Update on Technology Education in Scotland

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Abstract

The Scottish education system is currently undergoing great changes at upper secondary school level. The past three years have seen the preparation for introduction and implementation of a reform entitled *Higher Still, Opportunity for All* and the amalgamation of the two national curriculum and assessment bodies, Scottish Exam Board (SEB) and Scottish Vocational Education Certificate (SCOTVEC) to create one unified body – the Scottish Qualification Authority (SQA). Technology Education for Scottish Schools was endorsed by the Secretary of State for Scotland as statement of position.

This paper discusses the opportunities as they existed and the resultant courses which subsequently evolved through the process of drafting, consultation with practicing teachers, scrutiny by the members of the Design Engineering and Technology (DET) advisory panel and redrafting by the Higher Still Development Unit (HSDU).

Background

The Government's response to the recommendations of the Howie Committee (1992) on the future shape of courses, assessment and certifications for young people in the upper years of secondary education resulted in an educational reform entitled Higher Still, Opportunity for All (1994).

The Scottish Office objectives of the reform can be summarised as follows: Current Standard Grade courses, equivalent to Key Stage 4, GCSE, will remain in S3 and S4 (Y9 &Y10). Scottish Examination Board (SEB) and SCOTVEC course, including GSVQ, will be brought into a unified curriculum and assessment system under the auspices of a new body, Scottish Qualification Authority (SQA). The courses are designed to be modular, with a mix of internal and external assessment, to allow greater flexibility of progression routes. The system should accommodate students capable of being presented for assessment in advance of their schooling stage and also those students who can achieve over a more steady gradient of learning pace compared with the current 'two-term-dash' towards SEB Higher Grade.

To sum up, the reform aims to create opportunities for all students to attain the highest standards of which they are capable. It attempts to rationalise the existing framework in such a way as to allow for a wider range of courses to be offered, with 'vocational' and 'academic' enjoying equal status. All students are to achieve in a broad range of areas, and demonstrate proficiency of 'core skills' which are so important in work and other aspects of life. After a number of implementation timetable issues, Higher Still is to come on line for students from August 1999.

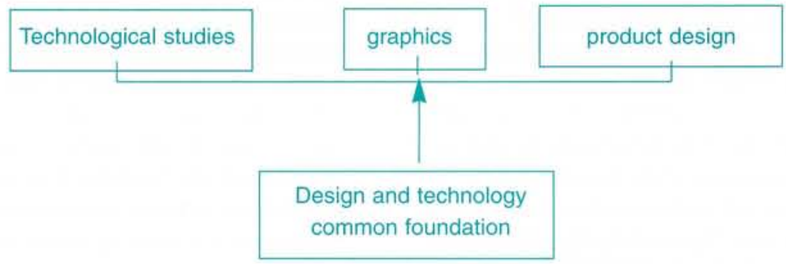
Impact on technology education, upper secondary

The decision to create a folio of Design, Engineering and Technology (DET) courses for *Higher Still, Opportunity for All* provided opportunities for both rationalising and strengthening the existing school curriculum area which presented such courses to secondary school students. A review of the nature, value and goals of Technology Education, conducted by Scottish Consultative Council on the Curriculum (Scottish CCC) was adopted by Higher Still. The resultant document describes the nature and purpose of developing technological capability in our young people. It was subsequently endorsed by the Secretary of State for Scotland as the basis for all new curriculum developments in *Technology Education. Technology Education for Scottish Schools, A Statement of Position* (1996) was embedded within the rationale for Higher Still courses in Craft and Design, Graphic Communication and Technological Studies and also Home Economics, and Art and Design.

The discussion of this paper is confined to the subject areas that are thought to be those that will be most commonly adopted by Technical/Technology Departments in secondary schools: Craft and Design, Graphic Communication, Technological Studies and Practical Craft Skills.

Initially, the prospect of grasping the Higher Still reform as an opportunity to review the very nature and purpose of much of the current teaching in technical departments of Scotland seemed exciting and timely. A number of government white papers, such

Figure 1



as *Realising our Potential – A Strategy for Science, Engineering and Technology* (May 1993) and *Competitiveness – Helping Business to Win* (May 1994) added weight to the perception that technology education could become a leading player in the curriculum.

It was the intention of Higher Still developments to capitalise on the growing interest and belief in technology education for all young people and the value of a strong technological capability for all.

