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# Real contexts for design and technology : an evaluation of the Six Counties Technology Flexible Learning Project

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## Abstract

*School projects in design and technology, through work on grain storage and processing, technology through archaeology and leathercraft, supported by materials developed as part of the Six Counties Technology Flexible Learning Project, are described. An evaluation of the projects is reported and the links between real contexts, flexible approaches to teaching and learning and quality outcomes in design and technology are emphasised.*

## Introduction

Six Counties Technology, a Company Limited by Guarantee with registered Charity Status, has produced, in conjunction with museums and industries, flexible and interactive materials for National Curriculum design and technology at key stages 3 and 4. The development work was sponsored by Northamptonshire, Leicestershire and Oxfordshire LEAs, British Telecom and Nuclear Electric.<sup>1</sup> The materials, which are being used in some schools in Northamptonshire and Oxfordshire, were evaluated as part of the 'Towards a Learning Society Project' based at the University of Reading and funded by Grand Metropolitan plc.

## Real contexts

The materials were produced in the belief that quality outcomes in design and technology are a function of meaningful contexts and flexible approaches to teaching and learning, and that meaningful contexts, where the focus can be on "real" problems and situations, are best generated collaboratively between schools and external agencies.

Several collaborative ventures were explored in the first phase of the Six Counties Technology Flexible Learning Project including grain storage and production, technology through the ages, leathercraft, domestic technology, animal care and control, steel in the construction industry and the logistics of moving commercial premises.<sup>1</sup> Of these, the grain storage and processing, technology through archaeology and leathercraft ventures were taken forward into the second phase of the project when materials were developed, trialed, piloted in schools and evaluated. The accounts which follow, of the piloting of the materials in schools and of the associated evaluative work, were generated through observational visits and questionnaire returns.

## Grain storage and processing

The grain storage and processing materials were used in an 11-16 comprehensive with just under a thousand students located on the edge of a large village and serving a rural area in North Oxfordshire. The school, which opened in 1971, is one of only two in Oxfordshire with its own farm. It is a working farm with a range of livestock and is housed in purpose-designed buildings with associated classrooms and workshops. The design and technology faculty at the school includes the departments of business studies, craft, design and technology, home economics and textiles.

The materials were used in support of a 10 weeks x 70 minute project with a mixed ability year 10 GCSE design and technology group. The project was problem-centred and concerned with the practicalities of grain storage at a local farm and transportation of grain from the farm to a centre for processing. The project started with a visit to the local farm where the students saw, first-hand, the practical problems associated with grain storage and transportation. They were given a general specification, with relevant technical detail, of the problems to be investigated. The problems were:

- (i) dealing with heat generation, and maintaining temperature and moisture within acceptable levels in stored grain; and,
- (ii) devising a system for loading grain onto lorries which minimised waiting time. Loading hoppers on the farm hold 10 tons of grain. It takes 2 hours to load the grain into a hopper. The haulage lorries can take 25 tons of grain. The lorry driver thus has to wait 3 hours before the load is complete. A charge is made for this time. Two variables which cannot be changed are the height of the chain and flight mechanism (for loading grain into the hopper) and the clearance height between the bottom of the hopper and the lorry receiving the grain.

The materials produced by Six Counties Technology, which included background information on grain storage and processing, and technical information relevant to the two problems under investigation, were used in a support capacity in the workshop. The problems were investigated practically in the workshop by small-scale modelling. The students were expected to consider how their modelled solution could be applied on a large-scale.

#### Technology through archaeology

The technology through archaeology materials were used in a church aided middle school catering for 350 students from a wide catchment including urban and suburban residential areas of a large town in Northamptonshire and some outlying rural communities. The school is organised on a faculty basis which includes humanities (integrated history, geography, social and environmental studies) and technology (art, craft and design and technology). There is a tradition at the school of combining work in certain subject areas to form integrated projects.

The materials were used in support of an integrated project on the Roman Villa in Britain for all children (approximately 75) in year 7 (11-12 year olds) for 8-10 weeks in the summer term which culminated in a Roman dinner party. The children were organised into groups, each with a role in the overall scheme. Worksheets produced at the school and by Six Counties Technology, and artefacts loaned by the Northamptonshire Archaeology Unit, were used to stimulate work on some of the ten themes around which the dinner party, and the work leading up to it, were based. The themes were: food, games, Latin, writing on wax tablets, clothes, hair styles, Samian ware, frescos, slaves and entertainment. On the day of the dinner party, students were involved in the preparation of Roman style food and in a variety of workshops, for example learning Latin and Roman style hairdressing.

#### Leathercraft

The leathercraft materials were used in an 11-16 comprehensive for over 700 students which serves a mainly suburban area on the northern outskirts of a north Oxfordshire market town. The design and technology faculty at the school has a staff of twelve and includes the departments of craft, design and technology, art, home economics and business studies. Staff in these departments work as small teams.

Leathercraft has associated with it a number of specific skills. These skills were acquired by two members of the technology team at a training workshop at the Leathercraft Museum, Northampton. The skills training was then cascaded

to the rest of the technology team through INSET session.

