edited by clare benson, penny bailey, suzanne lawson, julie lunt and wesley till

seventh international primary design and technology conference

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Seventh International Primary Design and Technology Conference –

Making the Difference

26th June – 30th June 2009, Birmingham, England

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DEDICATION

This publication is dedicated to Sue Hancocks, who has continuously supported CRIPT through a range of projects and hosted visits for many conference delegates over the years. We wish her well for her retirement – a great loss to primary design and technology.

Introduction

It is twenty years since the first primary design and technology National Curriculum was published (1989) for implementation from September 1990. Previously art, craft and design had been part of the primary curriculum, but this was the first time that the subject appeared as a requirement. Looking back over the twenty years there have been some significant points that have led to the position we are in today. Those that immediately understood the nature of the subject undertook some exciting, innovative projects, making appropriate links across the curriculum. However these were the minority. There was no organised programme of professional development for teachers and understanding of the nature of the subject was limited.

Almost as soon as the first document was published it was reviewed and changed several times until in 1995 a National Curriculum was created that was more streamlined but understood by teachers. The idea of Investigative, Disassemble and Evaluative Activities (IDEA) and Focused Practical Tasks (FPT) leading to a design and make assignment (DMA) was crucial in supporting the development of appropriate skills and knowledge and understanding as children undertook a project. Whilst much has been written about the Scheme of Work published by the Qualification and Curriculum Authority (QCA) (1998), it has done much to help those teachers lacking in confidence in the delivery of the subject and it was only ever intended as a guide for schools to use to create their own scheme of work. 2000 saw another new version of the Curriculum and now in 2009 we have the Consultation document to comment on for yet another 'new' National Curriculum. Throughout the twenty years the nature of design and technology has not changed; it is the content that has been adapted but all the key elements can be traced.

As always, for this conference, we have a wide range of papers detailing large and small scale research projects, case studies and curriculum development papers. We look forward to continuing the debates and discussions that arise from the variety of papers to be presented at the 2009 conference.

Clare Benson / Penny Bailey / Suzanne Lawson / Julie Lunt / Wesley Till
June 2009

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Curriculum Development

Technology Education: Making the Difference Education for Enterprise

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Abstract

This paper aims to identify what actually takes place when policy directives bring together Technology Education, Enterprise Education, and School Community Partnerships. Since the introduction of a national technology curriculum to New Zealand schools in 1999 there has been little critique as to the intentions of the curriculum.

In late 2005 a Ministry of Education two-year Education for Enterprise (E4E) project was let to run a professional development programme with a group of 16 schools, to examine ways in which teachers' capability to include education for enterprise can be developed. Specific focus was to be on technology education and the fostering of links with the wider community. This paper will introduce research carried out to analyse the professional development programme and look at the impact it has had on classroom practice with consideration given to the ideologies behind the initiatives.

Models of implementation will be identified and exemplars of real practice in the primary classroom will be presented. Similarities between international attempts to align technology and enterprise education will be explored and an argument for technology education making a real difference will be put forward.

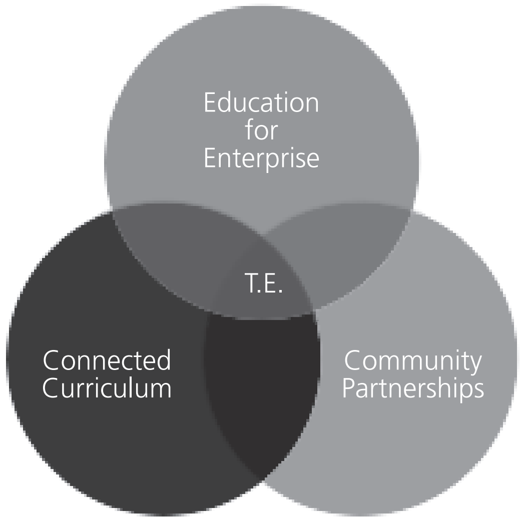
The paper highlights these key factors:
- ***What makes technology different?***
- ***What is a creative connected curriculum?***
- ***Practice in primary technology education***
- ***Tensions between reality and ideology***
- ***Fourth generation evaluation***

Introduction

Making the difference is the focus of this CRIPT conference. This paper introduces technology education as the central pivotal theme of a tripartite relationship which may make the difference in a primary classroom. The paper is based on a recent research project which aimed to identify what actually takes place when policy directives bring together Technology Education, Enterprise Education, School Community Partnerships and the notion of a Connected Curriculum.

Although focussing on New Zealand as an exemplar this paper can be applied to recent curriculum developments occurring throughout the world. Since the introduction of a national technology curriculum to New Zealand schools in 1999 there has been little critique of the intentions of the curriculum. In late 2005 a Ministry of Education two-year Education for Enterprise (E4E) project was let to run a professional development programme with a group of sixteen schools, focussing mainly on the primary sector, to examine ways in which teachers' capability to include education for enterprise can be developed. Specific focus was to be on technology education and the fostering of links within the wider community. This paper will introduce the professional development programme; the ideologies driving the initiatives will also be highlighted.

Making the Links



Background

Internationally, there has been a shift in education policy away from liberal-humanist education towards a more vocationally focused curriculum. The change has come about partly as a response to economic targets and objectives set by national policy makers (Price, 1991). An example of this shift can be seen in the growing emphasis on making education more responsive to the needs of industry and business.

The New Zealand Education Review Office produced a publication called *School Business Links*. In this publication their report states:

> *Many New Zealand schools have relationships of some kind with local businesses. There is little information available, however, about how extensive these relationships are, why they are established and whether they contribute positively to the learning outcomes of students.* (Education Review Office, 1996)

Around this same time, the technology curriculum was published and was seen by some as the way to bring these relationships more formally in to the curriculum. In fact the curriculum itself contains a statement which clearly foreshadows this intention.

> *The link between schools and the community, including business and industry, tertiary institutions, and local authorities, is important to a well developed, inclusive technology curriculum.* (Technology in the New Zealand Curriculum, 1995, p.17)

Various stakeholder tensions such as the economic imperative have been used to propagate technology education's position within a national curriculum framework. More recently these have manifested themselves under the guise of enterprise education. In late 2005 a Ministry of Education two year E4E project was let to run a professional development programme with a group of 16 schools to examine ways in which teachers' capability to include education for enterprise can be developed. Specific focus was to be on technology education and the fostering of links with the wider community. This paper introduces the research which ran alongside the professional development programme and looked at the impact it has on classroom practice with consideration given to the ideologies driving the initiatives.

In 2006 the New Zealand Ministry of Education released a new draft curriculum for consultation. This draft curriculum had an introductory page about technology which included the following statement;

> *Technology education connects students with a range of employment opportunities, particularly those that are enterprising and innovative in nature.*
> Ministry of Education, 2006, p.23)

The New Zealand Curriculum released in 2007 is a statement of official policy relating to teaching and learning it describes a vision by setting the direction for student learning.

Included in this vision is a desire to develop young people;

- Who will be creative, energetic, and enterprising;
- Who will be confident, connected, actively involved, and lifelong learners.
- They should be confident and this is reflected by them being
- Enterprising and entrepreneurial.

(Ministry of Education, 2007, p.8)

This enterprising theme is developed further in the curriculum when discussing key competencies which are described as capabilities for living and lifelong learning. Under the *Managing Self* competency it is suggested that students who manage themselves are enterprising. When describing the curriculum area of technology itself we are informed that technology will make enterprising use of knowledge and skills. Under the technological knowledge strand of the technology area students are encouraged to develop knowledge particular to technological enterprises. This enterprise relationship is explicit in the policy directives and was also the focus of this research.

The process of technology education in the New Zealand curriculum 2007 is described as:

> *Technology is intervention by design: the use of practical and intelephonelectual resources to develop products and systems (technological outcomes) that expand human possibilities by addressing needs and realising opportunities.* (Ministry of Education, 2007, p.32)

Do the policy makers see technology education as a key medium for delivering E4E whilst involving the community? If so, is this the way technology education can make the difference? Is technology the key for developing a connected curriculum?

Objectives

The research component of the E4E project investigated what promotes the development of enterprise attributes in students and what school wide practices can be introduced to support this. The research also evaluates the professional development undertaken by teachers working in schools with facilitators focussed specifically on E4E outcomes within technology education.

The author's objectives for this paper include firstly to illuminate the role technology education can play in developing innovative, enterprising and creative attributes in children. Secondly, it is to highlight how current practices in schools, teachers, and community partnerships impact on this development. This illumination may in fact lead to an effective model of curriculum delivery which could be significant in the development of technology education as a discipline and offer a way forward as part of a connected creative curriculum in the primary school.

It should be noted particularly when considering Technology Education that political ideology and the latest fads have far too much sway over the directions proposed. Others have also raised some concerns:

> *Decision making in education continues to be driven by political agenda, by models adopted from other countries and industries, and philosophical beliefs about what 'should' work.*
> (Masters, 1999, p.1)

A recent article by Clark (2004) published in the New Zealand Journal of Educational Studies highlights the differing views about the word enterprise when used in association with education. This article also highlights some of the main issues surrounding interpretation particularly those associated with the economic imperative.

Research Method

The selection of any research design involves a number of interconnected stages (Crotty, 1998; Denzin & Lincoln, 2008). These stages can be summarised as firstly, locating the study within a research paradigm; secondly, the selection of an appropriate methodology; and thirdly using the selected research paradigm and methodology to identify the methods used to collect and analyse the data.

A paradigm consists of ontological, epistemological and methodological beliefs which help to decipher the complexity of qualitative research. Researchers are guided by particular paradigms, and the associated ontological and epistemological beliefs influence their research questions, their choice of research methodology, and their methods of data collection and analysis (Guba & Lincoln, 1994; Kember, 2000; Lincoln & Guba, 2000). This study uses an interpretivist paradigm (Denzin & Lincoln, 2000) which is supportive of constructivist philosophical approaches. Such approaches share the notion that reality is a social construction, created between the observer and the observed, and that lived experiences need to be understood from the perspective of the observed.

For the purposes of this paper an interpretative constructivist paradigm is employed. Under the interpretative constructivist paradigm interactions between all stakeholders including the researchers are deemed equally important. These interactions combined with an exploration of values held by all the stakeholders help shape the information which becomes a major focus of the study. The interpretative constructivist paradigm can be characterised by its use of primarily qualitative data gathering techniques in a hermeneutical and dialectical manner. Interpretative constructivist researchers focus on the multiplicity of viewpoints held and illuminate how these interact to shape the study. It is the interpretative constructivist researcher's belief that these mutual interactions between those studied and those doing the studying guides the research outcome. The interpretative constructivist paradigm supports the view that the observed reality exposed as part of a research study is a social construction process with no one truth discoverable (Tashakkori, & Teddlie, 2003).

In the case of this specific research, defining, and making sense of the impact of a professional development programme needs to be co-constructed from the perspectives of all the participants. Interpretivist methodology is thus a participative and collaborative endeavour concerned with constructing new understandings *"that get inside the ways others see the world"* (Neuman & Kreuger, 2003, p.75). Fourth generation evaluation was used as an effective method to critique the (E4E) professional development programme for teachers. The tensions and conflicts associated with this methodology were considered including theory and practice issues, the role of active participants and ownership of evaluation studies.

Significance

With the new curriculum implementation underway and also the E4E professional development contract concluding, it is timely and important for academic research to be introduced in to this area. Connecting school activity with out of school experience is not a new concept it relies heavily on the work of Dewey and reflective thinking as explained by Marshall.

> *This was not to make the schools an adjunct of industry and commerce and to acquiesce in the 'untransformed, unrationalised and unsocialised phases of our defective industrial regime', but of utilising the intelephonelectual problem-solving potential inherent in modern technology; 'to make school life more active, more full of meaning, more connected with out of school experience'.* (Marshall, 1997, p.309)

Young (1998), when talking about flexible specialisation and its relevance to education, introduced a notion of 'connective specialisation'. This contrasts with the insularity of the traditional subject specialists and ultimatelephoney with the divided curriculum which dominates in the secondary sector. Divisive specialists see the curriculum from the point of view of their subjects, whereas connective specialists see their subjects from the point of view of the overall curriculum. Young argues for a shift from teacher centeredness to learner centeredness. According to TKI, the Ministry of Education website:

> *Education for Enterprise provides opportunities for students to link their learning to 'real-life' situations. It combines classroom learning and participation in the broader community, including the world of business, and reinforces the relevance and value of what is learned in the curriculum.* (http://education-for-enterprise.tki.org.nz/About-E4E/Why-focus-on-E4E/Benefits-of-E4E-approach)

A connective curriculum acknowledges that education takes place in a community of practice and that learning is purposive and a social process (Lave & Wengler, 1994 cited in Young, 1998). It exposes the need to relate educational activities to developments in the wider society including but not exclusively linked to industry. So connectivity is more than just a curriculum model, it is the purpose of school itself!

The E4E Professional Development Contract

The Education for Enterprise (E4E) project team was made up of two experienced facilitators and a senior university researcher. The project included a number of scheduled group meetings during the two year contract. These 'workshop' meetings were used to inform and shape the research. The meetings were conducted as a partnership between the 'local' experts (the teachers) and 'non local' experts (the facilitators and researcher). The facilitators were involved heavily with planning sessions as well as being in the classroom whilst projects were being undertaken. The focus was 'mutual aid' to improve teaching and learning with an emphasis on 'Enterprise for Education' through the learning area of technology.

At each of the meetings the groups were introduced to the research stages via an address from the researcher which included power-point presentations and question and answer sessions. These meetings helped to clarify the role of both the researcher and the research, explain the methodology and to highlight the participatory nature of this form of research. It was decided that where appropriate the project would focus on existing planned units of technology education and that the teachers and facilitators would work together to enhance these offerings to develop E4E activity.

A growing international consensus of enterprising attributes was considered:

- Identifying, recruiting and managing resources
- Working with others and in teams
- Communicating and receiving ideas and information
- Negotiating and influencing
- Generating and using creative ideas
- Identifying, solving and preventing problems
- Looking for and creating opportunities
- Planning and organizing
- Being flexible and dealing with change
- Identifying assessing and managing risks
- Using initiative and drive
- Reflecting on what has been done
- Working with the community
- Using their knowledge and skills to go for goals
- Being fair and responsible
- Collecting organising & analyzing information

According to (Kuemmerle, 2002) entrepreneurs can be distinguished from others by their ability to accumulate and manage skills and knowledge as well as mobilize resources to achieve specific goals. They steward resources whilst remaining open minded, learning as they find a way forward to develop responses with some merit or value (Sarasvathy, 2004). Hundreds of transcribed participant interviews were mapped against three focus areas and the 16 enterprising attributes above to ascertain coverage. These were discussed with all parties so the different realties of what was occurring could be identified.

The constructivist view as described by Hipps (1993), that reality is changing whether the observer wishes it to or not, is an indication of multiple constructions of reality. Constructivism values the individual multiple realities that stakeholders have in their minds. Therefore, to acquire reliable multiple and diverse realities, multiple methods of searching for or generating data are in order.

For this project a number of methods were employed to generate and collect data:

- Baseline data from workshops and questionnaires
- Observational field notes
- Audio and video recordings of activities and discussions
- Interviews

In constructivist research it is important that the study is thorough, coherent and comprehensive. It should be trustworthy and useful; the interpretation should be provocative and generative of further inquiry. An open-ended perspective in constructivism adheres with the notion of data triangulation by allowing participants in a research to assist the researcher in the research question as well as with the data collection. An example of how this was achieved by the project was the 'daily snoop' where the team facilitated participants to interview each other in a role play situation. This interview was included as an informant of what was actually taking place.

Many of the primary schools struggled with identifying the early stages of their technology projects the facilitators re-acted to this need by providing a workshop on the *'fuzzy front end'* from (NPD) research. This included developmental work around:

- Opportunity Identification
- Opportunity Analysis
- Idea Genesis
- Idea Selection
- Concept and Technology Development

(Koen et al., 2001, pp.47-51)

These PD sessions proved to be both popular and invaluable to the project team as it helped foster a win, win situation for the teaching staff and researcher alike.

Some key success themes have begun to emerge from the research:

- An emphasis on a real need while designing the unit
- Making the need transparent to the students so they see what their new found skills and knowledge will be used for
- Doing more than presentations at the using and doing stage
- Keeping E4E attributes in mind when designing the whole unit rather than as an add on
- Curriculum integration, it creates time. Real life is an integration-it's the only way we get things done
- Making sure the students see the timeframe, deadlines and expectations continually
- Continued reflection on progress
- Scaffolding that will help groups organise things-making it simple-initially
- Building the background knowledge to ask relevant enquiry questions
- Focus and continuity– not three units happening at once
- Not too much fuzzy front end
- Student involvement in planning, goal setting, and tangents. Student ideas are actually used

The following table adapted from earlier research carried out by O'Sullivan 2001 was utilized to promote community involvement. In reality community involvement in technology education is often from industrial experts.