The evolution of DET for schools

A structure was proposed initially by some of the development group which explored a common design and technological foundation and branched into a greater degree of specialisation of specific aspects of design and technology education such as graphics, product design and technological studies (see Figure 1). However, this was short lived.

The argument against this proposal seemed to be that it had taken many years and a great deal of effort to have Technological Studies, SEB Higher Grade, recognised as a valid university entry qualification and it was too radical a move to integrate all three traditional areas into one technology education course.

The impact of 5–14 Environmental Studies, Technology![1], SOED 1993, was at this time an insignificant player in the thinking of those in the common core concept model. The second, less radical, proposal was also squashed at embryonic stage. The idea was to set aside technological studies whilst an integrated common core design course of graphics and product design would have options for specialisation (see Figure 2).

As a result there was no rationalisation, little updating of content and little evidence that the rationale of developing technological capability was to be reflected directly in the courses. More evident was a mutation of the existing offerings which currently over stretch some technical departments and challenge teachers' education institutes in the training of the teachers required to teach an ever expanding remit.

Resultant school-based folio

The existing SEB Standard Grade certificate courses available to S3 and S4 students are in Craft and Design, Graphic Communication and Technological Studies. For 'reasons of continuity and coherency, for

Figure 2

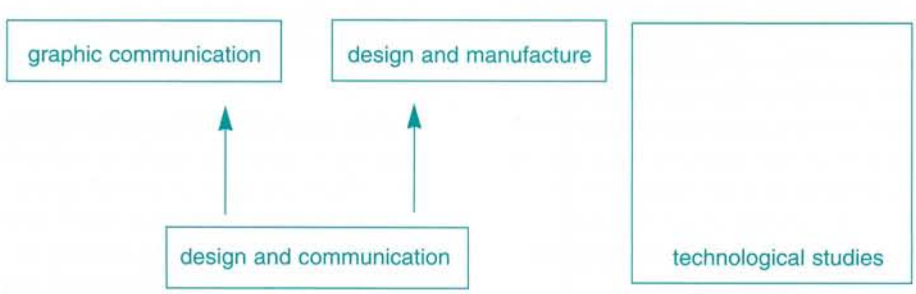


Figure 3

pupils and parents' these same titles and a similar structure were to be maintained in the evolution of Higher Still. And so, there remained three technological subjects (see Figure 3).

In addition, following the consultation, there was to be a return to more traditional practical craft skills in metal and wood. This had not been part of the original agenda and the relevance of such skills for a modern, industrialised nation was questionable. A debate then raged when, in an attempt to compromise, suggestions were made that working with plastics and electronics should be included to at least acknowledge that manufacturing had progressed in process and materials used.

However, the Practical Craft Skills Courses were born and continue to be met with either complete glee or viewed as a return of the 'saber toothed tiger' philosophy.

> *"New Fist was also a thinker. Then as now there were few lengths to which men would not go to avoid the labour and pain of thought. More readily than his fellows, New Fist pushed himself beyond those lengths to the point where celebration was inevitable. The quality of intelligence which led him into the socially approved activity of producing a superior artefact also led him to engage in the socially disapproved practice of thinking."* Benjamin, 1939.

Personal critique of design and technology, SQA Higher Still courses

1. Practical Craft Skills

Contained within Practical Craft Skills Access 3[2], is a unit entitled Craftwork through Enterprise. This involves young people working as a team to develop a product from its conception through to costing and selling it in the 'marketplace'. It provides a practical focus for communication, planning, decision making and negotiation, quality control and evaluation, record keeping and general literacy and numeracy. These are examples of the core skills requested by future employers of a range of levels of abilities.

Intermediate 1 and 2 follow. These courses are catering for those students who achieved a 4, 5 or 6 in standard grade Craft and Design (i.e. low achievers). The content is based on traditional hand and machine tools for wood (Woodworking Skills) and metal (Engineering Craft Skills). Optional units are Fabrication and Welding and Practical Electronics. Practical Electronics survived in the form of an elective as a compromise. There were many respondents to the second consultation exercise who felt that electronics did not belong in a practical craft skills course. However, the counter-argument held firm. Scotland had secured and hoped to secure many more manufacturing companies which had at the centre of their production lines, electronic assembly. Indeed many youngsters would be involved in service trades which demand at least a working knowledge of electronic assembly and repair.

