for within the curricular designs of Scotland's compulsory sector. Technical education can credibly claim to be the main contributor to courses that directly aim to produce technological capability. Historically, technical education in Scotland developed a continuum of knowledge, understanding and skills that could be described as fitting entirely within what has come to be defined as technology education. This range of learning both predates the introduction of technology as a principle of curriculum organisation and has, in turn, been shaped by its introduction.

Scotland's Official Curricula

Technology education is more than technical education, but technical education is the major contributor, at the secondary level, of courses that directly seek to produce technological capability. It could be argued, in the Scottish context, that technical education is more than technology education with its inclusion of creative, aesthetic and social dimensions. This paper, therefore, focuses mainly on change in relation to technical education, but acknowledges the contribution made by other courses. At present, technology education is explicitly included in each of Scotland's curricular frameworks that together form a programme of learning covering the 3-18 age band.

Preschool

Curriculum guidelines for pre-school children published in 1999, (*A Curriculum Framework for Children 3-5* SCCC, 1999) explicitly included technology education:

"The children's environment is one in which technology is important in their everyday lives. As children use blocks, put on a warm jumper, look through a magnifying glass, clamber on to a climbing frame, use a computer or travel by train, they become aware of the everyday uses of technology in the home, in transport, in communication and in leisure." (SCCC, 1999 :23)

In developing their knowledge and understanding of the world children should:

- *ask questions, experiment, design and make, and solve problems*
- *recognise patterns, shapes and colours in the world around them*
- *sort and categorise things into groups*
- *understand some properties of materials, for example soft/hard, smooth/*
- *become aware of everyday uses of technology and use these appropriately, clothing, fridge, bicycle.* (SCCC, 1999 :24)

The 5-14 Curriculum

Following a period of reform in the late 1980's, technology education is an official dimension of the curriculum for all pupils in primary education and in the first two years of secondary. At present there are two main 'attainment outcomes' for technology education contained within the 5-14 curriculum; Knowledge and Understanding and Skills in Designing and Making, there is a third 'permeating' outcome; Developing Informed Attitudes. The present guidelines locate technology education within the 'Environmental Studies' (see Figure 1) aspect of the structure of the curriculum, along with science and social subjects.

Technology is a distinct form of creative activity where people interact with their environment to bring about change in response to needs, wants and opportunities. Technology is not new: it has always been profoundly influential in all human societies and impinges strongly on human relationships and on many aspects of social and economic development - locally, nationally and globally. It is an intrinsic part of all cultures, and reflects and shapes the values and beliefs of the wider cultural context - past, present and future. A broad, balanced and coherent experience of technology is an essential part of the curriculum of all pupils 5-14 and beyond. Pupils will be

better equipped to live purposefully, productively, confidently and wisely if they have been enabled to acquire and deploy a broadly based technological capability. (L.T.S, 2000:5.16)

The Secondary Curriculum

Scotland's secondary curriculum is a subject based curriculum. It is constructed around a modal arrangement that corresponds to a schema for the classification of knowledge developed by the philosopher P.H. Hirst. Hirst argued that forms of knowledge are, "complex ways of understanding knowledge which man has achieved" (Hirst,1965:122). Curricular modes have proved to be a very durable conceptualisation of Scotland's subject centred secondary curriculum, surviving a number of curricular reviews and continuing to form the framework for the middle and upper school curriculum. Subjects and courses are grouped under eight curricular modes (see Figure 1). Within this framework, pupils should be able to negotiate individual curricula that respect curricular principles of breadth, balance, coherence, progression, continuity, and elements of compulsion (see Table 1). An element of technology education is ensured, under this arrangement, by pupils being required to study a course under the mode, Technological Activities and Applications, or a combination of other courses with an auditable technological content.

Technological Activities and Applications, and Creative and Aesthetic Activities, are the two modes under which students can opt to study technical education courses. At present technical departments can choose to offer up to four courses, across two different modes, allowing pupils to study up to two technical subjects (within the curricular arrangements of a minority of schools, pupils can study three subjects) as part of their middle secondary curriculum (see table 2 for the relation of Intermediate and Standard Grade):

Technological Activities and Applications

- Standard Grade or Intermediate Technological Studies
- Standard Grade Craft and Design
- Standard Grade Graphic Communication
- Intermediate Practical Craft Skills

Creative and Aesthetic Activities

- Standard Grade Craft and Design
- Standard Grade Graphic Communication
- Intermediate Practical Craft Skills

Post-16 Provision

The same general modal arrangement that governs the middle secondary is applied (albeit, with more flexibility) to the curricula that are negotiated by individual pupils post-16. Under the same curricular modes as the middle years, technology education is present in the form of a range of courses leading to a national qualification (see Table 3).

Higher Grade is aimed particularly at students who have passed subjects at Standard Grade credit level, or who have successfully completed a subject at Intermediate 2. Highers are the qualifications normally needed for entry into university or college to study for degrees and Higher National courses (HNCs and HNDs). Advanced Highers are aimed particularly at students who have passed Highers and are usually taken in sixth year at school. They extend the skills and knowledge gained at Higher and can

allow direct entry into the second year of some degree programmes. Technical departments can offer a range of post-16 courses including, Higher and Advanced Highers in Product Design, Graphic Communication and Technological Studies. In addition, technical departments provide a range of Intermediate courses at post-16 including a new course; Practical Craft Skills.

Recent developments in the Scottish system has seen effort expended on developing a coherent system of post compulsory education, and training, embracing the final two years of secondary education, further education and higher education (See Table 2). One key aspect of this initiative is the promotion of a Scottish Credit and Qualifications Framework. This framework seeks to promote a more coherent and flexible system for the awarding of qualifications and permitting progression across different sectors of learning. Technical and technology education would seem to be well placed in this climate with obvious links to vocational and further education.

Mode	**Minimum time over 2 years**
Language and Communication	360
Mathematical Studies and Applications	200
Scientific Studies and Applications	160
Social and Environmental Studies	160
Technological Activities and Applications	**80**
Creative and Aesthetic Activities	**80**
Physical Education	80
Religious and Moral Education	80
Core 1200 hours	

Table 1: Obligatory time allocations for each Mode in the 14-16 Curriculum.

Scottish Credit and Qualifications Framework

SCQF level	Schools	Schools and colleges	Colleges and universities	Workplace (Scottish Vocational Qualifications)
12			Doctorate	
11			Masters degree	SVQ 5
10			Honours degree	
9			Ordinary degree	
8			HND/Diploma of Higher Education	SVQ 4
7		Advanced Higher	HNC/Certificate of Higher Education	
6		Higher		SVQ 3
5	Standard Grade — Credit	Intermediate 2		SVQ 2
4	Standard Grade — General	Intermediate 1		SVQ 1
3	Standard Grade — Foundation	Access 3		
2		Access 2		
1		Access 1		

Table 2: The Scottish Credit and Qualifications Framework (SCQF) has been developed to help students, employers and the general public understand the full range and equivalences of Scottish qualifications.