Possible Benefits of School Community / Industry Partnerships	
School	Community / Industry
Increased personal motivation working in partnership with people outside of the classroom.	Increased motivation for individuals and employees able to participate in a social good i.e. education.
Purposeful action working with others in the community and an increased awareness of the role industry plays.	Increased awareness for community industry of how schools work a chance to develop some connectedness.
Improved individualised careers information.	Opportunities for employees to develop communication skills, liaising with a different social grouping.
Accurate up to date information about specific enterprises and industries.	Accurate information about school technology education programmes.
Access to experts in the community/ industry.	Access to experts e.g. language teachers.
Access to facilities beyond the scope of the school.	Access to educational facilities beyond the scope of the industry for training etc.
Possibilities for sponsorship to support the curriculum.	Improved employer / employee relationships allowing staff to have contact with children in their community. Giving the employee personal satisfaction.
An increased understanding of the world outside of the classroom. Including expectations of possible employers and how this relates to their personal growth.	An increased understanding of the world of education including the expectations of schools and individuals living school.
Increased understanding for teachers of how communities and industries work ultimatelephoney improving teaching and learning for individuals in their class.	Fulfilment of a possible personal altruistic desire to help improve the quality of teaching and learning.

Some of the frustrations experienced during community participation in this project included:

- Mentors taking too much control over the direction of work
- Lack of response from community experts
- Mentor's/expert's timeline and school timeline not matching
- Experts work commitments during school time obviously taking precedence
- Experts wanting to relax from their own job in their own time a willingness but commitment issues

This paper has introduced technology education as making a difference through being the centre of a tripartite relationship when policy endeavours to bring E4E, Community partnerships and a belief in a connected curriculum together through technology education activity. Further evaluation is underway to assess the success of these endeavours.

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Using Design Diaries to Develop Critical Reflection

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Abstract

This is a case study by two senior lecturers in Initial Teacher Education (ITE) responsible for facilitating learning in primary design and technology (D&T). This paper outlines specific changes in practice that were made in response to a concern that, although student teachers were frequently recording their ideas and experiences in D&T, they were seldom engaging critically with their learning.

Design diaries were introduced in 2006 for use by undergraduate student teachers specialising in primary D&T. The aim was to develop pedagogies that encourage students to reflect critically in order to improve the depth of their learning. The outcome of this small case study was encouraging at a range of levels, both for the students and the tutors. From our experiences, we conclude that use of design diaries is an effective way to develop critical reflection on learning so we continue to include them as an integral part of the design and technology specialist modules.

Introduction

As tutors responsible for facilitating the learning of primary teaching students in an Institute of Higher Education we are constantly reflecting on our practice in order to improve it. We convene the specialist modules in primary design and technology and encourage our students to become reflective practitioners. We identified a concern that, although students were able to describe detailed design processes undertaken to design, make and evaluate final products, they were not always reflecting critically on what they were learning. Discussions with students, assessment of work submitted and tutor evaluations indicated there was an opportunity to develop learning further, and to explore the thinking behind design decisions and processes. This case study outlines changes that were implemented in the specialist D&T modules to address this concern in order to make a difference to the quality and depth of learning experienced by students, focusing particularly on how we used design diaries to develop critical reflection.

Our context

Both the second and third year undergraduate BA (ITT) specialist D&T modules consist of fifteen weekly sessions. Some students who select D&T as a specialism are already confident in specific areas of subject knowledge and skills and want to build on their previous learning. Others have very little subject knowledge or skills so choose the subject to develop their D&T capability. Included in both modules is progressive development of personal subject knowledge, understanding, skills, attitudes and values, as well as ways to plan, teach and assess D&T in the primary classroom.

In response to our growing awareness of the importance of global issues (such as sustainability) in design decisions and evaluating products, we made this is an area of focus with the second year students (in the contexts of food technology and packaging). In the third year we focus particularly on developing students' pedagogical understanding of creativity and their own creative capacity (in the contexts of textiles, mechanisms and control).

Our concern

Reflection on the modules prior to 2006 raised our concern that although we encouraged students to record learning experiences, there was insufficient opportunity for them to reflect critically on their learning. Students seemed to position lecturers in the role of 'knowers' and perceived them as deliverers of subject knowledge and pedagogical approaches as in Freire's (1996) description of the 'banking' model of education. Our perceptions conflicted with our epistemological values and beliefs that students should be actively involved in their learning, acquiring and co-creating knowledge with their peers and tutors. Reflecting on experiences as a way of learning and creating knowledge (Schôn, 1983; McNiff and Whitehead, 2006) is an essential element for professional practice. We felt there was a need to move away from a largely transmission approach to teaching, leading students along a pre-conceived, planned curriculum towards more emancipatory and critical pedagogies (Habermas, 1971, Giroux, 1988 and Apple, 1996). We believed that the introduction of design diaries would provide us with the opportunity to support students in taking ownership of their learning, reflecting on their changing ideas and gaining a deeper understanding of their learning in design and technology.

The nature and importance of reflection for learning

Reflection, with an intention to learn (Boud, 1998) is a core part of learning and is emphasised in the primary education modules at our University. The significance of reflection for improving learning is not a new idea, featuring particularly in the writings of Dewey (1933) who makes close links between reflection and thinking. Dewey suggested that reflective practice can deepen pedagogical understanding and help to understand the complex inter relationships between teaching and learning. In design and technology we recognise that reflection plays a key role in designing and making activities. Habermas (1971) identifies reflection as a tool for understanding and generating knowledge particularly when there is shared discourse in a supportive learning environment. Schön (1983) recognises the value in deepening understanding by 'reflection-on action' and 'reflection-in-action' both of which have relevance to design and technology and primary practitioners. Students engaged in developing skills, knowledge and understanding in D&T are involved experientially at cognitive, practical and emotional levels where reflection can lead to deeper learning and an improved experience, linked to Kolb's (1984) model of experiential learning. Rogers and Clare (1994) developed this model in the context of D&T and placed reflection at the centre of the process of design activity which they saw as a spiral with reflection forming the central spine. In our modules we aim to encourage students to recognise the importance of reflection in design activities and to become reflective practitioners.

Design diaries

Design diaries are more generally referred to as reflective diaries and used across different disciplines in many countries. Moon (2003) describes reflective diaries as 'helpful in personalising and deepening the quality of learning and in helping learners to integrate the material of learning – such as that from different modules or theoretical and practical learning' (p.3). Tang (2002) recognises their value for personal reflection and implications for practice and Webster (2001) promotes the importance of reflection in design diaries compiled by architecture students to improve meta-cognition. In most instances the overall purpose of introducing an element of reflection in design diaries is to deepen the learning experiences for the practitioner.

Changes we made to our practice

Prior to 2006, in order to assess learning, students completed a design and make assignment and were required to record and annotate their final design drawings with reflective comments. Students gave reasons for design decisions, evaluated the final product and the personal design process undertaken. Often these were descriptive and we felt we could offer more opportunities for students to reflect on their learning experiences.

Therefore in the academic year 2006-7, we modified the assessment to include the completion of a design diary with weekly records and reflections about all learning experiences included in D&T sessions, as well as students' independent research and readings. We introduced the diaries for a number of reasons including:

- To develop students' awareness of their D&T capability and their capacity for creativity as designers and teachers
- To improve the depth of reflection on teaching and learning experiences
- To personalise student learning
- To encourage students to engage more critically with their learning

At the end of the first year of using the diaries, we reviewed the work submitted both for subject content and for quality of reflections on learning. We recognised the significance of the diaries as a means of encouraging students to express their capacity for reflection, and in developing independent autonomous learners. We felt that the percentage of the final mark allocated to the diaries in 2006-7 was not representative of the high quality of work submitted by some of the students. Therefore, in 2007-8, we adjusted the weighting of the marks to give a greater percentage to their design diaries.

In order to encourage students to become more engaged with their learning, and to provide the right conditions for reflection (Moon, 1999b), we also made pedagogical changes to the way we planned our D&T sessions and allowed more time for collaborative learning, discussion and reflection. We focussed on creating a learning environment where students felt supported and their views respected, as tutors and students learnt in a co-operative community of practice (Wenger, 1998).

Outcomes

We assessed the success of the diaries of the 2008-9 cohort of third year specialists by asking students to complete a questionnaire about the value of the completing the diaries for their learning (use of the diaries) and by reviewing their personal assessments of the module. We also recorded our own perceptions of the quality of the reflections in the diaries as we assessed them.

Design diary questionnaires

Students were asked four questions relating to the four reasons why we introduced the diaries (see previous page). Fifteen out of seventeen students completed the questionnaire. All students felt that the diaries had changed their perceptions in their own ability, improved the depth of their reflection on teaching and learning activities, helped to personalise their learning and encouraged them to engage more critically with their learning. Figure 1 shows the results in more detail.

Responses to the Design Diary Questionnaires 2008-9 cohort

Has Completion of the Diary....	1 (not at all)	2	3	4 (very much)
1) Changed perceptions in own ability?		2	9	4
2) Improved depth of reflection on teaching and learning activities?		3	8	4
3) Helped to personalise your learning?		4	4	7
4) Encouraged you to engage more critically with your learning?		2	9	4

Comments made by students in the questionnaires provided more evidence to support the significant difference the diaries had made to their learning and perception of their own abilities. For example, student H commented that when she looks back over the diary she is able to see the change in her ability. She also wrote that 'when reflecting on lectures we have been able to increasingly link it with future teaching' and 'when reflecting on tasks set I have been able to think more critically about what has happened in terms of my own learning'. Student K said that the diary 'helped me to recognise my own strengths' and 'to see what I have learnt and what to improve on'. Student A commented that the diaries has 'reinforced lectures and allowed me to be creative. It has given me opportunity to reflect'.

Figure 2. Examples of 3 design diaries with linked products

Student E commented that the diaries made her realise that she is more creative than she originally thought. She also wrote that completion of the diary 'forced me to reflect on aspects that I may not have done otherwise. This will benefit my teaching'. Commenting on whether it helped to personalise her learning she wrote, 'Everyone's diary is different and original. It gave us the opportunity to show our own personality. We also focus on different things that will benefit our own individual learning'.

Evidence from students' personal assessments

Students submit a personal assessment with each assignment and analysing these provided further evidence of the value in using design diaries to deepen their learning experiences and improve their confidence in D&T. However, some found reflecting a challenging task. For example, student M wrote, 'The reflections, though sometimes difficult to write, have benefited my learning through the design and technology course enabling me to become a more evaluative teacher.' Student P recognised that reflection on her practice has helped her identify ways to improve as she writes, 'I have been able to evaluate my own work and think of how to improve it.' We hope that having developed skills in deepening reflections on practice the students will take their new learning into school as student B explains, 'I have encouraged children to reflect on their learning as I do in my reflections which I completed after each session.' We were also pleased that Student N noted that, 'Before taking design and technology as a specialist subject I had little confidence in teaching it. Through this course and the reflections on my learning I feel that this confidence has grown enormously.'

Comments in design diaries

It was a real privilege to look through and read the student design diaries as we recognised the personal nature of many of them and the learning journey that some revealed. For example, Student O, who submitted a particularly high standard of work

Figure 3. Student B with her design diary and related products

and shared, ‘recording my ideas about creativity has helped me to understand how my creativity has changed and developed though my life’. She links this with strategies to develop creativity with children and building up confidence in her own ability.

Figure 4. Examples of work from student O

Some students reflected on ways they had worked in sessions which gave us valuable feedback on successful ways to establish an environment that encourages thinking and reflection. For example, Student J commented that collaborative work helped to broaden her own thinking and that, ‘through working in this way (collaboratively) I have learnt more about how I work individually and in a group’. Student O commented on the value of working as a team in some of the activities. She wrote, ‘I enjoyed working with friends who I could express my emotions to.’ Reflections from students contributed towards our understanding of successful ways to organise a learning environment, one that encourages students to work and learn together, and to reflect on their learning.

Tutors’ reflections

The high standard of presentation, professional skills and depth of reflection evident in most of the students’ design diaries has convinced us of the value of including design diaries in our modules. By reading the diaries and reflecting on the impact of the changes we have made, we believe we have learnt ways to encourage students to reflect successfully on their learning experiences.

Figure 5. Examples of design diaries and products from student Q. This student completed a seperate design diary for Mechanisms and Textiles

Moving forwards

We recognise that this paper outlines a small case study but there are implications from the outcomes which inform our future practice and we continue to make changes as we reflect on the actions we have taken. The diaries completed have been successful at a range of levels in terms of increasing students’ engagement with their learning experiences and their ability to reflect on what they have learnt. We recognise that learning to reflect effectively is a difficult skill and can involve complicated mental processing of issues (Dewey, 1933). As Rodgers (2002:844) noted in an article defining reflection, ‘Dewey reminds us that reflection is a complex, rigorous, intelephonelectual and emotional enterprise that takes time to do well.’ Whilst some students were able to reflect at a high level, which provides evidence of a deeper learning experience, there were some students whose reflections remained largely descriptive. Therefore we think there is a need to provide students with more support such as a structure guided by key questions for initial reflection activities in order to encourage progressive development towards reflecting at a deeper level. In future, it may also be useful to encourage students to revisit and reconsider earlier reflections, based on Moon’s (1999a) understanding of stages of reflection. In addition, we would like to encourage the use of design diaries in our non-specialist courses at our institution to encourage our first year and PGCE students to reflect on their learning in D&T.

It is also our hope that the D&T specialist students will continue to reflect on their practice when they qualify as teachers, and we will encourage them to continue to make entries in a diary. This would provide a means of further developing as reflective practitioners, and as researching practitioners in the future. It is our hope that we may be able to support our students (once qualified) in classroom based research, similar to research undertaken by Rogers and Clare (1994). They carried out action research with teachers to find out how effective process diaries are in supporting children’s learning and developing reflective practice.

Conclusion: Making the difference

We recognise that developing reflection using design diaries is only part of the learning taking place during our modules but we believe that integration of the diaries has been significant in enhancing the quality of students’ learning in D&T and, potentially, their professional practice. The diaries have enabled us to make a positive difference in our practice, supporting the personalised development of learners who are not only competent at recording learning experiences, but also able to reflect on their learning as reflective practitioners.

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Revelations of Designerly Activity During an Immersion Experience

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Abstract

The purpose of this paper is to report some findings from an empirical study in which 12 Grade 8 pupils completed a design & make activity during three full days of design & technology. These findings form part of a larger three-year program of research that investigated progression in pupils' ability to make design decisions. The following research questions drove the study reported here: (a) To what extent will pupils use learning from a sequence of Support Tasks to inform designing and making in response to a design brief? (b) What sort of design decisions will pupils make? (c) To what extent will pupils' responses be creative? Data for this part of the larger study was collected by photographing pupils' products after completion of Support Tasks and after completion of the designing and making. A preliminary analysis of the data has revealed that the Grade 8 pupils responded creatively in response to a set of Support Tasks. Further, that when completing a design and make activity the pupils, working in pairs: (a) utilized their learning from Support Tasks; (b) made a range of design decisions, including those concerning construction, aesthetic, and technical matters; and (c) designed and made products that were individualistic and creative.

Introduction

The purpose of this paper is to report some findings from an empirical study in which 12 Grade 8 pupils completed a design & make activity during three full days of design & technology. These findings form part of a larger three-year program of research that investigated progression in pupils' ability to make design decisions.

The pupils were given the following design brief: *Design and make a large statue of a creature that can be friendly (and welcome visitors to a classroom during the day) or fierce (and deter intruders to a classroom after dark).* This task met the statutory requirements of the Ontario Curriculum *(Ontario Ministry of Education, 1998*), which requires pupils to study structures. The task has also shown, in previous use by the authors as both an elementary classroom activity and as a focus for professional development, that it enables a wide range of creative responses by pupils. It allows for the four characteristics of creative processes identified by *Robinson (1999)*: (a) involves thinking imaginatively, (b) involves purposeful activity, (c) permits the generation of something original, and (d) results in an outcome of value.

The following research questions drove the study reported here: (a) To what extent will pupils use learning from a sequence of Support Tasks to inform designing in response to a design brief? (b) What sort of design decisions will pupils make? (c) To what extent will pupils' responses be creative? Data for this part of the larger study was collected by photographing pupils' products after completion of Support Tasks and after completion of the designing and making.

Review of the literature

This review will describe briefly a) the development of the pedagogy that introduced the idea of Support Tasks to empower pupils in designing and making activities, b) the nature of the design decisions that pupils might make in designing and making activities and c) the pupil creativity embedded in designing.

In 2001 the Nuffield Foundation in association with the Design and Technology Association published the primary solutions in design & technology pack of curriculum materials consisting of 24 units of work (on CD ROM) to cover the *primary school* design & technology curriculum in England for years 1 – 6 (ages 5 – 11 years), a sample unit and a teacher's handbook presenting a rationale for the subject and describing how to use the units of work to construct a scheme of work suitable for individual schools. *(Design and Technology Association, 2001)*. The Nuffield Primary Design & Technology Project developed a particular pedagogy to support the teaching and learning. The teacher uses Support Tasks to teach children what they will need to know, understand and be able to do in order to tackle a Big Task which involves designing and making a prototype product with a clearly defined purpose *(Barlex 2001a).* Children are therefore building a repertoire of design & technology problem-solving strategies whilst engaged in creative activity that makes sense to them and interests them.