The methodology of Practical Craft Skills is very much a 'demonstration and all do the same' routine. Therefore the Enterprise unit in particular has been met with derision by many technical teachers. There are those who say that it is too hard for 'those kind of kids'. It does require the teachers to take on a different role. The more student-centred approach is a less familiar model for those teachers who are accustomed to a very controlled vocational training approach of skill demonstration.

Many archived plans are being resurrected in preparation for launching the new courses. Those departments that never actually ceased making spade racks and cold frames are rejoicing. Practical Craft Skills is not available as a course beyond Int. 2. It is expected that students will progress to HNC at Further Education Colleges, or apprenticeship schemes or to join the labour force directly.

2. Craft and Design
Although the rationale for Craft and Design refers to the importance of developing the four aspects of technological capability[3], it seems to be entirely based on the consumer society of the western and developed world capitalist market economies. Very little reference is made to the part design and manufacture can play in working towards developing a sustainable future and exploring technological sensitivity in a fuller sense. The unit's titles describe the essence of Higher Still, Craft and Design courses:

- product evaluation
- designing for people
- designing for manufacture
- product model.

In general, due to the lack of any real radical change from the existing courses, Craft and Design has been accepted by the majority of the field, in principle. With Design as the central core, the needs analysis exercise (Oct. 1996–Feb 1997) which was conducted by HSDU identified a lack of design capability and confidence in the existing technical teaching force, the majority of whom were initially educated, or rather trained, for teaching technical drawing, wood and metal craft skills and possibly engineering science (Technical Diploma, pre. 1989). However, the revised Craft and Design courses have become the bread and butter of the SEB Higher certificates (Figure 4) offered by the majority of Technology/Technical departments in Scottish Schools.

Teachers from the tradition of 'technical' voiced their concern about the lack of any real construction and craft skills being evident. They felt that the courses could be covered without hands-on practical work featuring to any great extent. To placate them, clearer advice was included and there was a shift in the assessment weighting of units. The terminology of 'model' was expanded upon to ensure that prototyping was also understood to be appropriate.

Value issues developed through the curriculum of 5–14 Environmental Studies (1993) and as described in the CCC's *Technology Education in Scottish Schools* (1996) have not been pulled through explicitly in the unit descriptors. The new Higher Craft and Design does contain a few indications that students are to begin to contextualise and consider the non-neutrality of design and technology. However, the development of technological sensitivity[4] (Scottish CCC, 1996) will depend very much on the approach of the individual teacher. It is hoped that Higher Still teaching materials will support the development of teaching and learning approaches in this area. The Technology Education Development Programme, Scottish CCC, has established a working party to explore issues of evaluation, teaching approaches and strategies further.

Figure 4 Number of presentations and presenting centres for 1997

SEB	**Standard***	**centres**	**Higher***	**centres****
Graphic Communication	7561	330*	2287	253
Craft and Design	13992	396**	2856	301
Technological Studies	4876	306**	1098	196

* preliminary statistics as available Sept. 97
** based on centre statistics 1996

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The practical making and modelling must continue to be valued. A balanced technology curriculum should be based on acquisition of knowledge and skills, attitudes and their application to meeting needs and solving practical problems i.e. 'Privilege the practical' (Scottish CCC, p. 5).Teachers should be encouraged to see that this course is protecting the modelling and manufacturing in the realisation of the pupils' considered proposals.

3. Technological Studies
The content and flavour of technological studies (previous courses date from 1990) have altered very little in the Higher Still exercise. The rationale sets out the need for the technological studies courses to maintain their relevance with industry and commerce. It reinforces the need to use real applications of systems and calculations that reflect actual practice. It also emphasises the need to address the development of the aspects of technological capability. It acknowledges that technological perspective, confidence and creativity are more embedded within the assessable elements of the courses and stresses the importance of developing technological sensitivity in the contexts of the study. The students are to 'consider the social, economic and environmental issues of technologically driven change and the impact on society'(Int. 2 and Higher, p. 4).

Opportunities exist for engaging the students in greater consideration of the values involved in the world of Design, Engineering and Technology. At present, exploration of environmental, social, economic and moral dilemmas are underplayed in favour of skills, processes and specific content focused study units. Yet it is the integrated design and people centred nature of technological systems that provide the basis of involving the students in valuable and significant decision making. Technological Studies at school tends not to utilise the potential of processes and methodologies from design and product design engineering.