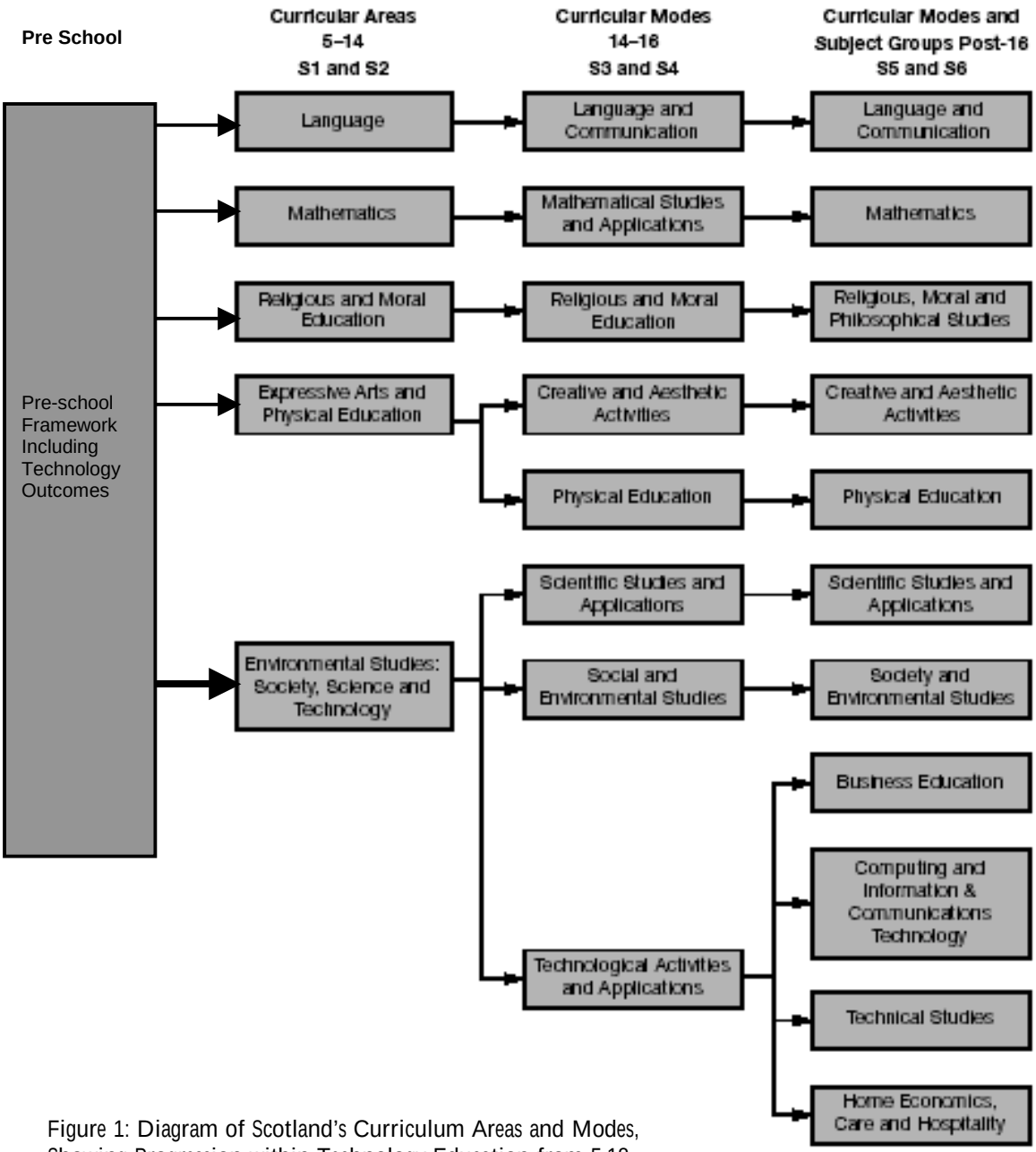

Figure 1: Diagram of Scotland's Curriculum Areas and Modes, Showing Progression within Technology Education from 5-18.

Standard Grades	National Courses/Units
	Advanced Higher
	Higher
Standard Grade — Credit	Intermediate 2
Standard Grade — General	Intermediate 1
Standard Grade — Foundation	Access 3
	Access 2
	Access 1

The 'New' National Qualifications, introduced from 1999.

Table 3: National Courses in the Post-16 Curriculum

SUBJECT	Technical Education: Standard Grade								
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Craft and Design	12578	13413	13992	13613	13783	14032	15148	15219	15029
Graphic Communication	6670	7118	7543	7319	7860	7796	8780	9589	9944
Technological Studies	5978	5258	4897	4282	3649	3211	2739	2659	2244
SUBJECT	Technical Education: Higher (post 16)								
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Craft and Design	2102	2428	2857	3010	3065	2593	2519	2606	2478
Graphic Communication	1888	2094	2290	2418	2423	2522	2808	3006	3071
Technological Studies	1146	1161	1106	951	964	847	1024	957	993

Table 4: Trends in presentations for National Examinations in Technical Subjects

SUBJECT	Entries by Gender at Standard Grade (Middle Secondary)				
	1999 Total	% Male	2003 Total	%Male	%Female
Craft and Design	10898	79	11426	76	24
Graphic Communicatic	5620	72	6854	69	31
Technological Studies	3370	92	2096	93	7

Table 5: Illustrative Statistics of Gender Balance in Middle Secondary Technical Subjects

Framework

In looking to examine and develop a critical account of change, we begin by setting out a framework for analysing change, drawing mainly on the insights of policy studies. This analytical frame is developed with sensitivity to such dimensions as historical antecedents, sociological perspectives, structural contexts and institutional and group actors. Using this approach we try to identify useful markers that indicate change within Scotland's technical and technology education curriculum. This approach is underscored by a conception of change as contested and mediated through a political economy characterised by groups of actors interacting in patterns of hierarchically ordered relationships, differentiated by asymmetries of influence, intellectual climate and policy ambitions.

Exploring an area of activity, such as change in technology education, and looking to do more than catalogue, report or identify stages of evolution requires a perspective that provides a critical purchase. One dimension that recommends itself for inclusion in such an interrogatory frame is that of 'deep theories', or attempts to uncover the unexamined assumptions that have been assembled in marking off the object of our analysis, in this instance, technology education. The idea of 'hegemony', from the work of the Marxist theorist Antonio Gramcsi, is a central notion in his model of power. For Gramcsi (1971), the exercise of power by the ruling class was at its most pervasive in their domination of culture, their shaping of the very subjectivity of the subjugated to the extent that their subjugation is seen as unproblematic, as a natural relation of the very fabric of the social order. Another example is Foucault's (1970) notion of power/knowledge, exemplified in the application of disciplines as discursive structures whose power acts on the subject, regulating social life through the process of 'normalisation'. Or perhaps, in a less universal example of such theorisation, Bowles and Gintis' (1976) idea of the hidden curriculum. According to Bowles and Gintis, what children learn from the hidden curriculum is the lessons required by industrial capitalism. This is not in the form of the subject matter of the formal curriculum, but through the very experience of schooling, its structures, hierarchies and organisational form producing subservient workers motivated by external rewards, the fragmented subject curriculum corresponding to the subdivision of labour within Fordist production.

What we think of as technology education, its content, its limits, its central concepts, constructions, contrasts and oppositions have been created in a process that has depended on a range of assumptions, rationalities and forms of knowledge. A certain consciousness disposes us to work within the limits of what appears as the unproblematic and natural boundaries that establish the landscape we understand as technology education. In terms of a model of curricular change and evolution, this is perhaps the most difficult dimension to integrate, operating, as it does, at a submerged level, supplying the discursive, rational, logical climate that shapes and forms practice in technology education.

"Education has the characteristics it does because of the goals pursued by those who control it ... change occurs because new goals are pursued by those who have power to modify education's previous structural form, definition of instruction and relationship with society...education is fundamentally about what people have wanted of it and have been able to do to it" (Archer, 1984:p1-3).

Archer's idea of doing something to education by 'those' who can, informs our approach to change in technology education. Our analytical framework sits counter to a rationalist model that assumes the continual progress of a modernising project of technology education. It is predicated on a conception of curricular change as the outcome of struggles, at different levels, to assert an authoritative definition of technology education and to control the practices that represent its enactment. Change is also restrained by what has gone before; each layer of curricular development both builds on, and is constrained by an accumulation of curriculum history.