This approach was independently evaluated by Patricia Murphy of the Open University. The evaluation focused on teachers' views of how successful the materials were in the classroom, children's experiences and perceptions and the evaluator's views based on video observations of lessons. The findings were used to judge the value of the approach and to improve it. Teachers saw the value of this structured approach.

> *"If you asked me what was best about the activity, I would say the way the small (support) tasks led to the large one. The way they laid out the sequence of activity so that they [the children] had experience of the main design aspects before making the final model. And so easy to use. Brilliant really."*
> Year 2 class teacher (page 4) (Barlex 2001b)

This approach was adopted by the Elementary Science and Technology Project developed at Queen's University, Kingston for the Ontario Elementary Curriculum *(Welch et al 2000)* and the pedagogy was further refined by building in an end of lesson review. In this review the teacher asks the question "What have we learned today about …". And then, more importantly, she asks "How will what you learned today about… help you in your Big Task?" The approach proved particularly effective in engaging the pupils with the Support Tasks – Big Task pedagogy *(Welch, Barlex & O'Donnel 2007).*

One of the key features of each unit of work is a listing of the design decisions that children will need to make if they are going to tackle the designing and making assignment that is at the core of the unit. These decisions are presented visually to give the teacher a rapid overview with notes indicating when the required learning to make the decision takes place in the suggested teaching sequence and when the decision will be made in the teaching sequence.

Barlex, (2004) has suggested that in the context of school-based designing, pupils' designing could be described in terms of making five types of interrelated design decisions: (a) conceptual (b) marketing (c) technical (d) aesthetic and (e) constructional. Conceptual decisions are concerned with the overall purpose of the design, that is, what sort of product it will be. Marketing decisions are concerned with, for example, who the design is for, where will it be used and where will it be sold. Technical decisions are concerned with how the design will work. Aesthetic decisions are concerned with what the design will look like. Constructional decisions are concerned with how the design will be put together. This can be represented visually, as shown in Figure 1, with each type of decision at a corner of a pentagon and each corner connected to every other corner. This inter-connectedness is an important feature of making design decisions. A change of decision within one area will affect some if not all of the design decisions made within the other areas.

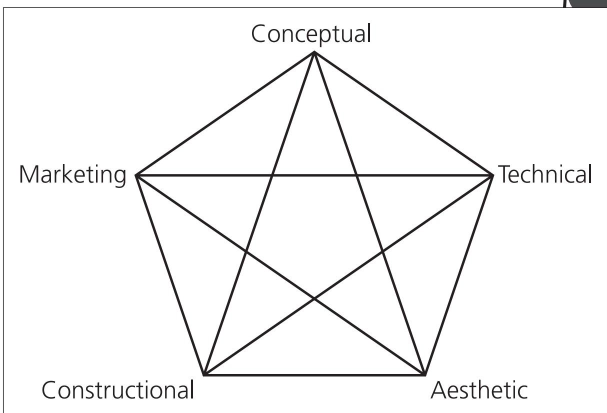


Figure 1

Usually the teacher identifies the sort of product the children will be designing and making. This makes it very difficult for children to engage in conceptual design. However, even if the type of product is identified for the pupils there are still many opportunities for making design decisions in the other areas.

The report 'All Our Futures: Creativity, Culture and Education' *(Robinson, 1999)* argues that a national strategy for creative and cultural education is essential to unlock the potential of every young person. It saw creativity in terms of the task in hand as having four features:

- Using imagination
- Pursuing purposes
- Being original
- Being of value

Although to many it is obvious that designing is a creative activity it is necessary to establish the relationship between creativity and designing. *Barlex (2007)* has used the work of *Nigel Cross (2002)* to establish that the act of designing does meet the four features identified by Robinson and demonstrated that this is not only in this the case for professional designers but also for pupil designers who may be considered fledgling designers *(Trebell 2007)* and that pupils who made design decisions were in fact being creative.

Method

A sequence of tasks was used across a single day to begin the teaching of a unit of work which culminated in pupils working in pairs across a further two days to tackle the task of designing and making a large statue of a creature that can be friendly (and welcome visitors to a classroom during the day) or fierce (and deter intruders to a classroom after dark). There were 12 pupils in the group. The task sequence on the first day consisted of the following support tasks.

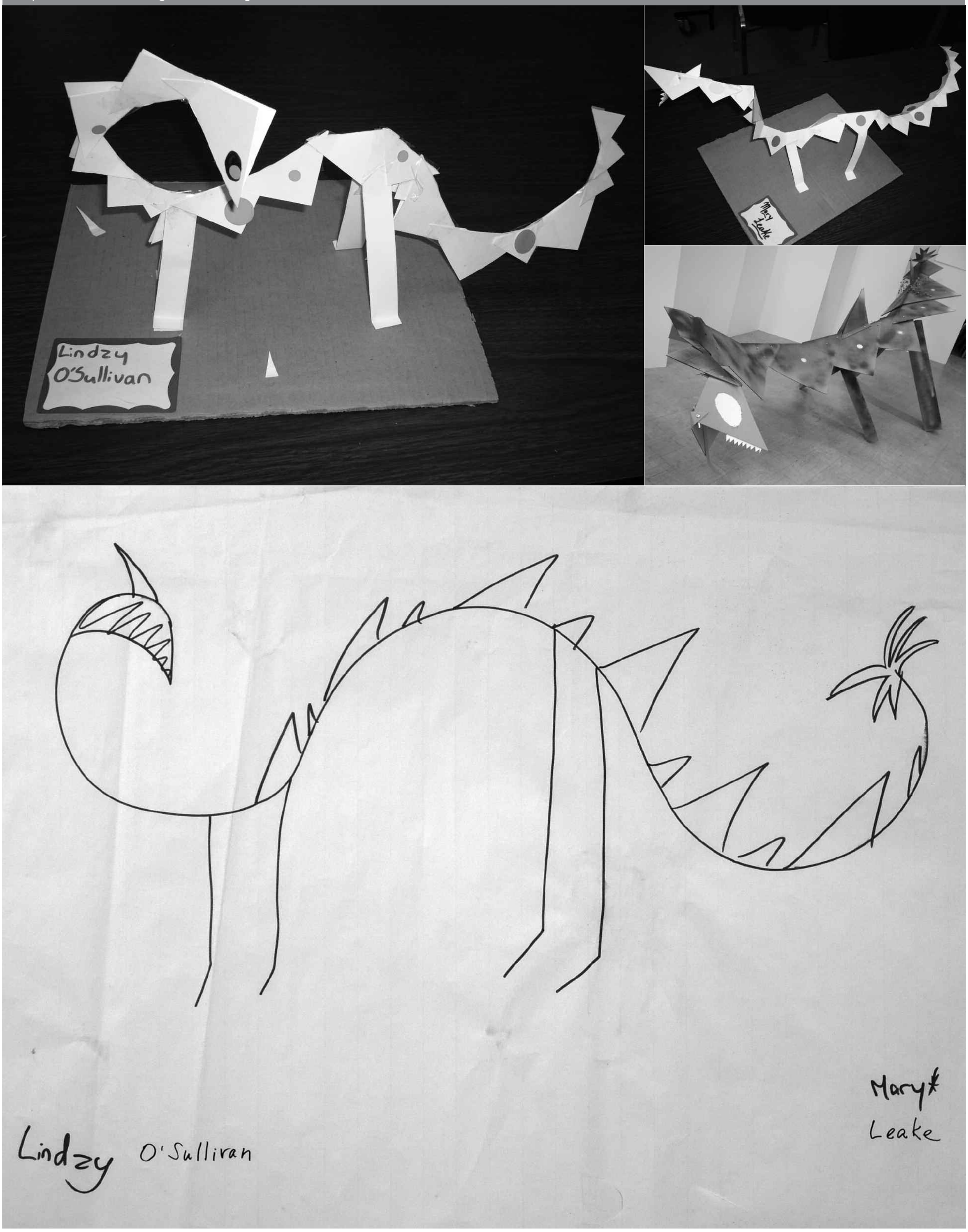
Introduction to the Big Task (the designing and making assignment)

- Support Task 1 Understanding facial features
  In this short activity pupils explored through sketching faces that appeared both fierce and friendly and made notes giving reasons for deciding whether a particular face was in fact fierce or friendly.
- Support Task 2 Are the faces fierce or friendly?
  In this short activity pupils were presented with pictures of a range of dinosaur heads and had to decide whether the expressions were fierce or friendly and give reasons for their decision
- Support Task 3 Understanding creature structure
  In this short activity pupils were presented with pictures of a range of dinosaurs and required to draw a stick figure over the picture to represent the main structural parts and where these were joined together. They then had to redraw this structure separate from the picture.
- Support Task 4 Designing and making a skillosaurus
  In this short activity pupils were shown how to use small thin card squares of different sizes to construct the body form of a dinosaur-like creature and place this on an arrangement of legs to produce a skillosaurus (so called because through designing and making one you learn lots of skills) or skillie for short. Each pupil was required to produce their own skillie although they could talk with one another and gain inspiration for each other's work. The pupils had considerable freedom with regard to the appearance of the resulting creature – the number, length and arrangement of legs, the size and shape the body, the nature of the neck and tail, the nature of the head and whether overall the skillie is fierce or friendly.

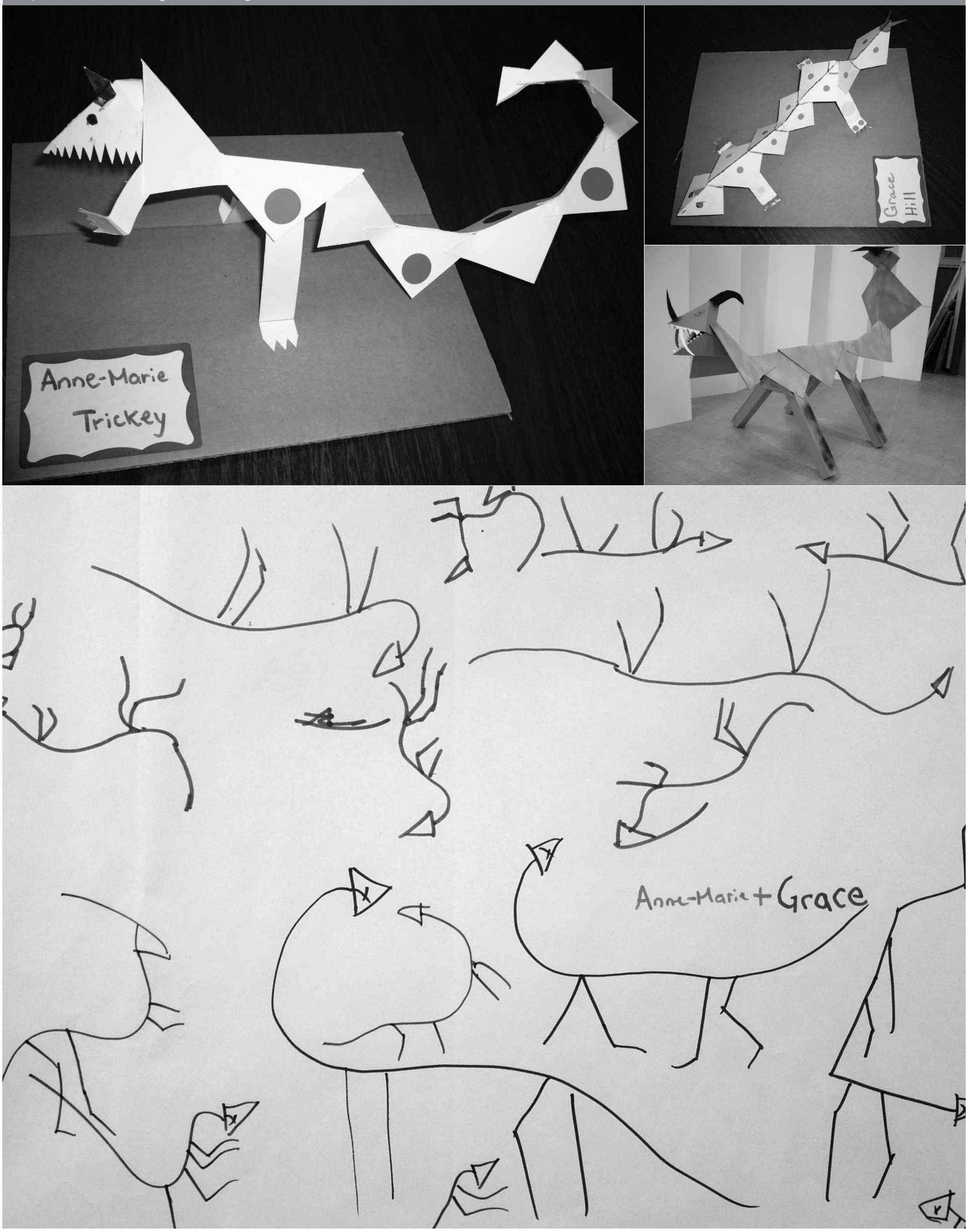
Results

A photographic record of the following was collected:

Pupil Pair 1 – Stick figure drawing, 'skillie' and final statue

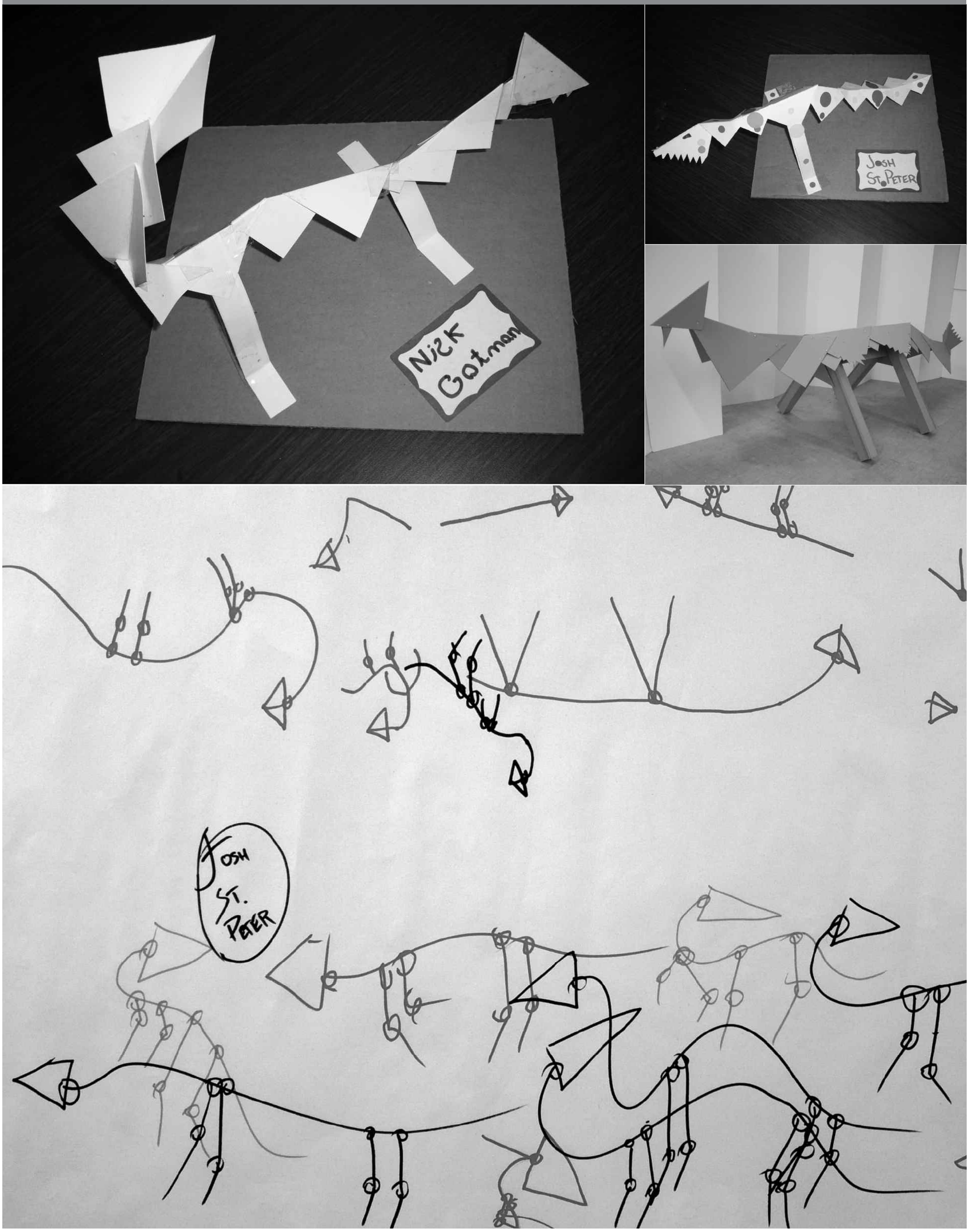


Pupil Pair 2 – Stick figure drawing, 'skillie' and final statue

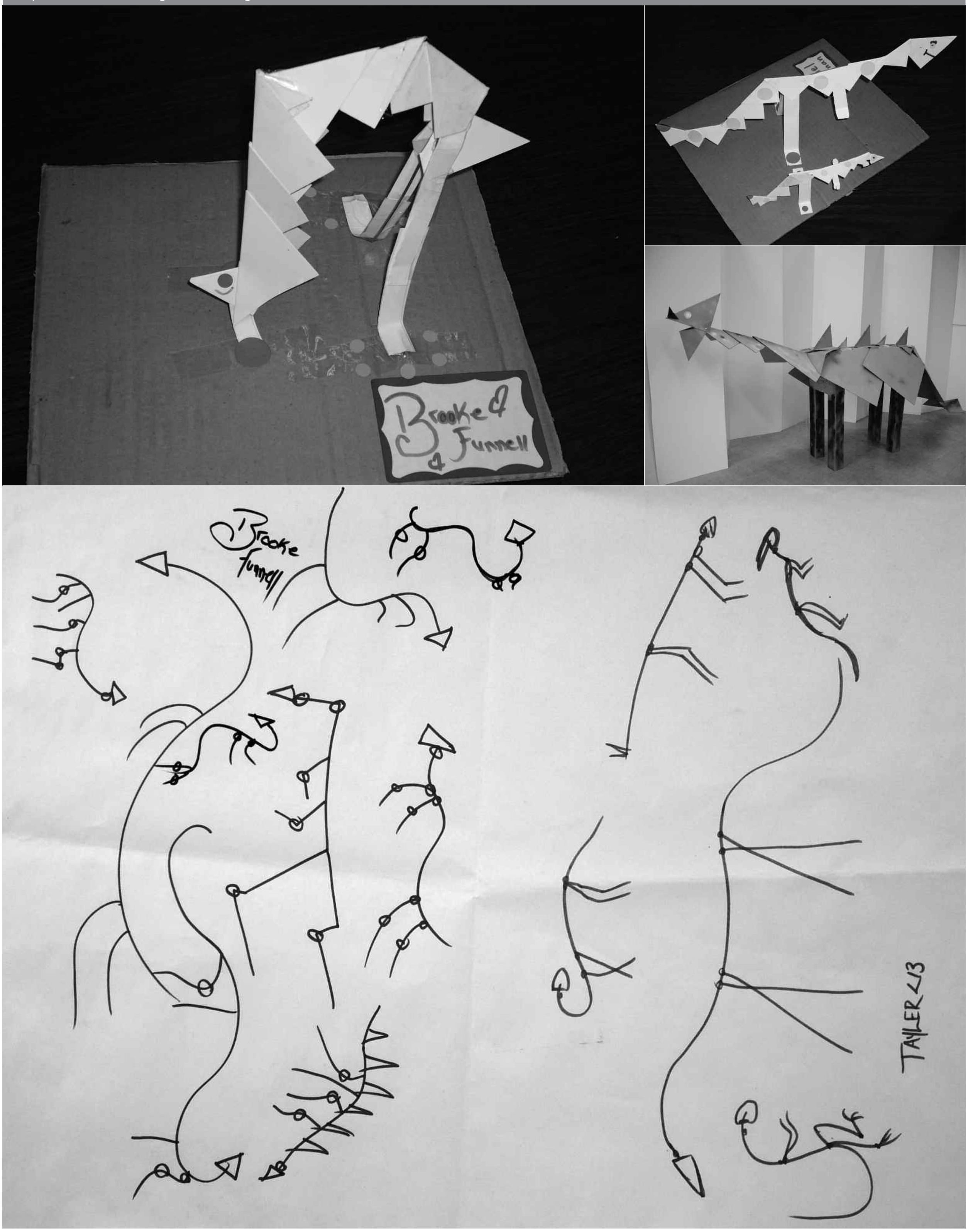


Results

Pupil Pair 3 – Stick figure drawing, 'skillie' and final statue

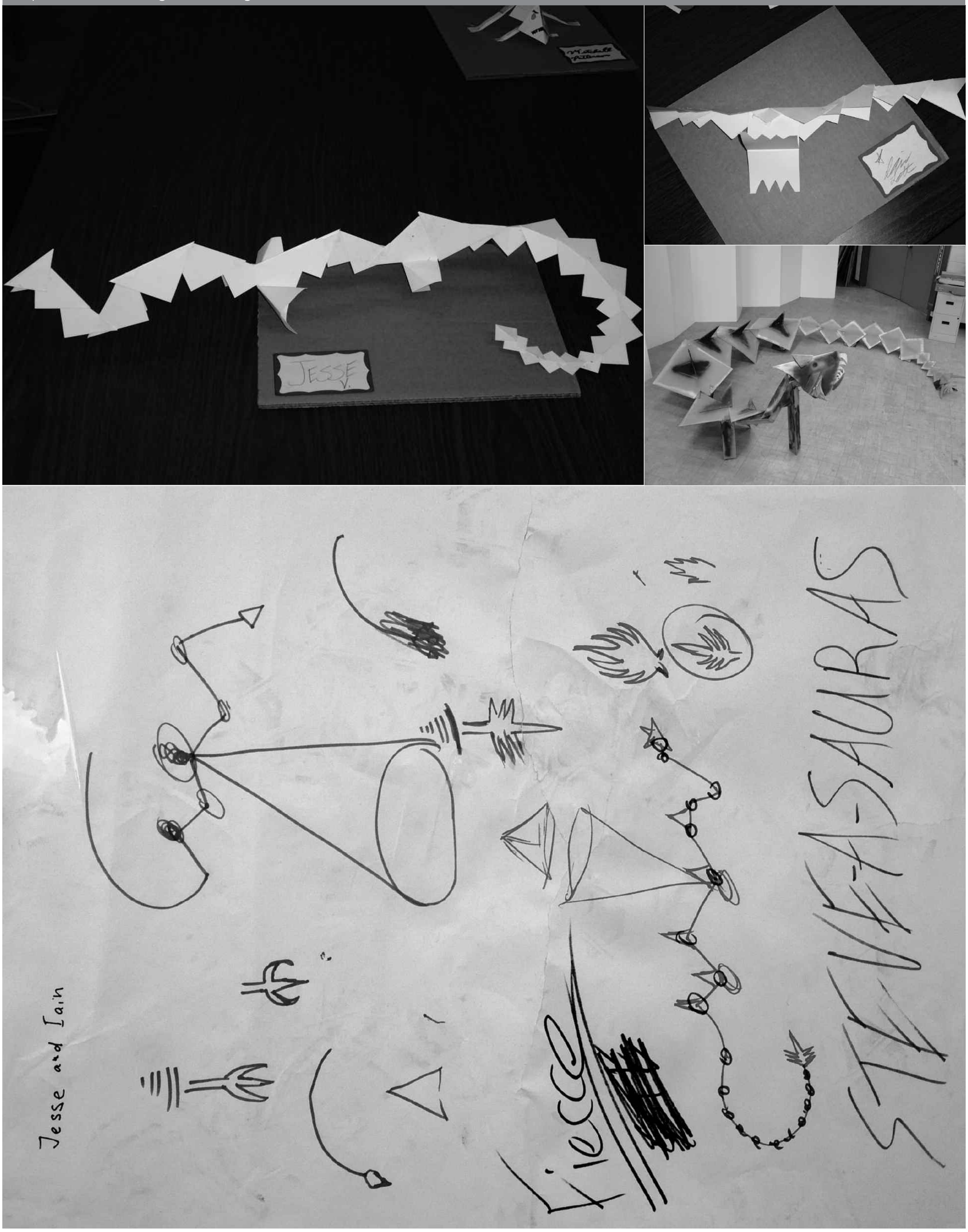


Pupil Pair 4 – Stick figure drawing, 'skillie' and final statue

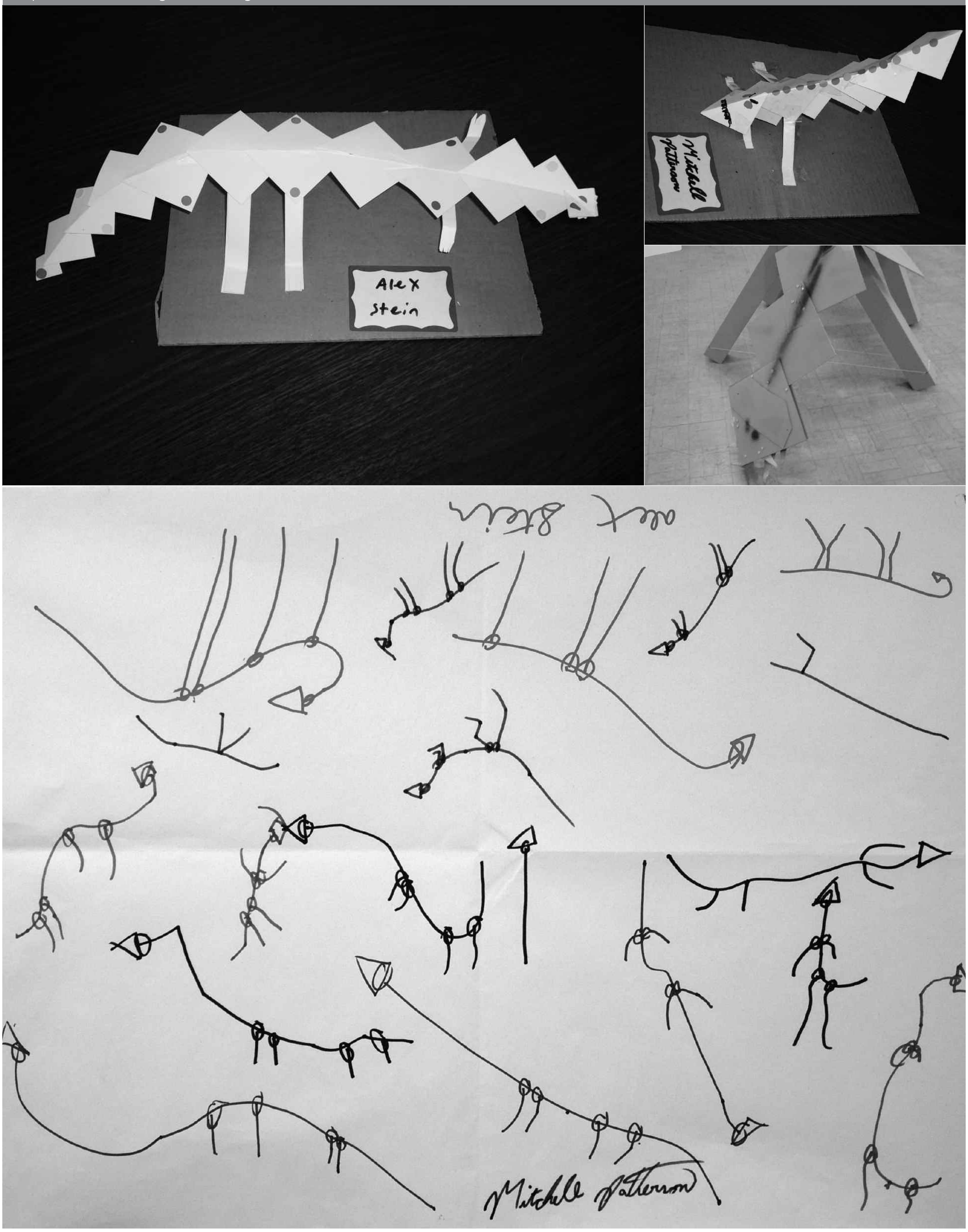


Results

Pupil Pair 5 – Stick figure drawing, 'skillie' and final statue



Pupil Pair 6 – Stick figure drawing, 'skillie' and final statue



At the end of each of these Support Tasks pupils were asked what they had learned and how would this help them in the Big Task.

After this sequence of activities the pupils were shown how they could use thicker corrugated card squares and split pins to develop larger but analogous structures. The pupils then worked in pairs to design and make their creature statue. To develop the overall structure of their creature statue the pupils were asked to prepare stick figure drawings of their design intentions.

Concerning the extent to which pupils used learning from the sequence of Support Tasks to inform the designing and making of the creature statue

Inspection of the small model creatures, the skilles, produced individually by each pupil in a pair reveals some similarities with features in both the stick figure drawing of the proposed design and in the final statue produced collaboratively by the pupil pairs. For example in the case of the work by pupil pair 5 the snake like character of the skillie is reflected in both the stick figure drawing and the final statue. In the case of pupil pair 2 the curl of the tail in one of the skillies is reflected in the final statue.

Overall the demeanour of the creatures is easily identifiable as either friendly or fierce, in all cases fierce with the exception of pupil pair 4,and informed through the learning carried out in Support Tasks 1 and 2.

The learning of construction techniques, specifically how to make the direction of the structure curl up or down, learned in designing and making the skillies (Support Task 4) has clearly been transferred to generating the required form in the final statue.

Concerning the sorts of design decisions pupils made when designing and making of the creature statue

It is clear that pupil pairs made many constructional decisions e.g. where and how to fold the card and where to pin the card. It is also clear that the pupils had to make aesthetic decisions in deciding on the appearance of their creature statue e.g. the number, length and arrangement of legs, the size and shape the body, the nature of the neck and tail, the nature of the head and whether overall the skillie was fierce or friendly. These decisions in most cases informed the constructional decisions e.g. "If we want the tail to get smaller and curve we need to choose squares that get smaller, fold and cut them so that when joined they curve upwards and pin them so that they stay together". This combination of aesthetic and constructional decisions in some cases led to pupils having to make technical decisions with regard to achieving stability or stiffness. For example in the work of pupil pair 6 the front legs required the presence of a string tie to prevent collapse (a successful technical decision). Note however that the neck buckles at the position of joining to the body – the result of a poor constructional decision. For pupil pair 5 the aesthetic decisions they made were so extreme, compared with those made by other pupil pairs, that these decisions might be regarded as almost conceptual. They conceived their creature as a kind of sea snake without legs.

Concerning the extent to which the pupils' responses were creative

The nature of the brief inevitably leads the pupils to show creativity in terms of two of the criteria for creative activity *(Robinson 1999)* – pursuing purposes and developing an outcome of value. The remaining two criteria are using imagination and being original. It is clear that each of these criteria is met although the materials for construction and the construction techniques employed by the pupils are the same in each case.. In conceiving the creature state the stick figure drawing illustrate that the pupils pairs have used their imaginations. The differences between both the design intentions as revealed by the stick figure drawings and the appearance of the final creatures indicate that each pupil pair has been original.

Discussion

The Big Task tackled by the pupils is not a very open task. The nature of the artefact to be designed and made was prescribed in the task statement. The nature of the materials to be used and the construction techniques to be applied was also prescribed. Such prescription is seen as necessary for two reasons. Firstly, the prescription renders the task manageable in the elementary classroom. Highly open designing and making assignments in which the nature of the final product is not defined at the outset are difficult to resource in terms of the necessary tools and materials. Secondly, the prescription indicates the knowledge, understanding and skill that pupils are likely to require if they are to be successful in tackling the Big Task. This sets the learning agenda for the Support Tasks. We must ask what sort of response would the pupils have been able to make to the task of designing a statue of a creature to welcome visitors or deter intruders if they had not carried out the Support Tasks that preceded the Big Task? It is likely that many if not all of the pupils would have experienced considerable difficulty in responding successfully to the task. There are strong indications from the photographic record of the pupils' work that they used their learning from the sequence of Support Tasks to good effect both in conceiving the form and nature of the creature statue and in realising the statue through construction using mainly card and split pins. And we must also ask how would the teacher decide on the range of tools, equipment and materials to make available in the absence of a sequence of Support Tasks. This could be based on knowledge of the pupils' previous experience but some formal revisiting would surely be necessary to ensure at the very least safe practice in using the tools.

Despite the somewhat closed nature of the Big Task there were many opportunities for the pupils to make design decisions and the photographic record indicates that they made mainly aesthetic and constructional decisions. The marketing decisions, i.e. who the product is for and the consequences of this, have been set within the brief and none of the pupils questioned this. The interaction between the aesthetic and constructional decisions made by the pupils in some cases led to technical decisions. The emergence of the creature through realisation involves the interplay of these decisions and can be considered from the perspective of ontological ambiguity *(Roth 1996).* The exact nature of the final outcome was uncertain and evolved during its development as the interaction between the design decisions played out. Some ideas were successful and could be, quite literally, built upon, whilst others were less successful and had to be abandoned. "Previously tentative design moves became "facts" and this factual nature shapes future design moves" *(Roth 1996).*

It is tempting to view the classroom as a community of practice and the learning that is taking place as the means of inducting the learners into that community through the participation in authentic activities *(Lave & Wenger 1991).* An apparent difficulty with this view is that it requires newcomers to a practice to participate with more experienced old-timers. This appears not to be the case in that all pupils were newcomers. However the use of Support Tasks will to some extent develop relevant expertise in the pupils and some will become particularly proficient in particular aspects and be able to adopt the role of experienced old-timer albeit to a limited extent. This plays out in the intense and effective collaboration that takes place as the pupil pairs develop and realise their creature statues.