The content, outcomes and assessments do not make the connections and applications explicit (see Figure 5). The courses read as practical skills and knowledge content only. The connection between technology and the needs of the society it is to address is not promoted. It appears that it is enough to learn the theory and neglect the central purpose for which we explore technological applications; enhancement of life, control and protection of our environment etc... In abandoning the design ethic, the course may have become more definable but it loses the experiences which would have allowed technological capability to be developed fully. Those specific experiences that technological studies could offer (which perhaps maths and physics may not, by their adopted nature in school) have been clouded.[5]

There are opportunities here to adopt both creatively practical and/or case study approaches[6] to the teaching of technological studies which will permit a contextual integration of varying duration. Students could be afforded greater individual control or 'ownership' of creative tasks in response.

Industry requires young people who are resourceful, capable, team-workers and confident. More could be done in Technological Studies to promote these skills and attitudes in addition to developing the foundation proficiencies. It seems the

Figure 5 Summary of technological studies: content / units

Int 2: Applied electronics, energy, systems and control, fundamentals of technology, mechanical systems

Higher: Applied electronics, systems, control and energy, structures and materials, case study report

Advanced Higher: Applied electronics, systems and control, structures and materials, case study report

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Figure 6 SEB certificate Presentations in Technological Studies

year:	93	94	95	96	97	98	99
Higher Grade	968	1140	1146	1161	1098		
Standard grade	5916	6076	5978	5258	4876		

rationale does not find adequate expression in the detailed specification for Technological Studies and opportunities for embedding the principles of *Technology Education in Scottish Schools* into content and approaches proposed have been missed.

Technological Studies is currently experiencing a drop in uptake at certificate level, both in numbers of presentations and presenting centres (see Figure 6.). Anecdotal evidence indicates that there will be an even greater drop for 1998–1999.

Higher Still Technological Studies could have acted as a rekindling and new stimulus to redress this situation. Another lost opportunity?

4. Graphic communication
The rationale indicates that the courses are intended to develop analytical thinking. This does not come across clearly/strongly enough in the evidence within the course. Much will depend on the individual teacher's interpretation, context setting and approach. The course could be taught in a particularly mechanistic way with little creativity and scope for personal 'ownership' being achieved by the pupils.

The courses seems to be devised on a practical skill foundation only (see Figure 7). As such it seems not to encourage intellectual challenges which provide the motivation and stimulus for sustained interest which is necessary if students are to progress in their technological capability as a whole.

The Report on Central Moderation for Graphic Communication 1997, supports the need to encourage a more creative, integrated approach.

"There was a clear distinction between the quality of work submitted from centres in which a creative approach had been adopted and that of centres in which all candidates had produced similar, teacher-led graphic items. As a rule, candidates who were encouraged to be creative, produced work which was more complex, complete, colourful, appropriate, varied, visual and detailed." (Standard Grade, Illustration and Presentation, p. 1.)

The evolution of Technical Drawing into Graphic Communication has neglected the issue of central importance in graphics. That is it makes use of basic psychology and understanding of visual perception and aesthetic appreciation. Students can develop a raised awareness of the graphics around them if they are encouraged to make critical evaluations of their everyday surroundings and bring this understanding of what proves to be effective and what doesn't to their own work. It is implied that this course should be student centred and resource-based … with opportunities to develop creative and analytical thinking and

Figure 7 Graphic communication in brief

Int. 2
Graphic communication: pictorial
Graphic communication: orthographic
Graphic communication: computer graphics

Higher
Technical graphics I (mostly pictorial)
Technical graphics II (mostly orthographic)
Computer graphics

Advanced Higher
Manual and computer-aided drawing
Computer-aided surface modelling
Computer-aided solid modelling
Computer-aided graphic presentation

yet there is little guidance which indicates that any of the learning outcomes specified would be enhanced, supported or taught in this way.

Overall, the arrangements for Graphical Communication at Int. 2 and Higher levels appears to be product outcome driven, with decision making at a 'low level' only, no reflection, little critical and evaluative reflection, and an inadequate emphasis on creative problem solving and design centred approaches.

Although, at Advanced Higher Level, social and environmental implications are dealt with in the rationale, all the courses could do much to encourage a more questioning approach to promotional graphics, considering some of the controversial ethical and moral issues and impact graphics can have. A critical appreciation of how the skills can be used and the personal code of values they wish to follow. An awareness of the ways in which graphics can be manipulated and can influence people is also acknowledged at Advanced Higher Level. Interestingly, this is the closest to a statement of progression from 5–14 Environmental Studies, Technology i.e. 'Ways in which the development of ... advertising and media influence ideas about...' (P7–S2, Environmental Studies 5–14, p. 49.)