The form of technology and technical education present in Scotland's official and observable curricula is a result of its historical evolution through the national processes of educational policy development. In attempting to chart its present form it would seem appropriate to turn our attention to the policy making processes surrounding technology education. Within the scope of this paper we endeavour to outline something of the structures and the stakeholders who exercise control, influence and hold legal authority within the Scottish system and offer some initial comment on present arrangements. In conceptualising the policy process we make use of the insightful framework developed by Bowe, Ball and Gold (1992). Bowe and his colleagues suggest three contexts for policy production, organising the contexts in terms of: influence, policy text production and practice.

The context of influence is the main source of initiation in relation to policy making or change. What is crucial here is to appreciate the informal networks around members of the government and senior civil servants holding different areas of policy within their portfolio. It is in this socially mediated world of access, contact, and involvement that actors endeavour to promote their projects and agendas. This is a key area of policymaking; it is here that struggles over meaning and the promotion of ideas take place. Fundamentally, conceptions of the aims and nature of the education system are shaped within this context giving birth to new and evolving discourses of education.

The context of policy text production contextualises a second level of analysis. Policy texts embody policy. These may include; official documents, speeches, public engagements, statements, commentaries and guides, exemplar material, videos, CD-ROMs and websites. This context also contains a significant degree of positioning around meaning and influence within the process of publication and its dissemination. This is the level of making new thinking about education operational, creating an implemental form. The context of practice tries to capture something of the complexity and messy reality of policy implementation. Policy texts are open to 'interpretations' and as such, may be susceptible to diversion, subversion and resistance.

The mapping of national policy to group and institutional actors in the decision making process is important in understanding the present form of technology education. More importantly it also serves to locate sources of new thinking, innovation and change as well as the sites of conflict and a whole array of priorities and vested interests belonging to established stakeholder groups. It is important to note that each context can, and does, interact, exert influence and gain access to the others (Figure 2), but each level represents a distinctive set of activities within the policy process with differentiated influence deriving from legal authority and structural position.

In considering a political economy of technology education policy making it is possible to identify seven main institutions and group actors, the interaction and activities of which, constitute the process of defining, changing and controlling technology education. Together they form and populate the three levels of the model proposed by Bowie and his colleagues.

Scottish Executive Education Department (SEED): this is the national government department with a responsibility for education. This is the key context of influence and the locus of responsibility for decision making. Her Majesty's Inspectorate of Education (HMIE): this is an agency of government responsible for inspection, quality assurance and advising in relation to education. This is a very powerful group who straddle all three contexts and exert a strong hold on the context of influence. The Scottish Qualifications Authority (SQA): this is Scotland's only awarding body for qualifications below degree level. Developing courses is part of its official terms of reference; this grants the SQA a prime position in influencing the nature of curricular change. Learning and Teaching Scotland (LTS): is a non-departmental government sponsored advisory organisation; it is active in curriculum development, dissemination and project management; it is predominantly influential in the context of policy text production. Local authority Quality Advisers: this is a smaller group of local government officers responsible for advising schools and quality issues. The Technology Teachers Association (TTA, formerly known as the Technical Teachers Association): this is a voluntary professional organisation; it is at its most influential in lobbying and articulating responses in relation to official consultation and issues of contention. Practising Technical Teachers: have the possibility to take part in formal consultations, often at the level of a school response, and to have influence through involvement in the activities of SQA, LTS or TTA.

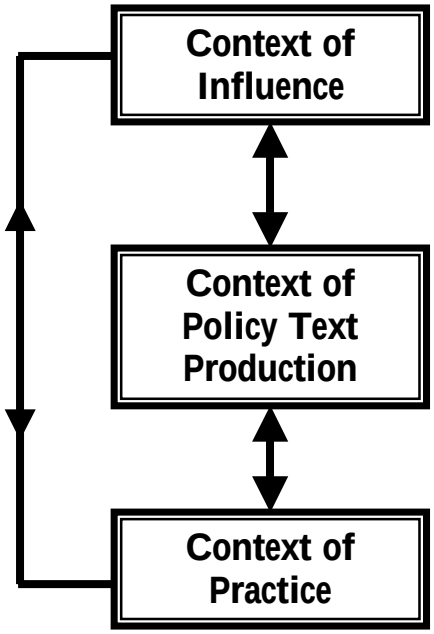

Figure 2: **Bowe, Ball and Gold (1992).**

The Curriculum

A central arena for viewing change, and the object of much labour around change, is the technology education curriculum. In accounting for change, much of our analysis is centred on the official curriculum as a marker of change. However, in problematising change in the curriculum, other conceptions of the curriculum offer the potential to provide critical leverage in this task. Beyond the official curriculum, the course of study endorsed by a governing authority, we could consider the 'observed' and 'experienced' curriculum (Pollard and Triggs, 1997), along side the hidden curriculum. The observed curriculum points our attention to the difference between what is assumed in official curricula and what can be seen at the level of practice in the classroom. The curriculum-as-experience, focuses on the programme of study from the viewpoint of the learner's experience, and has a concern to understand something of the meaning that pupils take from this experience. The hidden curriculum, as noted above, directs our analysis to all the learning and messages that accrue to the learner beyond that of the formal ambitions of the education system. A recurring characteristic of the context of change in Scotland's technology curriculum has been reform of the wider official curriculum. Such projects have acted as an opportunity and driver of change in technology education and can be seen as occasioning periods of curriculum fluidity. In, for example, a parallel with the development of the national curriculum in England and Wales, periods of curricular fluidity allow for change as part of a broader curricular renegotiation as former curricular settlements give way to new arrangements.

The politics of educational change are threaded through by long running contests between opposing conceptualisations, ideas and priorities for education. One such fault line, transversing the history of technology education, and its predecessors, is the vocational-liberal divide. Different goals, ambitions and pedagogical approaches to technology education spring from different ideological positions on this continuum. At the risk of over generalisation, this continuum could be characterised, on one side, as arising from an unambiguous instrumentalism that locates technology education as preparation for a clearly defined progression into employment, and on the other, a more child-centred justification of technology education. This liberal approach argues that the study of technology is inherently valuable in its self, is an important aspect of contemporary culture, and that it has much to offer the intellectual development of all students (Banks 1994).

Another shaper and former of change within national systems of education could be explored under the banner of myth. Scotland has long maintained and cherished its own distinctive system of education, perhaps not as different in essence from its large southern neighbour as some would like to believe, but it is a system shaped and inextricably bound up with national fortunes. It is almost impossible to survey constructions of Scottish identity without unearthing notions of Scottish education interwoven in some configuration. Explanatory and legitimising mythology is to be found in even the most sophisticated and modern of societies. Myths elude tests of reality; they operate at a submerged subtextual level, seeping values, beliefs and orientations to action into human consciousness.

The myth of the 'American Dream', success being available to all through hard work and talent, has an equivalent in Scottish consciousness, the 'lad o'pairts' (McCrone,

1999). This 18th century characterisation is of course male, typically a son of the soil, lowly of birth, originating from an agrarian social order predating urbanisation. The young man has his talents recognised in the school of the parish, bequest of the protestant reformation, and is supported by those of means to attend one of the ancient universities and often to enter one of the great professions. The lad o'pairts is a myth of social mobility, an important expression and motif of the strong egalitarian strand to Scottish identity. The symbolism of the lad o'pairts illustrates the way in which Scottish education functioned as one of the locations bearing and sustaining resources of national identity.