The materials produced by Six Counties Technology were used in support of a leathercraft project for 16 weeks x 2 hours for year 8 students (12-13 year olds). Students worked in their mentor groups, each of about 15 in number. The project was organised in four stages: stage one was a one week introduction; in stage 2 (nine weeks duration) students were organised on a 3-way rotation, skills were taught and the project was researched; in stage three (six weeks duration) students designed and made an artefact out of leather; in stage four (two weeks duration) the project was evaluated.

Skills developed through the project included: researching - characteristics of leather and the history of its use; discussion - of moral issues concerned with the use of leather and synthetic alternatives and attitudes to the use of leather in other cultures; designing - annotating drawings, modelling, prototyping, computer aided designing; manual - saddle stitching, beadwork, plaiting, braiding, weaving, macrame, measuring, marking, cutting, glueing, inlaying, tooling, dyeing, sawing drilling, thonging, punching; machine - turning and drilling. The project was designed to provide opportunities for integrating work (through linking tasks, skills transference and prototyping) in construction materials and textiles. Artefacts produced through the project included tools and equipment for leatherworking (for example, an awl or a punch) and goods made of leather (for example, a purse or a belt).

#### Flexible approaches

The working definition of flexible learning, generated through the 'Towards a Learning Society Project' at the University of Reading, is: an approach to teaching and learning that adopts a range of techniques which are fit for the purpose of attending to individual differences amongst learners and of emphasising the skills and attitudes involved in learning how to learn. A list of qualities and characteristics associated with this definition of flexible learning has been developed at the University of Reading. These qualities and characteristics, with some additions and modifications which are especially pertinent to design and technology, are -

Flexible learning may involve students in:

- negotiation of the programme of learning;
- negotiation within the programme of learning;
- taking alternative routes to given goals;
- adopting a range of learning styles;
- spending variable amounts of time on given activities;
- working in

range of locations within a context; appreciating the significance of quality outcomes; working within a framework of real constraints; producing services and products which are client centred.

Flexible learning may involve teachers in: adopting a range of teaching strategies; offering students a range of learning situations; encouraging students to accept responsibility for their own learning; encouraging students to take an active part in evaluating their own achievements; encouraging students to have a sense of ownership of their learning and the learning process; taking account of students prior learning; setting the students work in the context of "real" problem solving or designing and making to meet personal, school or client needs; enabling students to identify a variety of situations where they can apply their skills; enabling students to make connections and track themes between one curriculum area and another.

In terms of these qualities and characteristics, the following comments about flexible learning in the project work undertaken in the schools can be made:

Students were not involved in the negotiation of their programme of learning - the projects were a compulsory element in the curriculum in general or in design and technology courses. In one school it was noted that experience of the project may have influenced students' subsequent choices of GCSE.

Students were involved in negotiation within their programme of learning, typically through decisions about what problems were investigated, the choice of resources and what artefacts were made.

Various strategies were adopted to set students' work in the context of "real" problems or situations. These included designing and making to meet personal and school needs and by linking work to a high profile event (the Roman dinner party). Problem solving was perceived to be of particular importance when it was related to the needs of external clients (for example, the local farmer, dinner party participants, representatives from collaborative agencies).

Generally, the routes students took to given goals were determined by the structure of the project and the way in which it was organised. However, at specific stages of projects, evidence that students were able to take alternative routes to given goals was provided through the ways in which they

investigated problems (grain storage and processing) and the ways in which they solved their own production problems (leathercraft).

The range of learning styles undertaken by students included researching a problem (usually documentary), planning, practical designing and making and evaluating (grain storage and processing and leathercraft); and structured, investigative, practical and discussion-based learning (technology through archaeology). Some of these were project specific and were incorporated to cover National Curriculum attainment targets.

Generally, the formal time allocation to the projects was pre-determined and used to ensure maximum coverage of core practical skills. As projects progressed students were allowed to spend variable amounts of extra time on their work generally (leathercraft), through non-workshop allocations (grain storage and processing) or through humanities (technology through archaeology).

Students worked in a range of locations whilst undertaking their projects - classrooms, technology workshops, information technology workshops, libraries and resource areas.

In all three schools, students were able to appreciate the significance of quality outcomes. Perceptions of quality were related to their own values, the values of the staff and school community and the need to produce outcomes which satisfied people external to the school (the owner of farm in the grain storage and processing project for example).

In all three schools, students, were able to work within a framework of real constraints. The constraints were organisational, logistical and material. The most important organisational and logistical constraints related to timing and deadlines. They had to be addressed through concise planning (there was a tendency to spend too much time planning and not enough time doing) and students devising their own schedules and working to them. Material constraints included an understanding of the properties and limitations of certain materials (clay and plaster for example), and the need to make the most economical use of resources. In some projects there was discussion about business plans and monitoring performance against cash forecasts and budgets.

