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# Sustaining the Essence of Design and Technology:
# The case for textile technology

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## Abstract

This paper, which reports on preliminary findings from an ongoing study into the significance of design and technology in post-industrial communities, examines the changing nature of textile technology and how this may impact on its role within the UK schools' curriculum. The study, based on field work carried out in North West England, elicits a range of stakeholder viewpoints to inform the research argument. Empirical data has been gathered from two areas:

(i) secondary school teachers working in the design and technology field;

(ii) academic and industrial stakeholders who were able to comment on the changing needs of textile industries within North West England's post-industrial community.

The discussion argues that textile technology provides a basis with which to deliver the essence of design and technology within the current and rapidly changing economic environment. However, it is suggested in order for the subject to be more applicable as a curriculum subject it should be more technologically focused and that technological aspects of the discipline should be tightly coupled to the design function; a model easily realised within the textile technology field. This paper pays attention to the business and industrial environment in which textile technology is now embedded. Primary research findings gathered from semi-structured interviews carried out over a two month period underpins the work. The data supports the view that technological aspects of the discipline should relate to the design function; an approach which will make schools' textile technology more effective within the modern design and technology curriculum. This aspect can be developed through initiatives such as STEM and skills embedded within the 14-19 curriculum. Four short vignettes are included to illustrate some outcomes of the interview field work.

## Key words

teaching, post industrialism, textile technology, grounded theory, essence of design and technology

## Introduction

This paper discusses preliminary findings from ongoing research into the meanings practising teachers, industrial commentators and academics attach to the significance of design and technology in an emerging post industrial economy. The work is set in North West England; a geographical area which is characterised on the one hand by rapid decline in its once dominant industrial base, notably textiles, heavy engineering, food manufacturing, transport related technologies, electrical engineering and coal mining, and on the other by growth in its service economy e.g. retail, finance and small to medium size enterprises (SMEs). This follows a pattern of post industrialisation described by authors such as Bell (1973), Ritzer (2007), Toffler (1970) and Kumar (2005) who emphasise ways in which labour and capital resources are replaced by those of knowledge and information as the main source of wealth creation leading to notions of knowledge based economies (Drucker, 1969) (Kimbell and Perry, 2001) (Hargreaves 2003) and weightless societies (Leadbetter, 2000) (Quah, 1996).

Our interest in the study stems from our role as teacher trainers responsible for the development of design and technology training curricula which are relevant to the current and future needs of the subject in the school context. Moreover, we argue that the way in which design and technology is delivered at the micro-level is markedly dependent on the interpretations, skills, values, attitudes of teachers and other key stakeholders responsible for delivery in the classroom.

Initial field work, carried out as an exploratory pilot study with Heads of Department and experienced classroom teachers, has indicated that, even within a National Curriculum framework, there are wide variations in the meaning of design and technology at the school level. Some Heads of Department, for example, interpret the essence of the subject in terms of a modern manufacturing paradigm and how this underpins the needs of a flexible and advanced trained engineering workforce. Others, favour a curriculum based on craft oriented

skills and see these as developing the competences required by workers such as builders, plumbers and other construction workers. Preliminary studies, also, highlight that many teachers privileged art/design oriented skills over making skills; a practice that seems to relate to the intrinsic skills of those teachers delivering the design and technology curriculum in schools.

This research seeks to illuminate the influence post industrialist factors have on teachers and other stakeholders' perceptions of the role of design and technology in current and future economic circumstances.

North West England is a densely populated area with a large number of secondary schools, sixth form colleges and further education institutions that support a diverse population. The region includes Greater Manchester, Merseyside, Lancashire and parts of Cheshire and Cumbria. The area is unique in that it may be regarded as the first major geographical area to undergo the 'complete cycle' of industrial 'take off' (Rostow, 1960) (Ranis and Fei, 1961), through to industrial maturity (Orihata, 2001) (Taylor, 1985), industrial decline (Lloyd and Reeve, 1982) (Kilpatrick and Lawson, 1980) (Jones, 2003), competition with global markets (Michie, 2003) (Raco, 1999) and the emergence of the post industrial culture which now describes its economic status.

It is within this context that the overall research programme will explore the essential nature of design and technology and its relationship to economic forces from four interrelated perspectives:
(i) the diverse interpretations teachers and other stakeholders attach to the meaning of design and technology in their contextual settings;
(ii) the influence the post industrial dimensions of society have on stakeholders rationale for design and technology in current and future economies;
(iii) the limitations the National Curriculum may have on design and technology change;
(iv) the cultural influences of schools in which the design and technology curriculum operates.