The existence of myths provides a subterranean and powerful resource that can be put to work legitimising and persuading in favour of diverse agendas. The symbolism of the lad o'pairts has been laid claim to by the left and right, idealists and radicals alike. The place of educational mythology in the Scottish psyche has important implications for change and policy making. Reform perceived as injurious to Scottish education can rapidly be interpreted through national sensibilities as being synonymous with an assault on Scottish identity itself. This cultural context was to have a detectible impact on Conservative reforms to Scottish Education (1979-97) and in the posture and tone of New Labour north of the border following the 1997 election. The ancestry and pedigree of technical education is linked to its beginnings and fortune within the historical evolution of Scotland's education system and cannot be isolated from its place in a wider national narrative of education.

Teachers are a key set of group actors in the context of change in education. Making sense, in relation to change, of the role and impact of teachers in general and technical teachers in particular, suggests that any framework of analysis must accommodate the agency of practitioners. Sociological concepts and perspectives would seem to offer both a language, and range of theoretical approaches, that have a utility in accounting for this aspect of change. Ideas such as identity, professional self concept, role, status, governance and conflict would seem appropriate in attempting to describe and capture both the dynamic of this sector and teacher agency in relation to change.

Mapping Change

In limiting our review to a timeframe of the preceding twenty years we are prevented from attempting a detailed account of how technical education came to have the form it did at the beginning of the 1980's. In setting the context for our period of review we must limit our analysis to giving enough background to set the context for the following period. Key to this context, as to understanding many of the significant changes in technology education, are periods of change and reform that impacted across the whole Scottish education system. After the second world war, Scotland, in tandem with her large southern neighbour, sought social reconstruction through the extension of education and in particular the extension of secondary education. This reform was progressive in the sense that secondary level education was extended to all, but retrogressive in that it resulted in a two-tier provision of secondary education. Selection took place at age 11, directing a minority of children towards a senior secondary provision, with an academic curriculum, and allocating the majority to a junior secondary for a basic general education. It is here, within this general education sector, with its emphasis on a basic education, preparation for manual, unskilled and

skilled employment, and character formation, the Scotland's technology curriculum has its modern origins.

"Although for most of the course the boy is rightly content to be a boy and to enter wholeheartedly into boyish activities, there comes a time when he feels that a man's work would become him better. At this stage, normally towards the end of the course, he examines from a new viewpoint all that the school has to offer, and is apt to assess it solely in terms of what use it will be for him in earning a living. He now needs the satisfaction of tackling workaday jobs and of carrying them out with the appropriate tradesman's tools. It is at this point that the industrial aspects of Technical subjects make a considerable appeal to many boys." (Secondary Memorandum HMSO, 1955, p.231)

Significantly, for the development of technology education, by the mid 1960's Scotland's local government had been instructed by the central state to move to a comprehensive system of education, a directive that sat well with the spirit of the times and national sensibilities of the place of education in the national psyche. The move to comprehensive education, along with the raising of the school leaving age to 16, produced a confluence of factors that made deliberations on curriculum design, assessment and progression all the more pressing. By the early 1970s a range of certificated courses in technical subjects had become established in the emerging comprehensive sector. In addition to non-certificated general education classes, departments could offered up to five courses at national examination level (Ordinary Grade):

- Woodwork
- Metalwork
- Technical Drawing (conventional engineering drafting)
- Building Drawing (drafting in relation to civil engineering)
- Applied Mechanics (Newtonian mechanics as applied to engineering)

In 1972 the Scottish Education Department (SED) published Curriculum Paper 10, among its recommendations was that the title 'Technical Education' should be adopted in place of Technical Subjects and that the technical curriculum for the 14-16 stage should be reduced to three courses: discrete courses in Woodworking and Metalworking would be replace by one new course called Integrated Craftwork; Engineering Science was to replace Applied Mechanics; Technical Drawing would remain but Building Drawing was to be discontinued. The agenda for reform in relation to curriculum and assessment occasioned by the move to comprehensive education in the secondary sector continued to be felt during this period. In 1977 a report, *The Structure of the Curriculum in the Third and Fourth Years of the Scottish Secondary School* (the Munn Report, 1977) set out the modal framework (see Figure 1) for this stage of the curriculum made up of differentiated courses. A twin report on assessment (the Dunning Report, 1977) recommended 'assessment for all' as a principle. The recommendations of the Munn and Dunning committees was to set in motion, by the early 1980's, a reform of the middle school secondary curriculum (The Standard Grade Development Programme). This period of curriculum renegotiation created the context, in the following decade, for change to technical education's contribution to technology education in the Scottish system.

Retrospective

In the period under consideration, from the early 1980's, until the present, technology education has undergone an almost continuous process of curricular change and revision. This process began in the middle secondary curriculum in the 1980's, moved to primary and lower secondary in the early 1990's, then re-emerged in a significant reform of the post-sixteen curricular framework in the late 1990's. Each programme of reform, while targeted at the national system as a whole, represented a period of fluidity in which settled forms of curricula could be reformed and recast.

Such a process of recasting took place in technical education during the reform of middle school arrangements in the 1980's. Under the Standard Grade development programme, pupils would study a compulsory core and choose additional subjects to complete their curriculum. Ensuring breadth and balance of study was attempted by restraining choice to a number of modes under which certain subjects could be selected for study. By the early 1990's technology education in the middle school emerged from this development with three distinct national courses at Standard Grade. Each of the courses can be interpreted to reveal both its continuities, and its distinctive differences with its preceding ordinary level national courses.

Merging Craft and Design

Design first established a foothold in the secondary technical curriculum in the form of a less significant aspect of the Ordinary Grade course, Integrated Craftwork, first offered in 1979. The labours of a movement of individuals and organisations advocating design education (Design Council, 1980, Design Council Scottish Committee 1981) lead ultimately to integrated craftwork being developed into a new course; Standard Grade Craft and Design, launched in 1985. Courses in Craft and Design (C&D) encouraged pupils to understand and use the design process, to develop craft skills together with knowledge and understanding of related materials and processes. It has three assessable elements; Knowledge and Understanding; Designing; and Practical Abilities, notably the latter two elements are assessed internally by teaching staff and externally moderated. The establishment of this course initiated an almost automatic reform of post-sixteen provision through the production of a new national higher level course in C&D.

Technical and Vocational Educational Initiative

In the curricular history of technical education, the period from 1984 is marked by the impact of a vocational education imitative driven by the central state. The Technical and Vocational Educational Initiative (TVEI) began to make its presence felt in Scottish education around 1984. This was an initiative that originated in education system of England and Wales and was administered by the Department of Employment in London. This initiated what could be called a turf war, or the strategic organisation by the Scottish policy elite, to prevent the penetration of the London Based Manpower Services Commission across the border. The Commission was a significant extension of the Department of Employment. This context initiated a major reform to further education in Scotland, known as the Action Plan, the saw the creation of the Scottish Vocational Education Council (SCOTVEC). Within the Scottish system, arrangements for TVEI operated at local authority level. Local Authorities became the mechanism for dispersing the not inconsiderable £100 million

TVEI budget direct to schools making successful bids. This spurred a whole range of short courses and modules with technical and related content. Schools could bid for this money directly on the basis of offering technical or vocational aspects to the middle school curriculum. This source of funding boosted technical departments and in particular helped some schools with the start up costs of technological studies.

Technological Studies

Ordinary Grade Engineering Science was replaced by Standard Grade Technological Studies (TS) in 1988. The new course was very different from its predecessor that, historically, attracted small numbers of students. This was arguably the most fundamental curricular reform to the technical education curriculum, obvious in both the discontinuity with the content of its forerunners Applied Mechanics and Engineering Science, and in the approaches to teaching and learning encouraged in its inception. The content of Technological Studies (e.g. systems theory, mechanisms, electronics, pneumatics, computer control) together with its emphasis on the integration of technologies, coupled with an approach towards supporting learning that gave emphasis to project work, resource based learning and using technology in a problem solving context, all combine to characterise the distinctiveness of this development. Again, the establishment of this course initiated an almost automatic reform of post-sixteen provision through the production of a new national post-16 course in Higher Technological Studies.