The Big Task although relatively closed did lead to a wide range of different outcomes that met the requirements for creativity as identified in the Robinson Report *(Robinson 1999).* In terms of considering the class as a community of practice it is interesting to note that *Csikszentmihalyi (1999)* makes a strong case for building communities that nurture creative genius as opposed to developing highly gifted individuals. All pupil pairs were able to respond creatively to the task in hand. We believe that the required collaboration was significant in achieving this. Vera John-Steiner has written extensively about creative collaboration *(John-Steiner, 2000)* and has developed a 'family' pattern as one possible means of achieving this. In this there is a dynamic integration of expertise achieved through a fluidity of roles fuelled by a common vision and underpinned by trust. The sequence of Support Tasks developed expertise which the pupils could share, they were able to adopt different roles as they worked together in response to their developing and shared understanding of the final creature. It was clear that the pupils trusted each other particularly in dealing with delicate constructional matters that required two pairs of hands.

In summary the nature of the Big Task and the associated Support Task sequence and the way these were managed in the classroom empowered the pupils to design and make in a collaborative way in which they made a wide range of design decisions and generated different creative responses.

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Assessing the Impact of Peer – Peer Mentoring on Primary Pupil's Engagement with CADCAM

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Abstract

The purpose of this paper is to report some findings from an empirical study in which primary schools used peer – peer mentoring to facilitate curriculum development in design & technology. In a previous paper (Barlex and Miles-Pearson 2008) we described a case study on the introduction of Computer Aided Design and Computer Aided Manufacture (CADCAM) into primary schools. This paper will build on that work and describe the peer – peer mentoring that took place and the impact of that mentoring on a) the introduction of CADCAM to the primary schools; b) the experience of the class teachers who taught the CADCAM, c) the experience of the pupils who acted as mentors to their peers and d) the experience of the pupils who were mentored by their peers.

The following data will be used to assess these various impacts: field notes taken at the celebration event organised by the lead secondary school, and questionnaires completed by the teachers who taught the CADCAM units of work, pupils who acted as peer mentors and pupils who were mentored.

The paper will conclude by developing a set of guidelines that should be considered when introducing a peer – peer mentoring scheme as an aid to design & technology curriculum development in primary schools.

Introduction

This paper is a development from a previous paper (Barlex and Miles-Pearson 2008) in which we described a case study on the introduction of Computer Aided Design and Computer Aided Manufacture CADCAM into primary schools. Here we will describe in more detail the peer – peer mentoring that took place and the impact of that mentoring on a) the introduction of CADCAM to three primary schools; b) the experience of the class teachers who taught the CADCAM, c) the experience of the pupils who acted as mentors to their peers, and d) the experience of pupils who were mentored.

The paper is in five parts. First a short literature review will situate the peer – peer mentoring in the context of the work of Lev Vygotsky and Jean Lave and Etienne Wenger, will consider the place of design decisions within the CADCAM activities with particular respect to the role of dialogue and discuss how the role of the teacher may be considered. Second, a method section will describe how data was collected: field notes taken at the celebration event organised by the lead secondary school, and questionnaires completed by the teachers who taught the CADCAM units of work, pupils who acted as peer mentors and pupils who were mentored. Third a results section will report the data collected. The fourth section will discuss the results in terms of the impact of the peer-peer mentoring on the curriculum development process. The paper will conclude by developing a set of guidelines that should be considered when introducing a peer – peer mentoring scheme as an aid to design & technology curriculum development in primary schools.

Literature review

Vygotsky (1978) developed the concept of the zone of proximal development (ZPD), which he defined as "the distance between the actual development level as determined through independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Hence one rationale for the use of peer – peer mentoring can be made by an appeal to Vygotsky-based thinking. The small group of pupils were taught how to use the software and hardware required for CADCAM in advance of their class receiving tuition so that they could act as 'more capable peers'.

Lave and Wenger (1991) have written extensively on the nature of situated cognition indicating that how and what we learn, know and understand will depend on the situation in which this learning takes place. They view learning as becoming part of a community of practice in which learning can be seen as inducting novices into that community through participation in authentic activities. They acknowledge the importance of those already experienced and competent in the activities of the community in helping newcomers to become proficient. Hence if we see the classroom as a community which wishes to practice CADCAM, then the role of the pupils who have been pre-taught the knowledge, understanding and skills to be acquired by the rest of the class can be seen as that of experienced 'old-timers'.

The CADCAM units of work that were developed contain a listing of the design decisions that children will need to make if they are going to tackle the designing and making assignment that is at the core of the unit. These decisions are presented visually to give the teacher a rapid overview with notes indicating when the required learning to make the decision takes place in the suggested teaching sequence and when the decision will be made in the teaching sequence (http://www.primarydandt.org/news/cadcam-units-available-now,569,NNS.html)

Barlex, (2004) has suggested that in the context of school-based designing, pupils' designing could be described in terms of making five types of interrelated design decisions: (a) conceptual (b) marketing (c) technical (d) aesthetic and (e) constructional. Note that these decisions are not independent of one another. A change of decision within one area will affect some if not all of the design decisions made within the other areas. One important way in which pupils can be supported in making these decisions is through dialogue with one another. *Alexander (2004)* has argued convincingly for the importance of classroom talk that is based on dialogue. He notes that it is not only dialogue between the teacher and pupil that is important but that pupil-pupil dialogue has an important part to play. He develops a repertoire of learning talk which includes "analyse and solve problems, speculate and imagine, explore and evaluate ideas" (ibid p. 39). These types of talk are crucial if pupils are to be able to articulate their design decisions and within the situated cognition paradigm that this paper is adopting to describe the classroom activities it will be important to scrutinise the extent to which both the teacher and the peer mentors were able to engage in dialogue that supported this decision making.

It is widely acknowledged that teachers are central to any form of curriculum development.

> *"It must be recognised that teachers are the sole and essential means to educational improvement. If they do not share the aims and do not want to do what needs to be done, it cannot happen effectively."(p.60).* Black (1997)

Gage (2009) identifies six categories that should be included in a paradigm to describe teaching. Two of these relate quite specifically to the teacher. These are "presage of variables" (teacher characteristics) and "teacher thought processes". The presage category echoes Black's view at an individual level identifying traits (stable characteristics such as intelligence, knowledge about ways of teaching and introversion-extraversion) both in general in the context of a specific subject matter (ibid p. 47). It is important to note that in this case the specific subject was new to the participating teachers. The thought processes of the teacher have been separated into three categories – preactive (before the teacher interacts with the class), interactive (whilst the teacher is teaching the class) and post-interactive (after the teacher has had a class period with her pupils). In this study the questionnaires enabled some consideration of the post-interactive thinking.

Method

During March and April 2008 three secondary school teachers from Hayesfield School in Bath worked with three partner primary schools in developing the peer mentor exports. Each teacher taught a unit of work that incorporated CADCAM to a small number of primary school pupils so that the pupils could become experts and provide advice and guidance to their peers. The units to be taught were adaptations of Nuffield primary solution units:

- What should be stuck to your fridge? In this unit pupils are required to design and make a fridge magnet that is made of layers and is part of a set that will appeal to young children. This unit would be taught to Year 2 pupils.
- How will you store your favourite things? In this unit pupils are required to design and make a container to act as a treasure chest for favourite small items. This unit would be taught to Year 4 pupils.

How fast should your buggy be? In this unit pupils are required to design and make a controllable, battery-powered toy vehicle for an identified user. This unit would be taught to Year 5 pupils.

Later in the year the entire class from each school visited the secondary school with their class teacher and together with the secondary school teacher and the help of the pupil experts tackled the modernized primary solutions unit.

The lessons learned from this teaching were incorporated into revised CADCAM versions of the units which were posted on the Nuffield Primary Design & Technology website (www.primarydandt.org)

To explore the impact of the peer-peer mentoring the following data were collected.

On 18th November 2008 both authors visited the secondary school and made field notes during a celebration event at which the pupils and teachers presented their work to an invited audience including relatives, carers and friends.

In February 2009 the teachers and pupil mentors who took part in the development were sent questionnaires about the work they had carried out. Two teachers, seven pupil mentors and four pupils who were mentored responded.

According to *Yin (1989),* small sample size (as in this study) is not a barrier to external validity provided that each case study is detailed and analysis of data reveals elements of practice relevant to the study at hand.

Results

Field notes taken at the celebration event organised by the lead secondary school give rise to the following summary.

The event at the secondary school was well attended, with some 50 guests, mainly friends and family, attending as well as teachers from the partner primary schools plus the pupils who had acted as peer mentors. There were also teachers from other primary schools who were there to learn about the initiative.

The peer mentors, their class teachers and the secondary teachers were all involved in making presentations. The pupils were obviously proud of the products they had designed and made. The teachers had worked hard to display them to good effect. It was clear that the pupils were delighted that family members and friends were there and they responded with confidence in answering the questions. These mainly concerned their role as experts who helped their classmates and without exception they indicated that not only had they really enjoyed it, they were proud of being a mentor and wanted to continue in this role. Pupils who had not been trained as experts indicated that they were ready to take on this role and were looking forward to receiving the training. The guests were glad to be there, applauded the pupil presentations enthusiastically and were generally impressed by the work they saw although one grandmother did wonder "What was happening to handicraft?" A deputy head from one of the primary schools spoke favourably of the scheme and commented on the extent to which the primary secondary partnership respected the primary perspective and provided useful professional development for the primary teachers and appropriate curriculum development for the primary schools.

The secondary teachers recounted how impressed they had been by the autonomy and capability of primary pupils. They were enthusiastic about the potential for pupils, on transfer at the end of Key Stage 2, being able to use the software and hardware in the secondary school without much in the way of additional teaching. They talked of needing to revise the year 7 curriculum in design & technology in the light of these developments and their new understanding of the abilities of primary pupils.

The primary teachers who were not involved in developing the revised units indicated how impressed they were with what had been achieved, particularly with regard to what they saw as improvements in children's learning. They were all keen to try out the revised units.

The questionnaire return from the teacher who piloted the CADCAM version of the unit How fast should your buggy be? with her year 5 class indicated that she had not taught the Nuffield primary solutions units before and that with this class she usually taught the QCA Unit Slippers, a textile based designing and making assignment.

There were 31 pupils in the year 5 class that piloted the CADCAM unit How fast should your buggy be? and four pupil mentors, three boys and one girl. The teacher chose them all on their ability with ICT and their good communication skills. Three were high achieving pupils but one was seen as having special educational needs. Her view was that they enjoyed the mentor role a great deal and that the other pupils benefited greatly from the presence of pupil experts mainly because the expert pupils talked at a level the other pupils found easy to understand. She also noted that it freed her to 'move around the room' and so spread her presence. As to disadvantages of having pupil expert mentors to support the rest of the class she felt that there were none.

In the current academic year she has taught her class, now year 6, the year 4 CADCAM version of the unit How will you store your favourite things? She reported that she experienced no difficulties in teaching the unit, that the pupils were able to make their own design decisions to a great extent, that they were able to be autonomous in perusing the Big Task and that she had plenty of opportunities to assess the children during the Big Task. She also reported that she would be using the CADCAM units in the future.

The questionnaire return from the teacher who piloted the CADCAM version of the unit What should be stuck to your fridge? with her year 2 class indicated that she had not taught the Nuffield primary solutions units before and that with this class she usually taught puppet making. She also noted that in the current academic year she had not used any of the CADCAM versions of the primary solutions units although she did indicate that she would in the future. There were 21 pupils in the year 2 class that piloted the CADCAM unit What should be stuck to your fridge? and six pupil mentors, three boys and three girls. The teacher chose them on the grounds that they were some of the more able members of the group. Her view was that they enjoyed the mentor role a great deal but that the other pupils benefited only a little from the presence of pupil experts. However she did note that the expert pupils provided 'other supporting pairs of eyes' and that they knew more than she did. As to disadvantages of having pupil expert mentors to support the rest of the class she felt that there were none.

The pupils who returned the questionnaire consisted of seven pupils who acted as expert mentors and four pupils who were mentored.

Of those who acted as mentors all enjoyed being trained as an expert although their reasons varied and included "feeling good to help other people", "learning new skills" and "enjoyment of using computers". All agreed that they were able to help other pupils, would recommend it to other pupils and would like to be trained as an expert in future projects because "you get to learn more and feel special". The pupils who were mentored indicated that they enjoyed being taught by a pupil expert and that the experts had explained things well. Only one of these pupils indicated that he did not want to be an expert in the future as "it is too hard".

Discussion

The peer-peer mentoring process appears to have had a significant impact on the curriculum development process. It creates a community of practice in the classroom in which more than the teacher has responsibility for the learning that is taking place. The comments from the expert mentors indicate that not only did they enjoy their role, but also they clearly took their responsibility to support the learning of other pupils seriously although the teachers differed in their view as to how much the other pupils gained from the presence of pupil experts. The pupils who were not mentored were however unanimous in acknowledging that the expert peers helped them. In terms of considering the class as a community of practice it is interesting to note that *Csikszentmihalyi (1999)* makes a strong case for building communities that nurture creativity as opposed to developing highly gifted individuals. In this case the reason for training the pupils, who acted as expert mentors, was to build such a community as opposed to developing these pupil's individual talents.

The celebration event, although not a necessary activity, does validate the practice at a variety of levels and hence is important. It provides opportunities for those involved to show what they have achieved and receive appropriate recognition. The contribution of the expert peers to this event was significant as much of the presentations and the questioning centered on their role. The event revealed the mutually supportive and responsive nature of the relationship between the secondary school and the partner primary schools each valuing considerably the activities of the other party and learning from them.

It is clear that teachers were crucial in the enterprise at several levels. The role of senior leadership in both the primary and secondary schools facilitates and endorses their involvement in developing the expert mentors, teaching the revised curriculum and celebrating the achievements. The secondary school teachers provided the initial tuition for the expert mentors and without this there would be no expert peers. The primary school teachers collaborated fully with their secondary colleagues and with the expert pupils in successfully implementing the curriculum development. The tasks undertaken were appropriate for the primary design & technology curriculum and allowed a wide range of design decisions.

One teacher has taken the development forward and tackled one of the revised units using her newly developed expertise and that of the pupil mentors. This indicates that from a professional development perspective this activity has been highly successful in her case. She noted that the pupils were autonomous and were able to make their own design decisions to a greater extent. It is beyond the scope of this study to report in detail on her experience but it would be interesting to explore her practice from the viewpoint of the talk that occurred between the pupils in terms of the dialogue espoused by Robin Alexander in his support for dialogic teaching *(Alexander 2004).*

Both teachers reveal post interactive thinking of some worth. To some extent this has been stimulated by the use of a questionnaire but the reflection is thoughtful and in both cases reveals the intention to continue to develop innovative practice.

Guidelines

The curriculum development involving the use of peer – peer mentoring that has taken place has been successful in terms of developing a revised curriculum and the intention of the primary teachers involved to use this development in their practice. The following guidelines identify features that have contributed to this success.

Developing a shared vision of the development activity between the secondary school and the partner primary schools is essential. The following features contribute significantly towards this.

- Identifying activities that are appropriate for the primary design & technology curriculum and afford opportunities for designing.
- Support from senior leadership is necessary to facilitate the release of secondary school teachers to teach the pupils who will act as expert mentors
- Support from senior leadership is necessary to facilitate the teaching of the revised curriculum units as immersion experiences in the secondary school involved the expert pupils who then acted as peer mentors.
- Support from senior leadership at both the primary and secondary schools is necessary to achieve the celebration event
- In choosing the pupils who will become expert mentors an important factor is their ability to communicate well
- The teaching of the expert pupils is a significant task and needs to be given appropriate time in which the secondary school teacher visits the primary school to carry out the teaching.
- A celebration event is an important follow up activity as it shows the extent to which the development activities are valued and successful and also endorses the idea that the developments should be taken further within the curriculum for the following and subsequent years

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Making the Difference: Twenty Years of Primary Design and Technology in England

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Abstract

As this year is an anniversary year for primary design and technology, it seemed appropriate to link this paper to the conference title. Having been involved in primary design and technology since its conception, I have had the opportunity to review key activity that has impacted both on national implementation and personal practice. This paper will offer some personal reflections on the twentieth anniversary of a 'new' subject – primary design and technology – that was created within the first National Curriculum in England. Over this period of time there have been numerous documents and reviews produced; different support materials created; and a variety of projects undertaken. Some have obviously been more successful than others. The key activities have been grouped into 3 main sections – published documents, Continuing Professional Development and personal projects – and I have identified within each section influential activities that I believe have made a contribution to the personal growth of, and impact on, my beliefs and values within primary design and technology today.