## Grounded theory methodology

Grounded theory has been selected as the methodology for the programme. This will allow conceptual understandings to emerge from our investigation of the issues that influence design and technology at the school level. Central to the grounded theory methodology is the constant comparison of conceptual insights that emerge, both within and between data, during analysis. The theoretical explanations that result help

make analytical sense of data rather than providing a purely descriptive account of what is going on. Constant comparison is useful in keeping analysis closely related to the characteristics of the data set (Pandit, 1996) (Elliot and Lazenbatt, 2005) and aids the validity and reliability of the research outcomes (Seale, 2003) (Cresswell, 1998).

A constructivist grounded theory approach (see for example Charmaz, 2000; Charmaz, 2006; Schwandt, 1994; and Bryant, 2002;) in which knowledge is seen to be constructed between the researcher and those being researched will be adopted. This model takes into account the reflexive and biographical stance of the researcher and acknowledges that contextual factors contribute to the way in which social knowledge can be described. Constructivist grounded theory versions also facilitate a more flexible approach to data gathering and analysis when compared with 'Glasserian' approaches to the methodology.

For example, in its original form (see for example Glasser and Strauss, 1967), grounded theory emphasised concept generation from data without recourse to prior theoretical knowledge i.e. primarily using an inductive methodology. However, many commentators (notably Charmaz, 2000, 2005, 2006) now advocate an abductive methodology which combines both inductive and deductive theory generating procedures. When doing so, theoretical frameworks derived from literature and other sources can be used to orientate research design and analysis, and can sensitise the researcher to issues within the data set. Strauss and Corbin (1998) and Corbin and Strauss (2008) discuss how theory can be part of a pragmatic and structured approach to theory building whereby the researcher is encouraged to mix grounded theory with other methodologies and apply existing insights and experiences to the subject matter. Charmaz (2006) describes how theoretical concepts are constructed, rather than being 'discovered', and how the researcher's biography and reflexive relationship to data will influence research outcomes. Such thinking has informed our methodological stance.

Our methodology makes use of theoretical (or selective) sampling to generate data and set the agenda for subsequent research phases. In grounded theory, theoretical sampling generally takes place concurrently with data analysis as the main concepts become apparent. Further data can be selectively collected and the properties of the data identified as analysis unfolds. In this work, the theoretical sampling procedure is as follows:
• generation of analytical concepts within the data;
• constantly comparing concepts to examine links between data sets;

- generating theoretical constructs that describe and characterise elements of the data;
- 'constructing' analytical theories that help describe the work under investigation.

The work discussed in this paper forms the base for the first phase of the grounded insights into the data. The analysis of outcomes will inform the direction of the next stages of work. The first phase has focussed on textile technology and its role in the school curriculum; a research area which is now detailed and discussed.

## First grounded research phase: focus textile technology and school curriculum

Initial research has begun with the role and relevance of textile technologies in the current and future economic climate. We see this as a useful starting point for the grounded research because of the significance textile technologies have had on the economic, social and industrial structure of North West England. Textile technology in all its main forms viz spinning, weaving, apparel manufacture, finishing and specialised textiles have been central to its industrial development over the years. A number of commentators discuss the post industrial implications of how the industry has had to change in respect to more competitive market forces, especially in the context of changes in niche marketing (Parrish et al., 2006) (Hines and Bruce, 2007), increased globalisation (Tyler, 2003) (Kaur and Gale, 2004), product and process innovations (Forza and Vinelli, 1997) (Catling and Rothwell, 2002) (Abernathy et al., 1999) and changing workforce needs (Lowson et al., 2002; Tyler, 1989). Another concern, for us, are aspects of changing nature of textile technology in schools whereby many practitioners favour art led approaches to those developing pupils' understanding of the more technical aspects of the subject.

A number of writers including Hill (1985), Hines (1992) and Bentley (1991) have identified five area opportunities for improving competitiveness in economic environments characterised by post industrial changes;
1. Reducing the time it takes for new products to reach the market (time to market).
2. Reducing manufacturing lead times.
3. Reducing customer lead times.
4. Reducing process changeover.
5. Stabilising schedules.