Graphic Communication

In 1993 Ordinary Grade Technical Drawing was phased out, to be replace by Standard Grade Graphic Communication. The new course, Graphic Communication (GC) is concerned with the communication of graphical information in an engineering, technical or commercial context, the presentation of ideas and designs, knowledge of conventions and abilities in interpreting drawings and graphics. Students develop manual and computer based skills in drawing and graphic production. The course combines traditional elements of engineering drawing with illustration and presentation allowing some opportunities for creativity. The skills dimension of the course is assessed through a folio of pupil work assembled over the duration of the course. The folio is internally graded and externally moderated. The two other aspects of the course; knowledge and interpretation and drawing ability, are assessed externally by terminal examination.

The 5-14 Curriculum

As the shape of the middle school technical curriculum changed over the 1980's the focus of policy makers shifted to the primary school curriculum and the first two years of secondary. This new reform project has its origins in a number of educational concerns over this sector of the curriculum, taken up as part of more ambitious political agenda in education by the Conservative Government of the time. This strong political dimension (mirroring events in England and Wales that would culminate in the establishment of a statutory national curriculum) sought to limit teacher autonomy, more explicitly define the curriculum, and introduce the prerequisites for a system of national assessment in primary and lower secondary. The 5-14 development programme was to culminate in a series of national guidelines covering curriculum content, assessment, organisation and structure. Not unexpectedly, during the

development phase of this project, the curriculum became the subject of renegotiation and contestation as the new guidelines were formulated. Significantly, for technology education, it became established as part of the curriculum for all children in the primary stage and into the first two years of secondary education. Technology education is located within the 'Environmental Studies' sector of the 5-14 curriculum (see Figure 1).

As part of the environmental studies sector of the curriculum, technology education enjoys a formal presence in the primary school curriculum. Official advice encourages the arrangement of environmental studies education courses through the use of a nine-year plan that covers the entire primary period and the first two years of secondary. In the primary sector the use of 'topics', a long established, integrative, approach to this area of the curriculum, is encouraged. Over the course of primary education pupils would work on a number of topics at each stage (houses and homes, our bodies, exploring space, mini-enterprise), such topics may have a major focus on technology and a minor focus on science, or social subjects, or any combination of the three. The contention behind this argument is that over the 7 years of primary education there will be a balanced coverage across technology, science and social subjects. Environmental Studies will then continue to designate an area of learning after transition to the secondary school. This will take place in the first two years of secondary education through the coordinated study of courses provided by secondary departments of history, geography, modern studies, home economics, science and technical education.

Higher Still

Higher Still was the title given to the ambitious reform of Scotland's post-16 curricular framework implemented in 1999. It mirrors in its agenda and context the work of the Dearing committee in England and Wales and anticipated the recent policy direction of the Department for Education and Science(Dearing, 1997, Tomlinson, 2004). It had as one of its central ambitions the goal of bridging the gap between the vocational and the academic, in search of the elusive notion of 'parity of esteem'. The range of courses available to departments of technical education has expanded as a result of the significant renegotiation of the official curriculum that took place during this reform. Prior to Higher Still, technical department could offer progression of study from each of the Standard Grades to Higher, and in the case of technological studies, to a further level of Sixth Year Studies. In addition to this curricular strand, departments generally offered a parallel set of courses and modules of study that would be taken from a catalogue developed in further education (originally awarded by SCOTVEC, then the SQA from 1996). Such courses (typically: craft skill related; electronic assembly; engineering drafting) were vocational in nature and tended to reflect the interests of staff and the availability of resources. This parallel arrangement was to be replaced by the new national qualifications introduced under Higher Still.

During the development phase of Higher Still there was a movement, originating from within the management of the programme, to reduce the post-16 technical curriculum; generally thought to be difficult to sustain in small departments and making high demands of staff and resources. The idea of merging Graphic Communication and Craft and Design to form a new Higher and Advanced Higher course to sit alongside Technological Studies was proposed to teachers. In continuity with the past curricular history of technical education in relation to rationalisation, practitioners resisted this

proposal. Eventually, the final form of Higher Still introduced a new course (Practical Craft Skills) at intermediate level, resulting in an expansion of the curricular options that departments could offer. It is worth noting that Higher Still has resulted in a new catalogue of national qualifications many of which can only be delivered in further education colleges.

Middle school

A significant development resulting from the reform of the post-16 curriculum can be seen in terms of 'back pressure', felt at the level of the middle school. The settled Standard Grade curriculum of middle secondary has been destabilised by the new courses introduced under Higher Still. In particular, change has been driven by a government decision to allow schools to offer the new intermediate courses in the middle stages of secondary alongside, or in place, of Standard Grade (see Table 3 for equivalences) together with the resulting search for coherence and progression in curriculum planning. This post-16 reform has impacted on the middle school provision of technical education; the most obvious impact has been the introduction of practical craft skills (a totally craft based course with continuous assessment) as an unintended competitor to Craft and Design. The most recent innovation is a new Product Design course at intermediate level, another potential competitor for Standard Grade Craft and Design. The menu of technical courses offered in middle school has, (four subjects provided through the option of seven different courses), become more differentiated across national provision as departments have opted to offer anything from one to four different subjects.

Discussion

Change over the last twenty years in Scotland's technology and technical education provision has not fallen from on high or emerged complete from the social order. It has take one particular elaboration as apposed to another as the result of the interaction of a multitude of factors such as those discussed in the framework above. Mitcham (1994) classifies philosophies of technology as falling into one of two approaches, what he characterises as; an engineering tradition of philosophy of technology and a humanities tradition of philosophy of technology. In trying to take account of what we have referred to as 'deep theories' we conclude that Scotland's framing of technology education is profoundly engineering in nature. Broadly speaking, the engineering tradition assumes the centrality of technology in human culture and the humanities tradition and its exponents have approached technology from without, concerned to probe its moral and cultural boundaries. In its report, *The Place of Technology in the Secondary Curriculum* (1985:3), the Scottish Consultative Committee on the Curriculum defined engineering in the following terms:

"Engineering. The art of applying knowledge and experience of technology and scientific principles to satisfy some identified material need having regard to such factors as cost, safety, aesthetics and the effect on the environment."

Technology was defined in the same report in as being concerned with:

"...the identification of some of the material needs of man and the endeavour to satisfy those needs by the application of science and the use of materials, resources and energy. It is concerned

with solving problems where there is no right or wrong answer, only good or bad solutions to a problem. Technological behaviour requires activities that are creative and demanding, where the laws and principles of science, the constraints of society and economics are applied to satisfy human needs. Technological behaviour involves approaches and techniques, such as systems of analysis, problem identification, decision making, planning, ideas communication and solution evaluation, which are more than pure science or craft."

It is not hard to argue that the two definitions above share considerable conceptual ground in common. The defining of technology, in the engineering tradition, echoes through the official curriculum texts of Scottish education. In defining technical education HMIE (1999) again reinforce this position drawing unambiguous upon an engineering philosophy. In addition, in the quotation below, there is a clearly located vocational element within HMIE's construction of technical education:

"The curriculum in technical education has developed in response to society's need for a technologically capable population that can make effective, responsible use of available resources in devising solutions to every-day technological problems. The national and international importance of scientific and technological capability has been emphasised in many quarters, not least in the White Paper, Realising our Potential: A Strategy for Science, Engineering and Technology (HMSO 1993):

The understanding and application of science are fundamental to the fortunes of modern nations. Science, technology and engineering are intimately linked with progress across the whole range of human endeavour; educational, intellectual, medical, environmental, social, economic and cultural.