Introduction

It hardly seems possible that this year marks the twentieth anniversary of both the Proposals for Design and Technology of the Secretary of State for Education and Science and the Secretary of State for Wales (June 1989) and the consultation report from the National Curriculum Council (1989) (NCC) in which details were laid out for a design and technology curriculum that was to be introduced into the English and Welsh primary curriculum (now Wales has a separate curriculum.) Although the National Curriculum was not published or implemented until 1990 it seemed appropriate to consider how these documents and other significant activity have 'made a difference' to design and technology in the primary school. Both positive activity and some that I believe were detrimental to the development will be discussed.

Published documents

Both the Proposals and the Consultation document mark the first of the significant activity that will be discussed. Not since Religious Education had been included in the curriculum in the Butler Education Act (1944) had a 'new' subject been included in the curriculum in a formal way. It can be argued that economically and politically it was an appropriate time for a subject of this nature to be included (Kelly 1994, Eggleston 2001 and that through studying the subject young people should be better equipped to enter the rapidly changing world of work and to make best use of their leisure time As a new subject, it could be expected that extreme care would have been taken to ensuring that the documents were easily understood, were jargon free, and were written to enable primary teachers to understand the nature of the subject and ways of implementing the proposals in the classroom. However in the Proposals, there were 16 aspects of the programme of study plus an additional number of bullet points for each level (levels 1-5 were identified as primary levels) including titles such as systems, mechanisms, structures, business and economics, and imaging and generating. Now the language may seem appropriate but then it was not in common usage, certainly not in the primary school and trying to identify progression and continuity was difficult. Following this, the format of the NCC Consultation document changed dramatically to make it more easily understood, but the content did not change significantly. It was this format that was used for the final document Technology in the National Curriculum (1990) – the first National Curriculum. However the change in title to 'Technology' confused many. The Government had decided to include Information Technology (IT) in the same document as design and technology with the title 'Technology'. This did lead to confusion as many thought Technology was just IT – another hindrance that needed to be overcome quickly before the subject could move forward. It was not an auspicious start to the subject's creation.

Design and Technology in the National Curriculum (1995) was the next significant document for a number of reasons. Firstly, it had the title Design and Technology and so it was clear to all that it was not IT. Secondly, it was much slimmed down so that the key areas of content were clear, even to the non specialist. Thirdly the four attainment targets with different weightings were reduced to 2 of equal importance – designing and making. Lastly, and perhaps of most significance, 3 activities were identified through which the pupils would be given opportunities to develop their design and technology capabilities. These activities were (DFE 1995):

- "Focused practical tasks in which they develop and practice particular skills and knowledge
- Activities in which they investigate, disassemble and evaluate simple products
- Assignments in which they design and make products" p.2

Although the addition of 'for a user and purpose' relating to products would have clarified even further the idea of the need and purpose for a product, often lacking in the planning of projects today, this was the first time that teachers had been given some guidance as to how they might organise their design and technology teaching to support the children's development of appropriate skills, knowledge and understanding. Even school Inspectors (OFSTED 1996) identified that this had contributed to raising standards. Now we await the effect that the Rose Review (2009) will have on the future of the implementation of design and technology. At this point in time, the title of Scientific and technological understanding for the section in which design and technology is placed may lead to more misunderstanding of the nature of design and technology – back where we started 20 years ago.

Continuing professional development (CPD)

Face to face provision

It would have been appropriate to provide a range of CPD for all those involved in supporting and delivering the new subject – design and technology. In fact there was no national CPD for the subject, only dissemination conferences that focused on outlining the framework of the new document. It was left to the Local Education Authorities (LEA) to provide more specific support through their advisory services. There were a number of problems associated with this. Different LEAs had differing numbers of personnel with varied expertise who were able to offer CPD; there were different interpretations of the documents; it was left to schools to decide what, if any, CPD they would attend and could afford; and perhaps most importantly initially there were no opportunities for CPD that supported longer term development and impact. There was no subject specific CPD for those who would be undertaking the CPD and many worked in isolation or with a few colleagues within an LEA.

However there has been one national initiative for CPD since the mid 1990s that has offered teachers the opportunity to attend longer courses and provide support that can influence whole school development. The Teacher Training Agency (TTA) now the Teacher Development Agency (TDA) provided the opportunity to bid for funding for longer courses and the Design and Technology Association together with Birmingham City University has won funding every year since then to provide courses throughout England that offer practical skill and knowledge and understanding development in addition to support for whole school implementation of the subject. Impact can be seen through the papers written and delivered at CRIPT conferences over the years (e.g. Davis 2001, Hastie 2003, Butterfield 2005, Treleven 2007) but there are some limitations to the overall success of this provision. Courses can only be run if there are appropriate local tutors and these are decreasing in number and schools have gradually had to make a greater financial contribution for each participant and thus numbers attending fluctuate depending on schools' priorities.

Publications

Whilst there have been numerous publications since 1990 of varied quality and coverage, there are two that I would argue that have had the greatest impact.

The first was a guidance pack – Guidance Materials for Design and Technology Key Stages 1 and 2 (DATA 1995) that linked to the new National Curriculum (1995). Although this had financial support from the Department for Education it was not their official publication. It gave schools 30 units split into those for 5-7 years, 7-9 years and 9-11 years with built in progression and continuity. They were Guidance, not a set scheme of work and were intended as a "start up pack to re-establish a sound foundation for design and technology, from which teachers can take the subject further" p.2.

This was the first time that the curriculum leader in a school had help with planning and implementation and the teacher had a clear overview of possible, appropriate activities that would lead to skill and knowledge and understanding development. With each unit of work outlined on 2 sides of an A4 sheet it was quick to read and easy to access and understand.

The second came in 1998. A Scheme of Work for Key Stage 1 and 2 (5-11 years): Design and technology was created and published through the Qualification and Curriculum Authority (QCA). This was the first time that guidance had been offered from a national body, not only for design and technology, but gradually for all primary subjects. It was published at a time when primary teachers were being faced with many other initiatives to implement such as the Numeracy and the Literacy Strategies (DfEE 1998) and this did offer schools a complete scheme that could be used to suit individual needs. Schools could adopt it all and then modify as they trialled it; they could adopt some units that they felt were appropriate to their needs; or they could check their own curricula and discard it all in favour of their preferred units. QCA identified it as their most used scheme and OFSTED stated that it was a factor in helping to raise standards. The fact that many schools implemented the scheme without adapting it to individual needs was not the fault of the scheme. In the Teachers' Guide it states on the first page in bold:

> *" ..there is no compulsion to do so and schools should use as little or as much as they find helpful."* p.2

Sadly schools had been 'told' to undertake so many Government initiatives that this was viewed by many as a scheme that had to be followed. Where there is evidence of adaptation to individual school needs, excellent practice can be found (Vaughan 2003).

In addition to published materials, over the twenty years websites have increased in number and variety. The QCA website www.qca.org.uk has been one that has developed continuously over this time and has a great variety of materials including real projects and assessment, and work with new entrants to England. The Design and Technology Association has more recently increased its curriculum support for all primary teachers and now has a great variety of projects that can be adapted to suit the needs of all primary schools on its website www.data.org.uk.

Personal projects

Over the last twenty years I have been fortunate to be involved in a variety of projects, both in this country and overseas. All have had an impact on my practice, but I believe two have had the greatest influence in making the difference to my understanding of the enormous positive impact that design and technology can have on children.

I was invited to evaluate the first 2 phases of the implementation of design and technology in primary schools in Bahrain, part funded through UNESCO. In stark contrast to the way in which design and technology was introduced into England, the Bahraini Curriculum

Development department chose to identify a few key personnel, including teachers to attend training/fact finding in England through Sunderland University. Implementation of design and technology followed in just a few well equipped schools, each with a teacher who understood the nature of design and technology and how to use a range of teaching strategies appropriately. Support materials were available and the teachers evaluated and modified as they went along. These schools then acted as centres of excellence as the subject was introduced across Bahrain. As implementation had started in the first grade the children were able to build on their skills and knowledge and understanding. The evaluation served to highlight the important features that were missing in the way we implemented design and technology from 1990.

'Designerly thinking' was a project funded by the Department for Education and Skills and ran for 6 years in different forms (Benson 2003). The focus was originally on developing designerly thinking with Foundation Stage children (3-5 years old) and from all the evidence that was collected from over 600 Foundation Stage teachers, it was apparent that:

- This was an aspect that was missing from majority of Foundation Stage settings
- When included, it was an area that children found interesting and for many it supported rapid language development, and an interest in learning that previously had been missing
- By modelling more than just knowledge type questions, children quickly developed their own questioning skills
- By developing questioning skills (in this case based on Bloom's taxonomy) teachers were able to provide more effective learning situations for the children and to support the development of children's critical and creative thinking.

From this review, I am certain that involving children in design and technology will allow them to develop important skills, knowledge and understanding that will be for life, not just for school. As we embark on yet another phase of National Curriculum development with the Rose Review (2009), it will be interesting for others to review the impact that this and other initiatives have on design and technology practice in schools over the next twenty years.

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Making a Plan, Making Choices and Showing whether or not they are Successful: Simple Gestures for Learning Something other than Techniques

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Abstract

In France, for very young children (3 to 5 years old), starting to learn about technology starts with activities based on the use, observation and creation of technical objects/aids in the context of real life situations in the classroom, games for building things, production workshops and many more besides, in accordance with instructions given by institutions (Boen, 2002). These three types of activities are even more interesting, given that they lead pupils to ask questions about the object from the point of view of the relationship between a person and the product. Activities based on usage lead us back to the study of functions and how something works, opening the door to questions regarding the environment in which the product is used (conditions for use, ergonomics, clearing up, repairs, maintenance, energy, transport, safety, aesthetics, packaging, marketing...) Observational activities are more centred around technical solutions (transmission, assembly, resistance, materials...). Activities for making things allows one to think about work, techniques, tools, procedures, safety, organisation of production tasks, conformity of the product in relation to the initial specifications. All of these activities provide things to work on, both orally and in writing, and also in 'jargon' as shown by the works of Fleer (1992), Nonnon (2001), Parkinson (1999) and Schoultz (1997). Despite the interest to be found in such activities, technological studies remain for the most part centred around the result, the finished product (production of Christmas, carnival, Mother's and/or Father's Day; as was done prior to 1985 with manual teaching).

The aim of this contribution is to present a teaching sequence, the pupils' achievement which is not specifically based upon the result, but upon the constraints, choices and strictness of the technological approach.

Sequence objectives

The sequence involves nursery school children (aged 5). The aim is to create a moving puppet, in three 20 to 25 minute classes, spread out over the week. Making this kind of puppet is a classic example of this type of activity. It is mostly done in the context of a production/creation activity, where pupils start by learning to read a procedure sheet and then follow the technical instructions using the materials available to them *(Chatoney, 2003)*.

There are several aims:

- The idea is first of all to lead the pupil to undertake a project and stick to it. Here, the pupil has to be aware that (s) he is bound to a contract to produce a puppet in accordance with the agreement that has been made, and that the production process is strict/binding
- Secondly, attention has to be paid to the attachments which link the puppet together. The question of attachments is one of knowledge relating to « assembly/putting together » in technological terms, as shown in anthropology *(Leroi Gourand 1971, 1985)*, philosophy *(Dagognet 1989, 1999; Deforges 1985, 1990 and Simondon 1958)*, technical history *(Haudricourt 1987; Jacomy 1990; Latour 1992 and Russo 1989)* and by the place that it occupies in teaching of a technical nature (curriculum, works/books and time in education or training programmes) . Assembly deals with matters of play, amount of freedom, chain of mechanical processes, but also aesthetics and materials. Many aspects relied upon by functioning, aesthetics and product cost
- The final thing to be done is to communicate and exchange ideas with others in accordance with the guidelines and to enrich the pupils' lexicon (specific vocabulary) by introducing them to a technical vocabulary (drill/pierce, superimpose, assemble...)

The sequence is given to a class of 23 pupils. The activity is analysed based upon the teacher's strategy, the kind of tasks given to pupils, marks left by the activity and a summary evaluation of the sequence drawn up by the teacher after the event.

Sequence guidelines and remarks

The first intervention aims to place the pupil in an individual project scenario and make him/her draw up the puppet specification

Three phases structure it. Each phase lasts for between 7 and 10 minutes.

The teacher starts by reading from the book Mimi and Angélo by P. Bourgeault. This reading is accompanied by the use of a puppet representing the main character «Mimi». The puppet that is shown is neither observed, nor used by the pupils. It is small (15cm high) and made up of only three moving parts: head, chest and legs. There are six characters in all, with as many girls as boys. All of them are dressed in either a skirt or trousers (regardless of gender) and a pullover.

- Task 1: Participate in a group project modelled on the main character «Mimi».
  – Organisation and instructions: group and oral work. « Mimi is going to find his friends (last sentence in the book). We are all going to make puppets of them ».
  – Accessories: The teacher shows the pupils a chart with two columns allowing the pupils to describe the different characters in the story. She (the teacher) fills in the chart with the pupils' help, by putting crosses in the right places corresponding to Mimi (girl, red pullover, blue skirt)
- Task 2: Choose a character in the story in order to draw and make a puppet

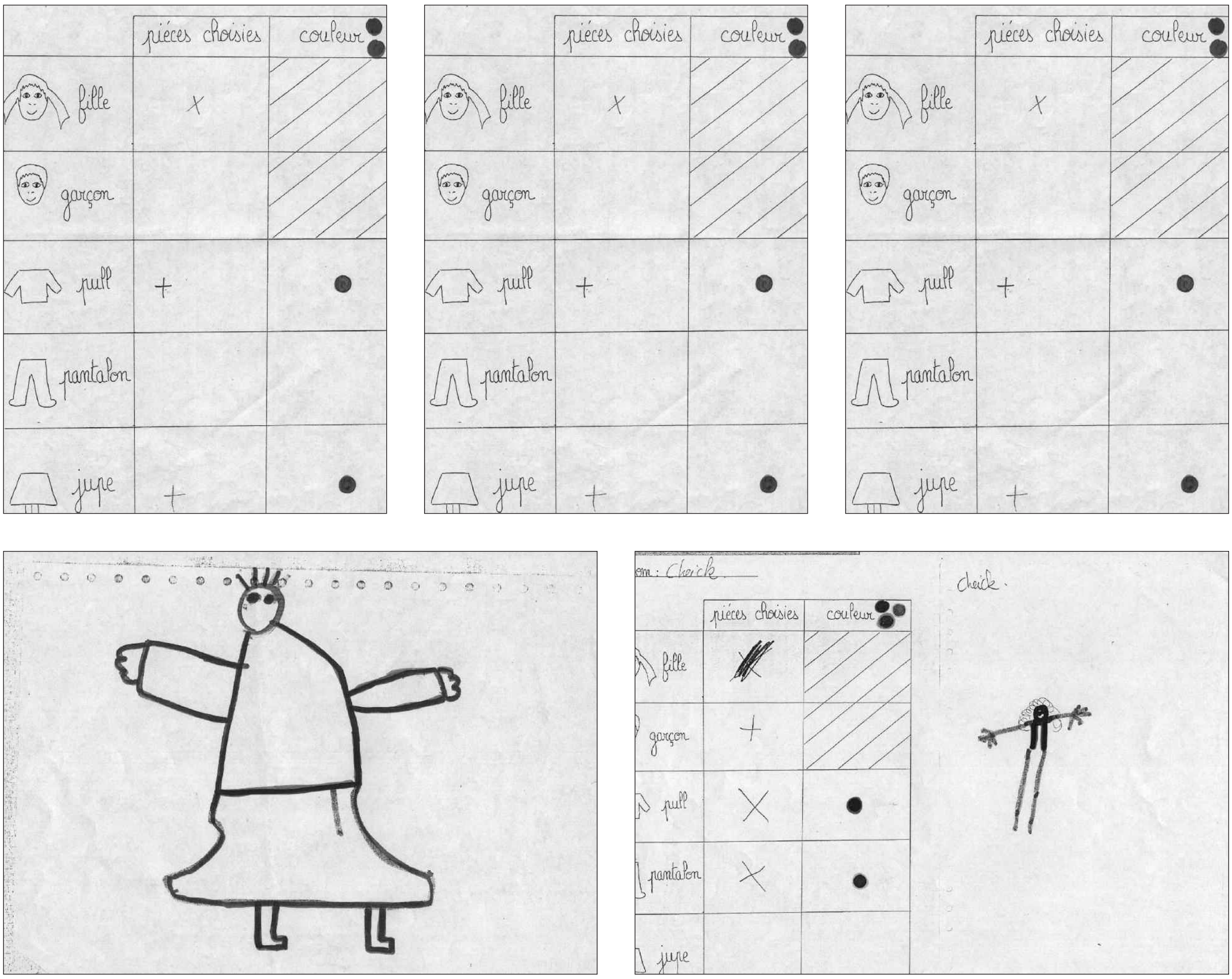

Illustration 1: Examples of pupils' drawings and charts

– Organisation-Instructions: individual work «Draw the puppet that you want to make. You can make a little boy or a little girl. You can only use the three colours that are on your tables»

– Accessories: All pupils have a white piece of paper and pots containing three colours of felt pens

- Task 3: Define their chosen character in a «specifications» chart

  – Organisation-Instructions: «You are going to fill in a chart, like the one for Mimi that I have put here, to explain what your puppets are going to be like». Pupils are in groups of six. The teacher and a nursery school assistant help those who do not manage to complete the chart on their own by following the instructions.