These strategies to increase the rate of technological innovation and associated benefits (more timely information, electronic

design, advanced manufacturing technology etc.) mean that product life cycles have been collapsing. Firms need to make decisions more quickly and speed up the rate at which new products are introduced to the market. Shorter life cycles shift the emphasis of competitive strength and value-added away from production and the consumption of raw materials and labour in manufacturing towards decisions and costs which are incurred before production.

Central to such changes have been the rapid advances in the use of microprocessor technologies, in particular computer aided design and computer aided manufacturing, in all areas of the textile industries. Clothing machine manufactures, for example, have introduced a number of innovations including tension free stitching with little or no intervention from the operator, new and improved fabric feeding and machines that operate with various degrees of automation (see for example Hughes and Hines (1993), Cooklin et al. (2006), McLoughlin and Hayes (2008) and Collier (1990).

In general such advances have been on two levels:
(i) High technologies with an emphasis computer aided manufacture (CAM) which is suitable for a limited specialised products; and
(ii) intermediate automation which is suitable for the majority of smaller, medium sized firms which benefit from economies of scale.

With the increase in automation there is a need for all textile technologists, whether involved with design or product 'make up', to predict and understand how fabrics will behave, cut, sew etc. during operations with little or no operator intervention. It is, therefore, important for all textile practitioners to understand such technologies in both design and manufacture and this has implications for education and curriculum design. The post industrial characteristics of the textile technology marketplace and how these are interpreted by those who influence the curriculum provide a stimulus for the first phase of our grounded study.

## Data gathering

Face to face interviews were carried out with (i) six practising teachers; two of whom were Heads of Department (ii) two academics responsible for teaching textile technologies at university level (iii) a textile industrialist. The purpose of the research was explained prior to each interview and ethical practices as described by BERA (2004) were followed during the interviewing process. These include the rights of respondents to refuse to allow any materials to be published if

they felt it necessary and that anonymity of institutions and people would be observed. As such, names of respondents and workplaces have been changed where appropriate.

The key questions for interviews were:
• Respondents' perspectives on textiles in the National Curriculum.
• The purpose and barriers to teaching the subject in the current economic, social and cultural climate.
• What are the respondents' biographical backgrounds and how these relate to their abilities to deliver the subject at the schools level.

Interviews were designed to be reflective. Respondents were encouraged to reveal their beliefs, values, illusions and feelings about their conceptual understanding of a training experience in an honest way, and care was taken to ensure that interview outcomes portrayed the true feelings of participants. A strategy suggested by Bowden and Green (2005) was used to direct the interview sequence. This was:
• An identical opening scenario was used for each interview followed by a set of lead questions.
• There were no further substantial inputs into the interview sequence except to refer to issues that respondents had introduced themselves.
• The only evidence used in constructing the descriptive understanding of trainees' practice was contained in the interview transcriptions.

The semi-structured interview approach allowed insight into respondents' understanding of school culture and how these relate to teaching and curriculum reform and development. This enabled a firsthand view of social world by focussing on individuals' meanings of the situations in question (Hitchcock and Hughes, 1995). A further merit of the semi-structured approach is that it provided an opportunity to probe and expand on the respondents' responses. The semi-structured nature of the conversations allowed new material to be incorporated into the discussion that had not necessarily been thought out beforehand. It also gave a greater scope for asking questions out of sequence and allowed information to flow freely and gave the opportunity to raise fresh questions. Care was taken to adhere strictly to the responses and not to influence the data by one's own pre-conceived ideas. A simple coding system was used to bring out the similarities and differences of the respondents experience. Coding consisted of identifying and labelling similar word and/or sentence responses within the transcribed work.

## Selected findings

We have selected four vignettes built up from research data to present in this paper. These give an indication of the findings from the first stage of the study. The vignettes briefly describe the background to each respondent, their experiences, the school culture in which they work and describe their views on design and technology and the post industrial culture in which they find themselves. The vignette dialogues provide a basis for our discussion of the issues.

### Vignette 1: John (Head of Department of a 11-18 Technology Status School)

John has been Head of Design and Technology in a school in North East Lancashire for the last five years. Previously he was the teacher responsible for systems and control in the school. The school has a sixth form block which is well equipped with a range of advanced manufacturing machinery including a laser cutter, wood machine router and an extensive computer aided design (CAD) suite. The school has recently introduced a 14-19 manufacturing programme into the curriculum. John came into teaching from a successful career in aerospace engineering where he worked on advanced computer aided machinery, manufacturing parts for aircraft engines. During his time in industry he gained a Higher National Certificate in Engineering Technologies. John is a highly skilled practitioner who's knowledge and skills in modern engineering techniques have helped him develop a working environment and curriculum which he feels is '...applicable to the needs of the area and the pupils who live around here'.