The need to improve technological capability has been recognised as a priority as the United Kingdom seeks to maintain its manufacturing base and compete in global markets. An adequate supply of appropriately educated and trained personnel is an imperative for contemporary society." (HMIE, 1999)

This understanding has developed, in relation to time, in parallel with other systems (England and Wales, Australia) and has no significant differences in conceptualising technology education. Scotland's position is illustrated most clearly through its national position statement (SCCC 1996) on technology education and its adoption of a 'capability' stance. This construction of technology education, and its resulting practices, has formed the intellectual climate within which thinking about technology education takes place. This positioning of technology education as an organising principle of the curriculum has not been contentious. Technological capability, if anything, is absent from the vocabulary of practitioners. Technology and its relation to technical education, and other contributors of capability, is somewhat vague and perhaps lacking in a coherent commonly shared understanding that could contribute a firmer direction and purpose to curriculum design and planning.

In understanding change and questions of power and control such as posed by Archer and Bowie and his colleagues in the framework above, our attention is drawn to the political economy of educational change formed by the patterned interaction of the institutions and actors listed in the framework above. Raising awareness and gaining the attention of politicians and key civil servants at governmental level, within the Scottish Executive Education Department (SEED), is an important component of

influence in attempting to highlight issues for reform or change. The channels of access both formal, and perhaps more importantly informal, are key dimensions of this context. The extent to which individuals, advisors, favoured organisations and networks have opportunity to exert influence, set the agenda or build a particular climate, is an important facet in understanding policy initiation and formation at this level.

There are a number of QANGOs and government agencies that dominate the context of policy text production and crucially, span the boundaries of contexts of influence and practice. Of significance here are the SQA, LTS and Her Majesty's Inspectorate of Education. By virtue of its structural position rather than design, the SQA casts a long shadow through its management and control of national courses and assessment. It has become a key player in developing and reviewing courses in Technical education and exerts a very significant influence on curriculum reform through its officers, working groups, panels and network of advisors and practitioners who work for it on a part-time basis. We would identify the HMIE and the SQA as the most influential actors in controlling the development and structure of technology education in the Scottish system. The role of practitioners is another interesting aspect of this context. Individual teachers can make representations to sites within the context of influence and publication, as can their professional body the Technology Teacher Association (TTA). Key sets of practitioners could be described as 'insiders'. Insiders may work for the SQA or LTS and sometimes both organisations; they are able to exert influence because of this position and also have the opportunity to influence other practitioners through the perception of their role as an actor within the process.

In advising, supporting implementation, attainment and teaching within national curricula guidelines and national courses, LTS is another organisation well positioned to influence reform, as well as current practice. The role of HMIE in the Scottish system was changed by national government in 2000. Until then this arm of government had provided both policy advice and quality assurance functions within education, after 2000 its policy function was officially removed. HMIE are still, however, very powerful players in policy reform. Attempting change in technology education in opposition to the views of HMIE is an undertaking with a very limited chance of success. Their current role as 'observers' on any significant committees and working groups within SQA or LTS as well as advising civil servants on education policy gives them very significant influence. This economy of decision making would suggest that control of technology education is centralised among a small group of actors who, no matter their ambitions for technology education, are constrained by the institutional and bureaucratic self-interest of their organisations.

In considering the secondary curriculum we would identify change in technical education as the outcome of a number of struggles over the meaning, content, and forms of knowledge and skills that should comprise the technical curriculum. We will explore this through considering a number of themes: the craft tradition, the drawing tradition, the introduction of design and (the turn to technology; e.g. electronics, pneumatics, mechanisms, systems approach and computer control) the new subject matter introduced by courses in Technological Studies (TS).

The craft tradition is the most established curricular element of technical curriculum dating back to the final stages of pre-war 5-14 schools and the earliest extensions of general secondary. It origins are clearly vocational, in an engineering context, and its

place in the curriculum defended over time form a number of positions including the vocational and the liberal. Until the 1980's, the development of craft skills was a central consideration in courses of teacher education. The fortunes of the craft tradition have been, until recently, characterised by decline in relation to their place in the official curriculum. This retreat is detectable in a curricular history that records a reduction from two distinct courses, down to one, followed by a further reduction to make way for design, preceding their expulsion from the upper school curriculum. Under the Higher Still reform we have witnessed a resurgence of the craft tradition with the introduction of new courses in Practical Craft Skills. Among Scotland's practicing teachers today there is a divergence in the value attached to the craft tradition, but it retains strong support among sections of the profession.

The fortunes of the craft tradition can perhaps be explained in relation to the prevalent thinking within the decision making climate, in particular the need to modernise in response to the changing needs of industry at technician level, and pressures to escape the low status that was associated with craft work in the liberal curriculum. The ambitions of Higher Still, (coherence between school and further education, the bridging of the vocational-academic divide) created the conditions for a reassertion of this tradition resulting in the new national course in Practical Craft Skills available across the middle and upper school curriculum. In terms of students, courses with a craft dimension are still the most popular aspect of the technical curriculum (see Table 4).

Drafting has long been a constituent of technical education being cognate to the engineering origins of the craft tradition. It too has changed significantly during the last twenty years. Drawing entered this period as a smaller, if well established, aspect of the middle school curriculum. During curricular reform in the 1980's, Building Drawing was dropped from the curriculum leaving the more popular Engineering Drawing. In what is an interesting example of the economy of curriculum policy making, the idea to rationalise the technical curriculum from three into two subjects was floated from what we could described as the context of policy text production. Drawing was to be merged with Craft and Design to form a new subject to be offered alongside Standard Grade Technological Studies. This reform was defeated by the resistance of teachers, led by their professional association (TTA) in coalition with employers. The mobilisation of industry in support of the retention of Technical Drawing greatly enhanced the case being made by the TTA. Drawing was retained, the response of the then Scottish Examination Board was to update this course into what has became Graphic Communication.

This course clearly retained elements from its predecessors, but would now include new aspects such as CAD, CAG and graphical illustration and presentation techniques. Graphic Communication, which can be offered under two modes of the curriculum, can only be described in terms of being a success story (see Table 4, the trend in presentations is upwards and at Higher level it is becoming a dominant technical course). This course has also enjoyed the greatest success of any technical subject in approaching a gender balance (see Table 5). In terms of the future, the development of this course would seem to suggest a direction that would require a greater proportion of knowledge, skills and understanding being accrued through, and in relation to, computer based applications. One inhibition to this is the difficulties perceived by the SQA in relation to the arrangements for administering national assessment and the financial obligations on schools in relation to resources. The next stage in curriculum

development seems apparent to practitioners, the use of contemporary software and computer based applications is attractive to pupils, but the administrative needs of national assessment and the resource implication for individual schools creates a disincentive for the SQA to action change. This situation exemplifies the political economy of curriculum policy in technology education within Scottish Education.

Design

Since its success in establishing a beachhead in the technical curriculum through Standard Grade Craft and Design (1985), design has continued on a march toward an imperious position in the technical and technology curriculum. The extension of design is indicative of its secure acceptance among curriculum decision makers at the level of influence and text production. In a chronological harmony with the establishment of design in England and Wales, and internationally, design entered the Scottish technical curriculum. This reform was supported by group actors outside of education who were very successful in convincing government of its importance (Royal College Art, The Design Council, see McCormick 1994). Middle secondary courses in Art became Art and Design with a clear commitment to solving design problems and contributing to design education. During the 5-14 reform of primary and the first two years of secondary, skills in designing and making became an officially endorsed aspect of every child's curriculum.