  – Accessories: Everybody has a document upon which is drawn a chart to be filled in, identical to the one for Mimi and their coloured drawing. (Images above)

  – Remark: The pupils readily participate in the activity. The fact that they have to on the one hand provide an answer, and also put it in the right place in the chart based on the Mimi model, allows the pupils to learn how to complete a two-columned table. However, choosing a character causes pupils a major problem. Not all pupils remembered the colours of the clothes for the characters in the story. Only three memorised the types of clothes described in the story, and set about drawing their character immediatelephoney. The other pupils had to memorise the characters again in a group, then choose their character. The drawings are done conscientiously and with lots of care. All types of human representation are seen together. Thus, we find drawings of stick men, potato men and more 'detailed' men. The vast majority of pupils directly define the colour of clothes by drawing a line, or by colouring in parts representing the limbs. Six pupils trace the character outline with a felt pen and then colour it in. One pupil improves the colouring in of the entire body of their character by re-drawing the pullover outline in the right colour. This task does not present any major difficulties. Hence, all pupils manage to accomplish the task, each in their own way, as shown above in illustration 1.

The second part is dedicated to the solving of two types of technical problems: fitting the parts together and fixing the moving joint.

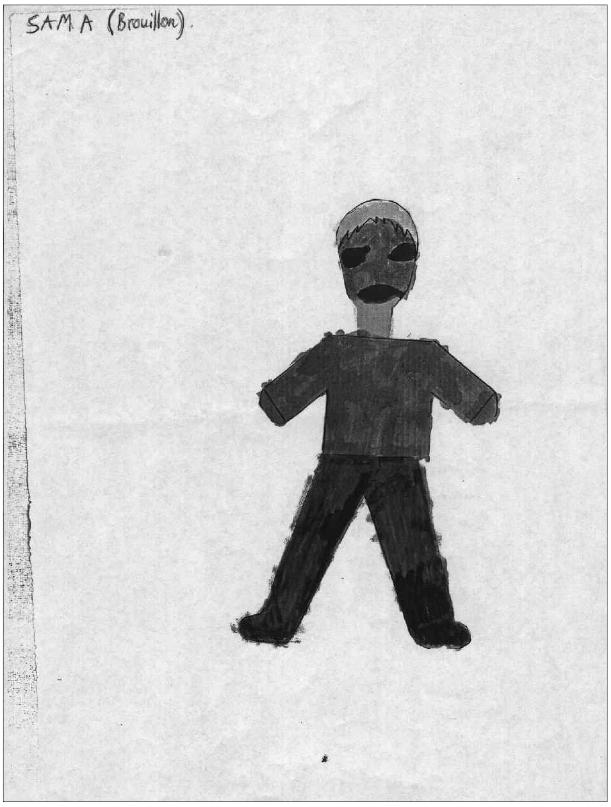

Illustration 2: Example of pupils' sticking their puppet together

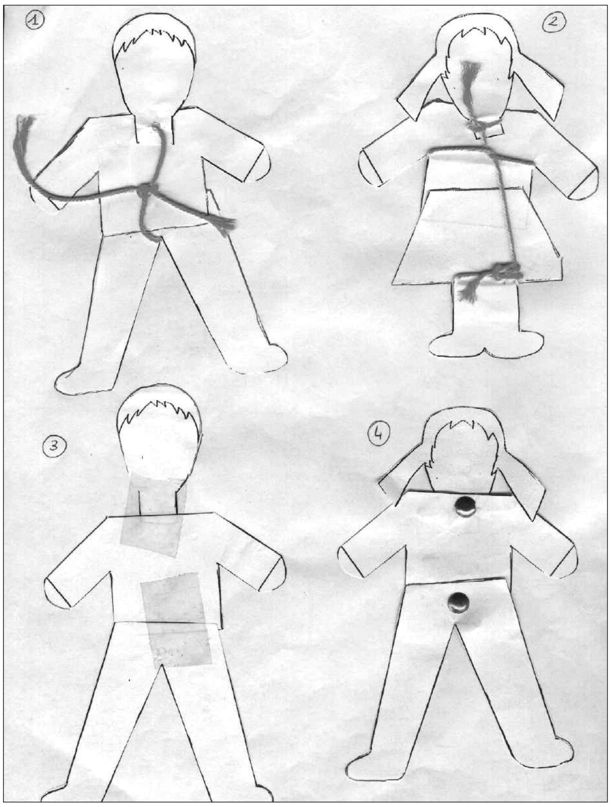

Illustration 3: Puppet – building solutions suggested by one group of pupils

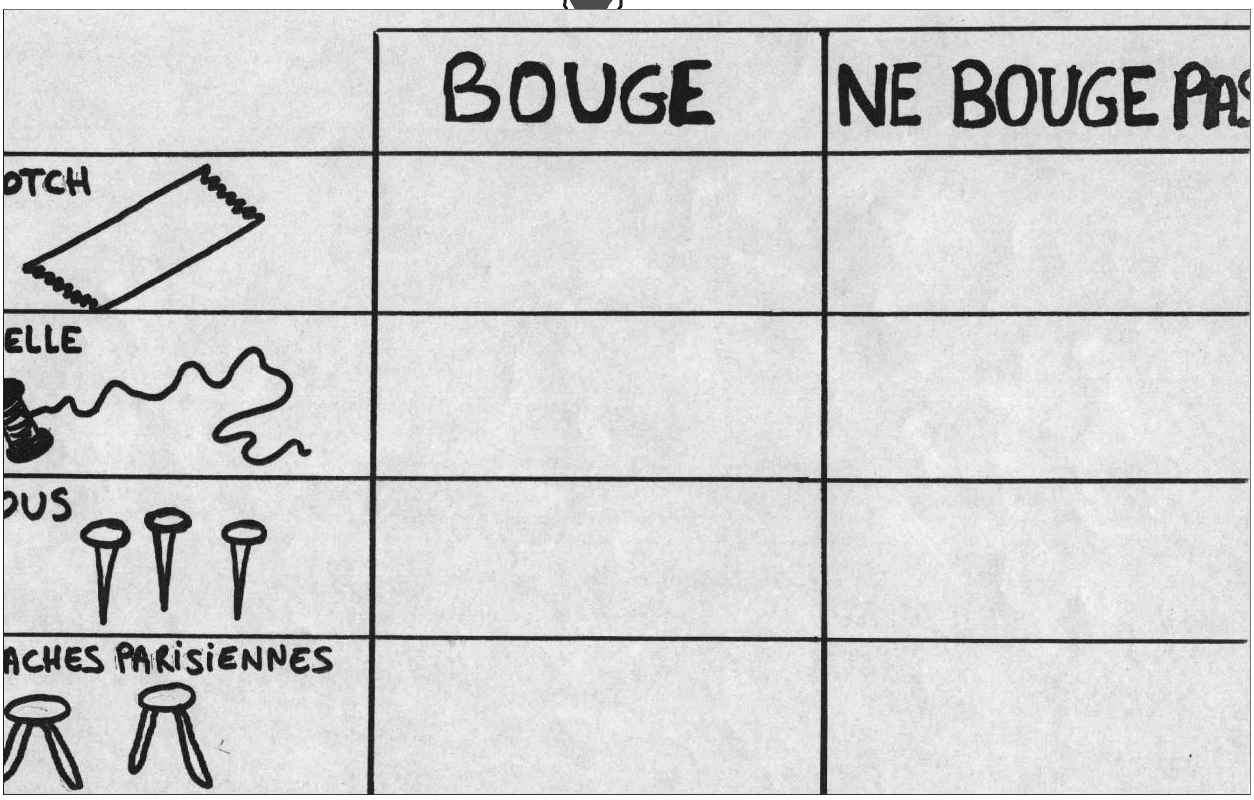

Illustration 4: Table comparing solutions

This is done in two parts. Each phase lasts between 10 and 15 minutes. In this session, the pupils will have to distinguish the shapes of the parts making up the puppet, and position them correctly while keeping to the project guidelines. They must then suggest possible ways of putting the puppet together using all available materials, before finally comparing them and choosing the most suitable system.

- Task 4: Choose the three parts that correspond to the pupil's project, position them all together correctly and give them the correct colour detailed in the specification. In other words: «build the puppet from scratch»
  Organisation-instructions: Individual work. «I've put forms/shapes on your tables. You are going to choose those that correspond to your puppet, and then stick them to your piece of paper. Then you have to colour them in using the colours you decided upon for your puppet».
  Accessories: Each pupil has all the pre-cut shapes made out of white paper (a girl's head, a boy's head, a pullover, a skirt, trousers), a glue stick, felts, a sheet of white paper, their drawing and their «specification» chart. (See illustration 2 on the previous page)
- Task 5: Find systems allowing pupils to put the parts of the puppet together, and compare them in relation to the anticipated result (head and lower body movement in relation to the torso).
  – Organisation-instructions: Pupils are put into groups of six. Oral work. «We want the puppet to move. How are we going to do that? We've got sticky tape, string, nails and brass fasteners». «Now that you have found a solution, you have to fill in the chart».
  – Accessories: paper shapes, string, nails, sticky tape, brass fasteners, a chart for 6 people to fill in. (See illustration 3 and 4)
- Task 6: Check whether each of the solutions has the two criteria allowing the parts to move (to turn and to stay still) then choose the most suitable assembly method.
  – Organisation instructions: pupils are grouped together in front of the chart, all sitting on the floor. Oral work. «We're going to see whether it turns and stays in place: the string? the nail? the brass fastener? the sticky tape?».
  – Accessories: the charts completed by each group, the models put together, a table serving as a summary chart, to be filled in as and when pupils make suggestions.
  – Discussion: The first activity, dealing with learning how to position the parts, takes place without any apparent difficulties. The pupils take the paper shapes and easily place the head above the chest, the legs below. But although all the pupils overlap the bust and the legs, most of them do not fit the head to the bust, as shown in illustration 2. The section that is supposed to be put on top of the head is perceived as the character's neck, rather than the 'technical area' for assembly. When the moment comes to colour the puppet, pupils who can no longer remember their plan are invited to read their specifications. The work is then individually self-evaluated, a comparison between their drawing, specification and sticking together. The second part, dealing with finding the solution, also proves somewhat difficult. The fact that pupils have to test in groups of six, four systems on four models, does not allow all six to try things out. Naturally, some pupils take a back seat whilst the others take control. These 'social' difficulties are dealt with in each case by the teacher or by the nursery helper, who supervise to make sure that the task is shared and that all pupils are able to take turns to work upon the model. This meticulous examination of the systems/methods put in place and the paper model enable pupils to make «technical» suggestions, for example: turn the paper model around in order to pass the string around both sides, so that it stays in place, make a hole in a set place in order to put the string or the brass fastener through, twist the ends of the brass fastener or knot the string to make it hold firm, as shown in illustration 4. Knotting the string and piercing with the hole punch do not prove possible for everybody. As happened previously, these now «technical» difficulties are dealt with by the teacher, who will make a hole in the place where she is asked to do so, or tie a knot as instructed to do so. Contrary to the other methods, the nail has the advantage of having a point that can pierce the paper. Having to fill in the chart step by step is completelephoney eclipsed by the action. The chart is completed at the end of all the test runs, with help from the teacher and the nursery helper, following an examination of the systems/methods devised within the group and making sure of both conditions to be fulfilled (puppet moves and stays still). The charts filled in by each group and the systems created facilitate the summary task. Pupils come to an agreement regarding the answers to be ticked for the sticky tape, the nail and the brass fastener. However, they find it difficult to agree on the kind of movement for the string. Depending upon how it is put into or wrapped around it, the puppet rotates quite well. The summary chart enables pupils to integrate the conditions for linking the parts of the puppet together, but also to agree on which solution to choose when several are available.
  – The third and final session is for creating the puppets (Each pupil chose their puppet character, so they are different). This session has two aims. Firstly, every pupil has to produce their puppet independently and then make sure that it complies with the original plan outlined in the « specification » chart. Each phase lasts for ten minutes.
- Task 7: Producing your own puppet.
  – Organisation-instructions: individual work. «From the shapes available here, you are going to choose the ones that correspond to your plan, then put them together and draw your character's face».
  – Accessories: All the shapes are available in all colours on a table, along with a box of brass fasteners and four die cutters.

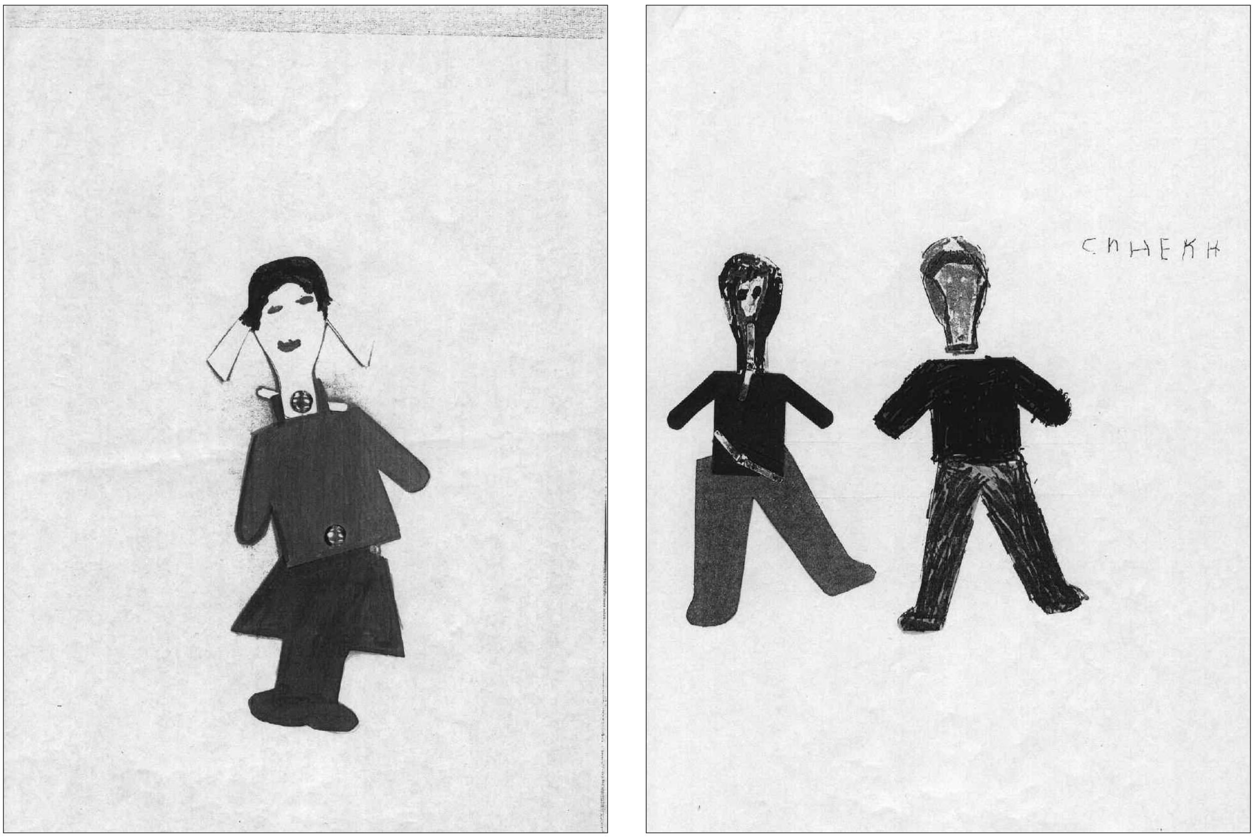

Illustration 5: End products highlighting difficulties linked to the notion of back and front, or above and below

- Task 8: With the help of the «specification» chart, check that your plan complies with what was outlined at the beginning.
  – Organisation-instructions: Individual work. Oral «Check that your puppet corresponds to the choices made and noted in your initial chart».
  – Accessories: «Specification» chart, finished puppet. (Images above)
  – Remark: The nursery helper aids the teacher in putting the puppets together. They pierce the holes so that the pupils only have to place it on top and build it, thus solving the neck problem. Ten pupils put the parts together perfectly. All the others do not anticipate the fact that the puppet has a back and a front. Hence the attachments appear on the top of the puppet, but they should be behind. So brass fasteners are introduced from bottom (back) to top (front), making the attachments appear at the front. These ways of putting things together are not considered as errors by the teacher, who does not interfere in the activity. The addition of facial lines is systematic and marks the end of the production activity. The pupils willingly spend time on this and talk. They show their puppets and play with them. The conformity test works, with all pupils checking that the right shapes and colours are ticked. Only five pupils made mistakes in the choice of available parts. Two of them take the initiative to change a wrong part for one that works, while the other three wait for instructions from the teacher.

Conclusion and proposals for improving the sequence

The most important thing to take from this study is the cognitive importance of the tasks set for pupils and of the teaching strategy used.