John, mainly because of his expertise in the subject area, has been given a great deal of autonomy in running the Design and Technology Department in a way he believes it ought to be organised. He plans well, and when negotiating bids for equipment and other materials he has been able to use persuasive arguments to gain funding for the various projects he has instigated. In doing so, he has been able to obtain a high proportion of the school's capitation budget to put into place strategies he feels '...important for effective running of design and technology in his school'. His industrial background has been '...very useful in helping him work well with local business contacts...' This has enabled him to '...secure [substantial] money from outside sources to fund major parts of his new building programmes...'
John's vision for the school is one of design and development based on the 'twin routes of systems and control and manufacturing...This is where we have the expertise and where we can get good results.' The other teaching and technician staff in the department have similar backgrounds and have all

come to teaching via a advanced manufacturing route. For John, this gives the department '...the expertise needed to achieve good examination results...' and also '...ensures that the teachers are competent at operating the machinery and equipment they have in the department...what's more, if it goes wrong they have some idea how to fix it...'

Under John's leadership, however, the Department only focuses on a limited range of design and technology subjects at Key stage 4 and above; these being systems and control and, resistant materials. The department does not offer textile technology as part of the school's curriculum at a higher level that Key stage 3.

When questioned as to why this was the case, John commented that '...there had not really been a textile focus at that level for the last few years. The Department had always gained a good set of exam results when sticking to electronics and product design... this is what we are experts at...we work together well and know what to do for the exams...we would find textiles much more difficult to do...and we'd have to get new equipment and rooms to make it as good as the other subjects...'

It was evident that John had a lot of control over the direction and essence of the design and technology curriculum within his school, and viewed the nature of the subject purely in functional manufacturing terms. He viewed the purpose of the subject '...as preparing pupils for future employment, in say, engineering...what we do gives them a good practical and theory base...'

### Vignette 2: Susan (Head of Department of a 11-16 Secondary School)

Susan joined the school eight years ago straight from teacher training college. She had previously worked in industry. Susan's degree focused on resistant materials and product design and, by her own admission, a '...very small amount of textiles...' Susan has worked hard over the last few years to update her '...knowledge in the textile technology area and has been on a small number of LEA run courses...' but most of the work has been '...self taught...'

Three years ago, the only experienced textile teacher in the school retired. This teacher had spent a number of years building up a '...very strong textile base...' and during this time had gained good results in the area. The textile classes being run at the time were three GCSE (AQA) groups and an As/A2 level group.

At this point in time, it became evident to Susan that her limited knowledge of the area combined with a strategic need to rationalise some of courses within the school '...forced her to make the textiles course more art focussed...' The textiles courses within the school are now shared between the Art and, Design and Technology Departments. The topics taught have moved away from '...the more technical aspects of the subject...for example automatic sewing machining and fabric testing...to projects which include more [textile] embellishing...' The projects '...we do in year 7 are cushions...year 8 bags...in year 9 we make a print on the front a T-shirts...'

Susan discusses that one of the problems is that she '...struggles to find courses that will stretch her knowledge in modern, industrially based textile technical aspects...There are a lot of art based courses on offer... [but] not a lot on construction... I have a good range of equipment to teach textiles with... programmable sewing machines, heat presses, CAD equipment... but I could do with more knowledge and experience in this area... I have also been developing my own knowledge in smart and other material areas... I work in an area which has lots of good industrial examples of up to date processes... in the past I've been on visits to factories making carbon fibre weaving and one making Kevlar bullet proof jackets for the army and police... but I could do with some background courses to help me with the some of the more technical aspects of these technologies...'