Design's commanding place in the official curriculum is illustrated by its success in displacing craft in the post-16 curriculum. The most recent change to this provision is the replacement of Higher and Advanced Higher courses in Craft and Design with a new course; Product Design (as from 2004). In its original arrangements, Higher Craft and Design had a strong craft element; this was revised to reduce the craft element, accommodating a practical element in relation to modelling, a more minor aspect of the revised course. In this third incarnation as Product Design, there is a clear commitment to product design with little progression from the craft element present in the middle school course.

From the perspective of the Scotland's official curriculum technology education includes a strong design dimension. As part of a series of reports on effective learning and teaching in Scottish schools, HMIE published a report on technical education (SEED, 1999) it drew upon inspection evidence from 200 technical departments. This sheds some light at the level of the observed curriculum. Design education could be described, on the basis of this report, as having mixed fortunes. The design aspects of C&D are generally reported as being the most problematic by teachers and unpopular with sections of students. Learning and teaching about design is also reported as being in need of strengthening in the early years of secondary. Technology education could be described as the Cinderella subject of the 5-14 curriculum. It is the area identified as most problematic by primary teachers. Initial education courses for primary teachers, to date, allow little coverage of the technology curriculum in general and less for design.

Primary school technology has had to develop in the absence of an organic development by confident primary specialists and has tended to look for guidance to practice in the secondary sector. The secondary sector has tended to conceive a primary technology education that resembles the form of secondary, hampered in turn by the difficulty of the secondary sector in bring together coherently its own strands

and traditions. There have been a number of initiatives to address perceived weakness in the technology curriculum in the 5-14 context. This includes national exemplar materials and a new project (launched in 2004) managed by LTS aimed at supporting technology education in the first two years of secondary schools. Another noteworthy development is the 'association' of Technical education with new initiatives around 'enterprise' education, both as a means of accessing funding for development and increase the currency of Technical education. The transition between primary and secondary technology education is consistently identified by HMIE as requiring improvement.

Arguably the most innovative curricular reform to technical education can be seen in the introduction of Technological Studies. The new content of Technological Studies, together with its emphasis on the integration of technologies, coupled with an approach towards supporting learning that give emphasis to project work, resource based learning and using technology in a problem solving context, all combine to mark the distinctiveness of this course from anything that had gone before. From its launch in 1988, the number of presentations for this course grew, in part assisted by funding made available through the Technical and Vocational Education Initiative. Presentations at Standard Grade in 1994 were running at 6076, however, significantly, by 2003 presentations had fallen to 2244. The decline of Technological Studies cannot be explained by reference to a single causal factor, but a number of contributing elements can identified (see Dakers and Doherty 2000). At the time of its launch, this new course was seen by curriculum decision makers as destined to become a new modern strand of a reduced Technical curriculum.

In comparison to the other course available to technical departments, the number of students opting to study Technological Studies has remained less than a quarter of C&D and around a quarter of GC and the trend is downward (see Table 4). Technological Studies was given a relaunch in 1999, the first cohort completing the new course in 2003. As part of its redesign, there was a move away from project and resource based learning approaches towards a more didactic approach coupled with a change in differentiation and entry requirements. The course is now available only to pupils capable of working at a Credit or General level, effectively asserting that this is a course for the more academic. The success of this strategy in halting the decline of Technological Studies will be a focus of future interest.

There is a historical perception, arising from its curricular history, that technical education is an area of the curriculum more suited to the education and vocational possibilities of boys. Technical education in Scotland is characterised by a significant gender imbalance in favour of males. Access to technical education was organised around gender in the newly emerging comprehensive system of the late 1960's. It was as recent as 1972 that equal access to this area of the curriculum became official policy (Scottish Education Department, Curriculum Paper 10). Today all pupils study in technical departments in the first two years of secondary as part of the environmental studies curriculum of 5-14. In middle secondary, pupils have an element of choice, and here some progress has been made towards more of a gender balance; particularly in GC and to a lesser extent, C&D (see table 5). Technological studies has failed to attract a significant portion of female students and this is one of the factors in explaining its decline in the same way as it accounts for a proportion of the growth in student numbers studying Graphics and courses in C&D. Patterns of gender balance within the post-16 curriculum are consistent with the picture of the middle secondary stage

described above. Interestingly there has been a significant upward trend in the number of females applying to become teachers of technical education.

Scotland's technical teachers are, in demographic terms, top loaded in favour of the over 40's. It seems defensible to loosely conceptualise teacher attitudes in relation to the dominant educational climate prevalent during the period of their initial teacher education. This 'socialisation' maps to the nature of the curriculum at particular times, the nature of courses that comprise the technical curriculum, and associated pedagogical and organisational norms. Again this is a general observation, contradicted by teachers who are exceptions and enthuse about new curricular content and arrangements that played no part in their initial preparation for practice. There is evidence (see Canavan and Doherty 2001) to suggest that there is a relation between length of time in service, perceptions and curricular preferences. Practicing teachers can be disaggregated by differing loyalties and preferences for the different traditions and courses within technical education.

Historically the majority of technical teachers entered the profession with a background in industry. They would study for a diploma in Technical Subjects, (latterly Technical Education), the length of study required varied depending on experience and qualifications. This context created a strong reinforcement for the craft and engineering aspects of technical education. In line with the introduction of the new curriculum content of Technological Studies, and the establishment of teaching as an all-graduate profession, a number of new degree programmes (1987) and post graduate qualifications were established nationally to provide the initial education of technical teachers. This reform has altered the context of teacher socialisation and raises the question of changing attitudes, values and curricular preferences resulting form the new programmes. This question would seem to deserve further investigation. The provision of teachers able to deliver courses in Technological Studiewas a major influence in shaping the nature of such new courses, informed in part by an assumption that there would be a rationalisation within the more established technical subjects in deference to this new technological direction. This rationalisation failed to materialise principally due to a combination of practitioner resistance, political lobbying and the mobilisation of industrial supporters. Recently design has come to play a more significant role in the curriculum of initial teacher education.

Status, within the profession, and in general, has been an issue for technical teachers. Coming from what has been perceived within the liberal curriculum as the lowly status origin of practical work together with the strong industrial and vocational elements of technical curricular history endowed technical teachers with a more lowly status in the first two thirds of the 20th century. One reason why Technological Studies was promoted by a section of the profession was in relation to what was described as its 'academic rigour', positioning it as a rival to more established subjects such as physics. This could be read in terms of a concern for status. The new graduate teachers together with the new content of Technological Studies and the widespread use of ICT within the technical curriculum have all helped to raise the esteem of technical teaching as we enter the new millennium.

There has been a tendency to appropriate, monopolise the 'technology' word by technical practitioners and technical teacher educators and academics. In a middle

secondary curriculum, in which competition for pupils operates between subjects, the title 'technology' can be perceived has having a higher brand value than 'technical', with its antecedents in lower status general, vocationally oriented, education. This has contributed to tensions over identity within technical education. Positioning technical education as synonymous with technology, coming from a curricular area with traditions that predate the introduction of technology has perhaps lead to some confusion in discussions of curricular issues and debate within the profession.

Future Prospects

One of the recurring features of reform around national courses in technical education is resistance by practitioners to a reduction in curriculum breadth. This has resulted in a wide range of discrete courses that contribute to the development of technological capability. One consequence of this breadth is a demanding range of knowledge and skills required by teachers. The cost of technical education tends to be one of the most expensive aspects of the curriculum in relation to consumables and the maintenance of equipment. Scotland has moved to a more devolved form of financial management at the level of the individual school. In such a climate, school managers are always alert for the possibility of economies, thus creating a pressure of technical departments to rationalise the range of courses they offer. This climate seems set to continue if not intensify.