In all three schools, students perceived that they were producing services and products which were client centred, particularly, but not exclusively, through the elements of their projects which involved people from outside the school system.

Examples of in-school elements of projects which were perceived as being client-centred included the development of any simple technology which speeded up a production process and an appraisal of the issue of single craftsmanship v team production in both economic and human values terms (leathercraft).

All teachers engaged in the projects adopted a range of teaching strategies, for example telling, explaining, discussing, and (particularly in the case of skills) demonstrating. Similarly, all teachers offered students a range of learning situations, for example whole class, small group (particularly in the context of developing team building skills) and individual (particularly with respect to specific skills).

Strategies adopted by teachers to encourage students to accept responsibility for their own learning included emphasising: the element of external accountability in their project work (grain storage and processing); the constraints under which they were working, the need to work to schedules, and personal and peer group accountability (technology through archaeology); and the ethos of the school (leathercraft).

Strategies adopted by teachers to encourage students to take an active part in evaluating their own achievements included: talking through with them criteria for success (technology through archaeology); striving for quality in what they made and took home and a formal evaluation of the project which emphasised skills developed (leathercraft).

The only explicit strategy adopted by teachers to encourage students to have a sense of ownership of their learning and the learning process involved defining students work in terms of the expected outcomes (of skills developed and artefacts made).

Ways in which teachers took account of students prior learning included the diagnostic monitoring of core skills through key stage 3 so that some consolidation of skills, where necessary, could be undertaken in year 10 (grain storage and processing) and through a cumulative, ongoing record of achievement (leathercraft). At the start of the leathercraft project, students were invited to take into school their own leather artefacts. This served both as a basis for stimulating interest and a means of gauging the extent of prior knowledge/ understanding.

Collectively, the ways in which connections were made between the projects and other areas of the curriculum were many and varied. In the grain

storage and processing project, the farm unit at the school was used to develop the connection with rural studies which was offered as an option and taken up by a small number of students each year. However, within this project, environmental, social, economic and personal preference factors were identified as influencing designs but these were not developed formally in any part of the curriculum. Similarly, no formal links were made with science about the teaching of related science concepts - these were introduced as required as part of the work in design and technology.

The technology through archaeology project was undertaken in a middle school where the structure of the curriculum meant that opportunities for making connections and developing links between curriculum areas were maximised. Connections were made at the practical level between artefacts made by the students and artefacts supplied by Northamptonshire Archaeological Unit, and at the level of discussion by extensive comparisons between "then" and "now" illustrated, wherever possible, with familiar examples.

In the leathercraft project, connections with other curriculum areas were made mainly through a consideration of the cross-cultural uses of leather, the ethical and environmental considerations arising from the use of leather (and synthetic alternatives) and the use of leather in the past. These matters took on some importance within the project, but were generally followed-up within technology sessions rather than through liaison with staff in other areas of the curriculum.

Opportunities for students to transfer skills were developed particularly through the design and technology-information technology link (grain storage and processing); and within design and technology (drawing - information technology - textiles - resistant materials; prototyping - card-leather and wool-leather) and through the design and technology-information technology link where design ideas were modelled (leathercraft).

In the case of the technology through archaeology project, the structure of the middle school curriculum substantially determined opportunities for the transfer of skills. It was noted that transference of knowledge was more likely than the transference of skills but that the latter was easier to monitor. Moreover, it was noted that good investigative work did not necessarily lead to a good outcome in technology or art.

## Real contexts, flexible approaches and quality outcomes

In general terms, the links between real contexts, flexible approaches to teaching and learning and quality outcomes in design and technology have been demonstrated. A discussion of the detail of the links must necessarily await the outcome of further development and evaluative work on the Six Counties Technology Flexible Learning Project and related projects. The summary issues, and generalisable observations arising from the evaluation of the Project, which follow are a contribution towards a research agenda.

1. What constitutes a "real" context? Must a real context be problem-centred?<sup>2</sup> Clearly there are no definitive answers to these questions. Client-centred problems and situations, particularly if they involve external agencies and have constraints which can be addressed by students in a more than superficial way, are important.
2. How should quality outcomes in technology be defined? The importance of attitudes, values and understanding to do with the wider moral, social, economic and environmental dimensions of technological activity,<sup>3,4</sup> as well as the products and processes of technology is emphasised. The barrier here seems to be the opportunity for teachers to work collaboratively across the curriculum, particularly in the comprehensive sector.<sup>5</sup>
3. How may students be helped to recognise, value and work towards quality outcomes? Generalisable factors include students knowing their own capabilities, having personal standards in relation to clearly focused self, peer, client and school community needs and expectations, and being offered a range of learning styles in a range of learning situations.<sup>6</sup>
4. How should the tension between the need for students to accept increasing responsibility for their own learning as their skills base and confidence develops, and the security that many students derive from being directed, be addressed? Generalisable factors include: allowing students to negotiate parts of their learning programme, validating their prior learning, providing explicit frameworks for them to transfer skills, and involving them in evaluative processes where criteria are made explicit.<sup>6</sup>

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