Although reference is made to *Technology Education in Scottish Schools* in the rationale, the courses, as they are, do very little to explore technological capability with respect to sensitivity and perspective through evaluation of the role and influence of graphics in society. There is no attempt to include the moral and ethical aspects of graphics and the consequences of a rapidly changing world of visual communication.

Support for Teachers

The outcomes of initial 'Needs Analysis' exercise (96–97) highlighted an overall request for support in developing appropriate teaching approaches, particularly in design and evaluation, knowledge, support in developing personal/ departmental understanding and skills with the new technologies (CAD, CAD/CAM and CAG) and support on assessment strategies and quality assurance processes. The Higher Still Development Unit, in its final two years of existence, will endeavor to meet some of these needs by publishing material under the Teaching Support Series (1998–1999) and presenting seminars. Local Authorities and schools will ultimately have responsibility for making the appropriate investment in resources and personnel to implement Higher Still as it is finally adopted by the Scottish Qualification Authority.

The role of Teacher Education Institutes (TEIs)

Preparing teachers to appropriate levels in all four 'subjects' of Higher Still, whilst maintaining the rigor required for a degree as opposed to training, will prove problematic within the traditional four year undergraduate courses, let alone the one year PGCE Technology. This fuels the debate about selecting a specialism or two from the Higher Still Design Engineering and Technology portfolio[7].

All TEIs which offer Design and Technology/ Technological Education are suffering from a lack of suitable qualified recruits for their undergraduate courses. Candidates are required to display evidence of competence in English, mathematics and science and also be creative and practical. The low numbers of applications has resulted in such university courses proving to be nonviable in economic terms.

For DET Higher Still to work as conceived, there must be appropriately educated teachers and appropriate high quality in-service courses on offer. The worry is that no investment is forthcoming to ensure that this is the case.

Conclusion

My personal opinion is that the future of Design and Technology Education in Scotland is at a very precarious time. Although Higher Still initially set out to create greater opportunity for all, it is unlikely that technology departments in Scottish schools will be in a position to offer all four of the forthcoming Higher Still 'subjects'. It is more likely that decisions will be made by senior management based on predicted numbers of presentations feasible,

accommodation and facilities available and annual revenue costs of such courses which inevitably make demands in terms of expendable resources and technician support.

Opportunities have been lost, but there is also much to work from in the technology education curriculum framework we now have to implement. It seems that there may need to be a concerted effort by Local Authorities, students, teachers, parents, individual departments, HMIs, Universities, TEIs, the Scottish Consultative Council on the Curriculum, employers and politicians to ensure that the aims of *Higher Still Opportunity for All, Design Engineering and Technology* can be achieved.

Notes

1 Non legislative National Guidelines for all curriculum areas are published for 5 through to 14 year olds. This covers Primary 1 to Secondary 2 after which students make options for the preferred Standard Grade courses. Guidance for Key Features of Study and Attainment targets are laid out in 5–14 Environmental Studies 1993. This umbrella title includes, Science, Social Subjects, Technology, Health Education and Information Technology.

2 Higher Still is structured through 'Access 3' (no prerequisite of Standard Grade), Intermediate 1, 2 (for those students who achieved a low level pass in Standard Grade) Higher (prerequisite of a good Standard grade pass) and Advanced Higher (prerequisite of a Higher Grade pass).

3 Technological capability comprises four mutually supportive and interconnected aspects: technological perspective, technological confidence, technological sensitivity and technological creativity. Scottish CCC Technology Education in Scottish Schools 1996.

4 It may be that the structure provides teachers with clearly defined outcomes which facilitate teaching. This in turn may lead to the pupils having greater confidence in their teacher, which may increase uptake. It may increase the uptake of Technological Studies particularly by females. However, this is a debatable and much debated issue. One for discussion in another paper. '*Is there any correlation between teaching technology through value based approaches, interest and selection of curriculum 'subject' for certification examinations*?'

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6 A balance of Creative Practical tasks, proficiency tasks and case study tasks are recommended as broad categories of learning activity appropriate for Technology Education. See General Characteristics of Appropriate and Effective Technology Education p.11–13 Scottish CCC Technology Education in Scottish Schools.

7 There are a total of 32 different courses on offer within the portfolio of Design, Engineering and Technology, 4 of which seem to be more appropriate for schools to offer, the others more for Further Education colleges.

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