One of the challenges presented to technical teacher educators is the breadth and range of knowledge, understanding and skills required by teachers of technical education. This is a direct consequence of its broad curriculum, exacerbated by further expansion under Higher Still. Within Higher Education, changes to degree programmes tend to take time to implement, with the resulting lag time in teacher education programmes becoming a concern for some technology educators. In terms of the economy of curricular decision making, changes in the curriculum occur at relatively short notice with the resulting difficulties of keeping initial teacher education programmes up to date. Postgraduate courses of technical teacher education struggle to find candidates with an appropriate first-degree entry profile. In such programmes, time is a severe restriction; educators have the challenge of preparing teachers to teach this wide curriculum in one academic year.

The future of courses in Technological Studies is a concern at this juncture. The next five to ten years will be decisive in answering questions about how significant a contribution to technical education this course will make. The content of Technological Studies is relevant and contemporary and would be a loss if this course did not survive. The teaching of technology (e.g. systems theory, mechanisms, electronics, pneumatics, computer control, together with its emphasis on the integration of technologies) in the lower secondary is an area of weakness. There is a tendency for craft, graphics, and design to dominate, more often in discreet packages as opposed to integrated projects. This can in part be explained by a lack of progression acting as a disincentive; many departments do not offer courses in middle school or as part of post-16 provision.

The teaching of drafting, CAD and illustration, and presentation within Graphics Communication courses will require to be updated to keep pace with the expansion in processing power and the development of new software and peripheral items. This will

have to be undertaken in tension with the needs of national systems of assessment. The movement towards 3D modelling is a case in point, it highlights the separation of graphics courses from design and computer aided manufacture, this could be seen as a weakness in current arrangements. There is a very real enthusiasm to teach and promote learning through the use of ICT. In relation to lower secondary, practitioners often report inadequate access to computer clusters as a difficulty. Technical education, and its curriculum content, is very well positioned to offer an embedded ICT curriculum in lower school. In some schools departments provide a whole school course for lower secondary to meet the requirements of the 5-14 curriculum. Access to computing resources will be an important issue in the future development of technical education in Scotland. The use of ICT by practitioners is a strength, this can be built on for the future, and it chimes well with governmental concerns with ICT literacy.

A recent restructuring of teachers' pay, conditions and the promoted post structure may in the longer term pose a threat to technical education, in particular within smaller schools. The new arrangements have introduced a flatter management structure and in future there will be fewer teachers in middle management positions. This means more faculty arrangements (where one teacher from a subject department will have overall responsibility for a number of departments in a faculty, i.e. art, technical and home economics) the loss of a subject specialist as department principal raises concerns over curriculum leadership. Recruitment of teachers is also an area of future concern. At present there are shortages in some of the more remote areas of Scotland, the demographic profile of teachers in service is top loaded and entry into teacher education courses has remained static. Potentially this issue could have a very significant affect on the future capacity of schools to offer a technical curriculum. The existence of The Technology Teachers Association, an organic, practitioner lead professional association is another indicator of the health of technical education in Scotland. This creates a relatively autonomous forum outside of the established economy of decision making where questions and concerns from practice can be debated and courses of action decided.

The balancing of technical education's different traditions and their competing claims for space in a crowed curriculum is an issue that will require work and negotiation in the near future. The balance, breadth and integration of the craft, design, graphics and technology elements needs to be more coherent and manageable at the level of the observed curriculum. A more unified and coherent weaving together of divergent aspects of curriculum content would perhaps bring a beneficial focus to the aims and ambitions of technical education and its contribution to technological capability. The broad range of course options that can be used by departments to construct a curriculum, as well as being demanding and challenging, is also a strength. It allows individual departments to respond to the needs and preferences of their own pupils taking account of the location and social context of their school. Added to this, the comparative strength of pupil uptake of technical courses in the middle school curriculum, and its positioning in two modes of curricular options, must be seen as a positive and successful marker of technical education's progress.

The established nature of technology education in the official curricular position statements of Scotland's education system is perhaps the most reassuring aspect of its present condition. Officially, and conceptually, technology education has won space in a crowed and pressurised curriculum. Maintaining and enhancing its contribution to

the education of Scotland's young people in a complex and changing educational landscape is the task that awaits in the near and medium future.

The Authors would like to express their gratitude to John Cavanagh and Bill Geddes for their thoughtful reading and incisive and helpful comments on earlier drafts of this paper.

References

Archer, M. (1979) *The social origins of educational systems*, London, Sage.

Banks, F. (1994) What is a Liberal Education, in Banks, F. (Ed) *Teaching Technology*. London: Routledge

Bowe, R., Ball, S. J., & Gold, A. (1992). *Reforming education and changing schools: Case studies in policy sociology*. London: Routledge.

Bowles, S. and Gintis, H. (1976) *Schooling in Capitalist America,* London: Routledge and Kegan Paul.

Bowles, S. and Gintis, H. (1976) *Schooling in Capitalist America: Educational Reform and the Contradictions of Economic Life*, London: Routledge & Kegan Paul.

Canavan, B. and Doherty, R. (2002) Technical Education within Scotland's Technology Curriculum: A Review of Structure, Policy and Stakeholder Perceptions. In Dakers, J., de Vries, M. J. (2003). (Eds.) *PATT-13 Pupils Attitudes Towards Technology*. International Conference on Design and Technology Education Research Proceedings. Dakers, J. and Doherty, R. A., (2002). Technology Education, In: *Scottish Education*. Bryce, T. & Humes, W. (Eds): Edinburgh University Press.

Dearing, R. (1997) *Higher Education in the Learning Society*. Report of the National Committee / National Committee of Inquiry into Higher Education. London: NCIHE
Design Council (1980) Design education at secondary school level, London: The Design Council.

Design Council Scottish Committee (1981), *Design Education and Training in Scotland : a Report from the Scottish Education Advisory Committee of the Design Council*. Glasgow : Design Council Scotland.

Foucault, M. (1970) *The Order of Things: An Archaeology of the Human Sciences*. New York: Vintage Books.

Gramcsi, A. (1971) *Selections from the Prison Notebooks*, Hoare, Q. and Nowell Smith, G (Eds and trans). London: Lawrence and Wishart.

Gramsci, A. (1971) *Selections from the Prison Notebooks*, London: Lawrence and Wishart.
Hirst, P. H. (1965) Liberal Education and the Nature of Knowledge, in Archambault. R. D. (Ed) *Philosophical Analysis and Education*. London: Routledge and Kegan Paul.

L T S (2000) *Environmental Studies: Society, Science and Technology*, Learning and Teaching Scotland 2000.

Mc Crone, D. (1999) Culture, Nationalism and Scottish Education: Homogeneitypppp; and Diversity, in Bryce, T.G.K. and Humes, W. M. Eds *Scottish Education*, Edinburgh: Edinburgh University Press.

Pollard, A. and Triggs, P. (1997) *Reflective Teaching in Secondary Education: a Handbook for Schools and Colleges.* London : Cassell.

SCCC (1985) *The Place of Technology in the Secondary Curriculum,* the Scottish Consultative Committee on the Curriculum.

SCCC (1996) Technology Education in Scottish Schools: A Statement of Position, Learning and Teaching Scotland.

SCCC, (1999) *A Curriculum Framework for Children 3-5,* Learning and Teaching Scotland.

SEED (1999) Effective learning and teaching in Scottish secondary schools: Technical Education : Edinburgh, SEED.

Tomlinson, M. (2004) *14-19 Curriculum and Qualifications Reform: Final Report of the Working Group on 14-19 Reform*. October 2004 DfES: Publications