### Vignette 3: Holly (Textile teacher at a 11-16 school in Greater Manchester)

Holly has taught apparel oriented textiles for eight years having completed a textile technology degree and a PGCE in design and technology education. However, due the imminent resource issues in her school, which had the effect of reducing the number design and technology staff in her school she has had to make the decision to move her textile course into the Art Department. Holly's rationale for this is that '...it will be cheaper in the long run...I will need to buy fewer fabrics for things like the garments I used to make... I will need fewer sewing machines... and we can share our equipment with art...' Due to lack of resources in the school, Susan found it more and more difficult to cover the examination specification to the required depth. She had no CAD/CAM textile facilities in the school and there was no money available to buy such equipment '...now or in the future...this would have had an effect on my results... and I was not really prepared to let this carry on. This limits what I can do and leads to lots of work which moves away from the sort of technical work I wanted to do...'

The move to art was a '...mutual decision...' between herself and '...the Art Department...'. Susan, '...hopes to keep some technology textiles... and the Head of Art was excited about the move because 'she told me the results would go up [in art] because instead of just doing pattern applications... the pupils can make what they design into a product ... but as it's not a requirement [of the exam] it won't be assessed in line with design and technology requirements... there is no real need for the sort of CAD/CAM I needed when doing the DT sort of work...'

Holly emphasised the fact that there would be fairly large budget cuts, no new equipment and no new resources in the school she was teaching in. Moreover, she thought '...that soon this would be more drastic that she first thought... I think I've made the right decision.'

### Vignette 4: David (Textile technology academic who has wide experience working in the area of apparel/textile manufacturing).

David works as a university lecturer teaching textile technologies to fashion, textile and textile marketing students. His expertise is in clothing and textile equipment technology and the property characteristics of materials during manufacture. David has worked for a number of clothing companies as a production engineer responsible for maintaining the efficiency and effectiveness of the manufacturing process and helping assure product quality. This experience has given David '...a fairly good insight into the needs of the fashion and textile industry... especially how garments are made in practice...'

David has worked in North West England for years and has experienced, first hand, some of the changes that have occurred in the industry due to globalisation. During the interview David discussed how there are still pockets of the textile industry in the area, but these tend to be based on small enterprises making products such as seat belts, outdoor clothing and corporate apparel. 'The once high volume manufacturing companies...making thousands of shirts, suits and jackets every week have now moved overseas... we have to work in specialised markets...'

For David, '...specialisation and understanding the market we are now operating in... is the key to success in today's market...' Paying attention to the quality of the product and '...how you can achieve both flexibility in product change and the number of products produced at any one time has been important in ensuring that we compete [in the modern market]...' This

means companies have to invest in '...quick response methods...' and that '...design needs to be linked closely to manufacture...' David emphasised the need for his textile students, whether fashion designers, textile technologists or management trainees, to understand the nature of the market place and how the technical aspects of textile processes relate to it.

David was keen to stress the importance of '...designers understanding the characteristics and how fabrics perform when being manufactured... how materials behave when being sewn... effects of the presser foot... [effects of] seam pucker... needle heating... and understanding the limitations of the equipment used...' For David, this emphasis on teaching the technical aspects of the discipline was very important in preparing students for work in the modern textile environment; it '...provides a better base for the people who are going to be the ones keeping our industry going in the future...'

## Conclusions

This paper has sought to illustrate some directions and outcomes of the future needs of design and technology in the context of a dynamic and changing economy. North West England has been selected for the research setting because of its largely post industrial base and connections to industries that inform the design and technology curriculum i.e. textiles, food, resistant materials manufacturing and, systems and control. The work presented in this paper is of interest to us because it informs the next stages of our grounded theory programme. It, also, illuminates the diverse paths design and technology may take in terms of perceived aims of the subject by those who are responsible for its implementation at the schools' level. This we argue comes from three sources (i) the autonomy some practitioners have over the interpretation of the subject at the school level and how this allows them to make school specific strategic decisions: as it the case of John, (ii) the expertise of teachers delivering the technical aspects of the subject area; especially the way they interpret elements of the National Curriculum, (iii) the emphasis school managers place on the role of design and technology in schools' programmes of study and how these, in turn, translate to funding for the subject.

These notions have been borne out, to some extent, by respondents' dialogue in our study that is specific to the textile field. As our research suggests, there have been moves in some schools not to include textile technology into their higher level design and technology portfolios and/or to integrate textile technologies into art departments; a strategy which, for

us, loses many of the vital skills needed to develop the capabilities of students for post industrial type expansion: a sentiment expressed by textile educationalists such as David (vignette 4). This problem to some extent may be addressed by initiatives such as STEM or new directions facilitated by the introduction of the 14-19 curriculum. These emerging curriculum changes will be a focus for further phases of our study.

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