From a learning point of view, the pupils succeeded in working on their own personal project. Indeed, for the vast majority, the choices made did not vary between activities (drawing and creating). Note that only three pupils changed their mind in the middle of the task, and taking into account the frequency of testing based on the specifications, they realised quickly and modified their drawing or product by themselves. The specification proved to be very useful. It allows pupils to keep track of what they are doing, making them take responsibility and giving them a clear autonomy in decision-making. Pupils learnt to read, fill in and use two-columned charts (specification and moving attachments charts).

In terms of knowledge acquired, the pupils learnt that there are two kinds of attachments between parts: fixed and moving joints and that they are named as such. They learnt that in both cases, several technical solutions exist and that some of them are more suitable than others. The nail, for instance, allows the parts to move but it does not hold them in place; hence it is not the right solution. Pupils also learnt that there are methods for holding different kinds of joints in place, some of which work better than others. The brass fastener has an advantage over the nail, for example, because it allows the parts both to move and to stay still. The pupils' inability to talk about the characteristics of moving/mobile joints is due to a lack of vocabulary at that age. Here, it is «spontaneously» compensated for by means of stimulation and teacher questioning.

Apart from these positive aspects, two difficulties are noted which the teacher did not sufficiently anticipate: the sharing of work in groups of six, and the problem of objects having a front and a back. Both these points can be easily improved.

Organising work in groups of six is justifiable at nursery school, because the teacher and the helper only have two groups each to look after. This is a justifiable argument. In this case, it would have been better to give the material corresponding to an attachment method to every pupil in each group (rather than having a lot of material) two identical systems explored in the group. That way, all the pupils could have tried things out.

The question of the front and back of the parts brings us back to spatial problems (in terms of rotation on a plan, in space, symmetry, reading, noticing things...) that pupils of that age are yet to acquire. Choosing to stick the parts onto a sheet of paper means that the order in which things are built will be maintained. On this occasion, several pupils just glued one side of the puppet or the other. It would be useful to look at these differences in order to look at the problem areas, and turn learning towards the matter of aesthetics of placing parts on the top or the bottom. This would allow the puppet to be given a front and a back and for them to be established. Studying attachments gives the teacher the same opportunity. Rather than the teacher being restricted to the two conditions/criteria for moving joints, they would be able to introduce the aesthetic problem that some systems pose, and to go back to the previously encountered notion of front and back, and establish a sense of how to put the brass fastener into place.

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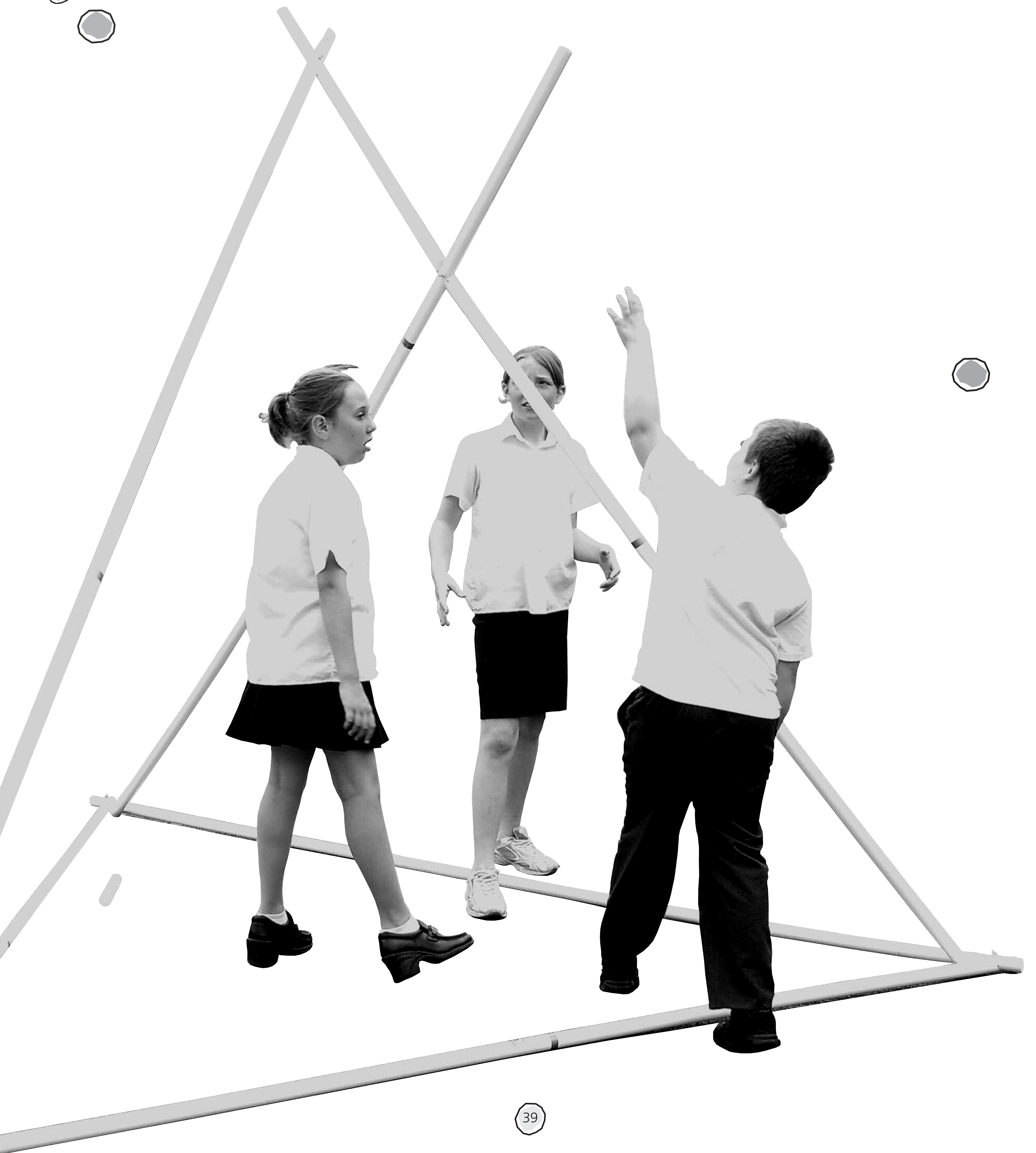

No Very Goods in D&T? Where are the High Achieving Pupils in D&T?

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Abstract

Design and technology has been a school subject in English primary schools since 1990. The subject's implementation in primary schools has seen success in that all primary schools have, throughout that period, taught design and technology. However the subject has suffered from low status relative to the other curricular subjects and repeated reports have indicated limited progress in addressing chronic shortcomings in terms of pupil achievement, teacher confidence and resourcing. Assessment of design and technology in primary classes has been and appears to remain inconsistent and perhaps as a consequence evidence for high pupil achievement in the subject has been limited.

One might expect that given a large sample, a range of achievement in design and technology might be observed just as in other subjects. In a relatively new subject like design and technology, where teachers lack confidence, we might expect to see depressed levels of achievement. These might be expected to rise over the years as teachers become familiar with the subject. Evidence suggests that achievement overall is below what might be expected, so why have we not seen a growing number of higher achieving pupils? This paper is exploratory, it reviews evidence presented by school inspectors and considers statements by sixteen primary school teachers who were asked about the occurrence of high attainment in design and technology in the primary years.

Introduction

Gaining an accurate view of achievement in primary design and technology is difficult as there is no reliable national summary of assessment in primary design and technology based on the level descriptors in the National Curriculum (DfEE/QCA2000) or any other criteria. One significant source of country wide evidence has been the system of individual school inspection in which until 2004 inspectors reported on each primary subject including design and technology in each school. Since then inspectors were not required to report on each subject separately. Throughout this period there has been an additional system of subject inspections which alongside school inspections have given Ofsted an additional evidence base. Recently a single summary report for the years 2004-7 was published in 2008 (Ofsted, 2008). These various reports have dealt with both primary (ages 5-11) and secondary (ages 11-16) design and technology education. Annual HMCI reports (HMCI, 2007) and annual subject HMI reports (HMI,2002: 2004; 2005) have drawn on these different sources of evidence. They draw on the full data base of primary school inspections which run into thousands each year and the smaller sample for subject inspections at just over thirty schools per year. Recently the author has questioned a small number of primary school design and technology coordinators about achievement by pupils in the subject and in particular the occurrence of high achievement.

A word of caution is required about purpose and terminology. Ofsted's agenda is much more than reporting the results of tests or observations, it is about the accountability of schools (Curtis, 2003). Ofsted's use of phrases such as 'in line with national expectations' is problematic (Cross, 2006 p.165). This is partly because there is no comprehensive statement of these expectations, in particular in terms of achievement. The only articulation of a national expectation of achievement is found by using the National Curriculum level statements. As originally stated in the 1990's an average eleven year old will be one who achieves a level four in the National Curriculum (DfEE/QCA, 1999). This is a measure of attainment against which any pupil can be compared providing a snapshot. To measure achievement we need to compare present attainment with a pupil's previous attainment and consider the time taken. Two pupils might have attained the same level in design and technology. One however, Pupil A might have been at this level for a year or more whilst pupil B's performance has recently risen to this level and therefore demonstrates greater achievement. Little government guidance was provided beyond the notion that for an average pupil a National Curriculum (DfEE/QCA, 1999) level equates to two years education. Thus this rate of learning might be considered to be average or satisfactory achievement, in line, as Ofsted say with national expectations. Whilst this may appear plausible we must remember that these 'levels' were written by writing groups and were not the result of direct research, nor were they trialled with significant numbers of children. They may therefore represent a national aspiration rather than an expectation.

Pupil Achievement Reported by Ofsted

Annual subject summaries for design and technology *(HMI 2005, 2004, and 2002; Ofsted 2008)* indicate something about changes over time. Unfortunately however, the information given in these annual reports on primary design and technology is presented in forms which are hard to compare year on year.

Reporting on the Year 2001-2

> *"Pupils' achievement in design and technology is at least satisfactory in the great majority of schools and is good in one school in four (25%). However it is unsatisfactory in Key Stage 2 (7-11years) in one school in six (16.6%)."* HMI 2002

Reporting on the Year 2002-3

> *"Pupils' achievement, related to their capabilities, is satisfactory or better in nine out of ten schools overall (90%). Unsatisfactory achievement in lessons has diminished since last year but remains slightly more frequent at Key Stage 2 (7-11years) than at Key Stage 1 (5-7 years). However, achievement is rarely judged to be good."* HMI 2004

Reporting on Year 2003-4

> *"Pupils' achievement in design and technology is good on only two schools in five (40%), comparing unfavourably with almost all other subjects."* HMI 2005)

Reporting on the Year 2004-5

> *"Achievement is at least satisfactory in over nine tenths of schools. It is good in only two fifths (40%) …"* HMCI 2005)

Reporting on Years 2004-2007

> *"In about a third (33%) of the schools in the survey, pupils' achievement and progress across the full spectrum of design and technology was as good. There was some evidence to suggest a trend of improvement, but examples of outstanding provision were rare. Achievement was no better that satisfactory in over two thirds of the schools surveyed."* Ofsted 2008

These reports *(HMI 2002, 2004, 2005; Ofsted 2008)* of Ofsted's judgments about primary pupil achievement in design and technology appear to indicate fluctuation in, for example, good achievement. In 2001-2 achievement was judged to be good in 25% of schools, in 2002-3 achievement was "rarely judged to be good", by 2003-4 good achievement was up to 40% and the 2008 three year summary saw apparent signs of improvement but recognized good achievement in only around 33% of its sample. Has good achievement by pupils fluctuated so much? Are there other reasons why these judgments might fluctuate? Is there a margin of error in such judgments? Could it be sample size? Is it the nature of the data? Or is it those who are making the judgments? Significantly very good achievement is never referred to.

The position is no clearer in relation to the proportion of pupils judged to be average or satisfactory or to use Ofsted's phrase 'in line with expectations'. In 2001-2 this group was summarized as "at least satisfactory in the great majority of schools" and in 2002-3 "satisfactory or better in 90% of schools" however in 2003-4 no equivalent summary statement was made. References to unsatisfactory achievement in design and technology appear to have disappeared. In 2001-2002 achievement in design and technology was judged unsatisfactory in one school in six. In 2002-03 unsatisfactory achievement in lessons has diminished since last year but remains slightly more frequent at Key Stage 2 (7-11years) than at Key Stage 1 (5-7 years). In 2004 pupil achievement in more than 90% of schools was satisfactory leaving less than 10% unsatisfactory. In 2008 there was reference in one paragraph to 'the rare instances where achievement was inadequate." It is possible that over the years there is a discernable trend of improvement, though based on the quotes above, it is difficult to see. If unsatisfactory achievement has diminished significantly, this in itself could be seen as a sign of improvement. It may reinforce a view of the vast majority of achievement in design and technology is clustered around average or satisfactory with limited evidence of achievement outside the average.

Difficulties faced by inspectors making judgments about non-core subjects like design and technology were noted by Ofsted in June 1998.

Ofsted recognizes that inspectors face particular problems in judging and grading attainment in the non-core subjects in primary schools. This is because:

- National performance data do not exist for use by inspectors as points of reference
- The evidence upon which inspectors base their judgments may be more limited than that collected in core subjects in primary schools and across the curriculum in secondary school inspections
- The term national standards and expectations used in the Framework do not have a definitive, nationally agreed meaning. *(Ofsted 1998)*

Has the position changed since 1998? There was a change to the National Curriculum's version of design and technology *(DfEE/QCA 1999)* but there has been a period during which schools have had the opportunity to become familiar with design and technology. A significant contribution has come from the national scheme of work *(QCA 2001)* and materials produced by Nuffield (2001) and DATA (1999). Individual school inspection events have now shrunk in size and only comment on subjects such as design and technology if they considered to be particularly weak or strong. Sarah Drake (2008) has condemned the present English school inspection regime pointing out that considerable areas of pupils experience are not now reported on, "other subjects can slip unnoticed." (p.21)

In 2005 HMCI (2005) reported that in design and technology, pupils at different levels of attainment "generally fulfill their potential in designing and making." But that some more able pupils towards the end of Key Stage 2 (9-11 year olds) "are not adequately stretched". In 2008 Ofsted referred more than once to shortcomings in teacher knowledge limiting their capacity to challenge pupils. "Staff lacked skills in design and technology and pupils had too little time to engage in designing and making." *(Ofsted 2008).*

It appears that the various Ofsted reports point to increasing and now high proportions of what they might call average achievement or achievement in line with expectations in design and technology. Put another way, inspectors did not observe large groups of low or high achieving pupils in design and technology. Does this mean that for one reason or another, more average design and technology achievement is occurring? Does this mean that there are very few high attainers in design and technology?

Throughout this period a number of issues have been regularly referred to as influential on the impact of design and technology in primary schools, these include: time; subject status; teacher expertise and teacher confidence. Time available can be linked to subject status. In 2005 HMI (2005) noted that inspectors were unable to judge teaching directly because they found that during their visits to many schools, no design and technology was occurring "time varies from very little to one hour per week."(HMI 2008). In 2008 Ofsted identified that sufficient time was a critical issue, recognizing that head teachers might feel they had to focus attention on literacy and numeracy. They recognized that no schools visited had an inadequate design and technology curriculum which they felt was better than previous years when over half the schools did not allocate sufficient time to design and technology. However it was not clear whether they were able to check that the planned curriculum was being taught.

In 2004 Ofsted concluded that teachers' subject knowledge and consequently their confidence was lacking. In 2007 Her Majesty's Chief Inspector (2007) commented on primary school subjects where the weak subject knowledge of teachers often leads to excessive reliance on mundane tasks, too much focus on knowledge of content and not enough on understanding and weakness in assessment. A year later Ofsted (2008) concluded that "…many teachers do not have sufficient subject knowledge for teaching the more technologically demanding aspects of design and technology or for helping pupils with more difficult technical problems which arise routinely."

For the majority of schools the QCA scheme (2001) has been the basis of the design and technology curriculum. In 2008 Ofsted referred to better performing schools where the curriculum was enhanced by links between design and technology and other subjects and to topics which provided meaningful contexts for designing and making.

Assessment was judged in consecutive reports to be behind that occurring in other subjects (Ofsted, 2008; HMI, 2007). Ofsted reported that in many schools assessment was weaker, either failing to assess or record in depth, insecure assessment and lack of pupil involvement. The better schools, judged by Ofsted, were observed to collect, record and use assessment data and in these schools pupils knew what level they were at and feedback from adults told them how to improve (Ofsted, 2008).

Survey of Subject Coordinators

Recently ten design and technology subject coordinators completed a questionnaire and six others dealt with the same questions in a focussed interview. The group included teachers from each year group other than Year 5 (9-10 year olds). The questions opened with one which asked whether they felt design and technology had they same proportion of higher attainers as other subjects. Very few of the sixteen teachers felt they could answer (nine people did not respond). One said "I don't think so… ...we just don't know what each level (in design and technology) looks like". Two responded with "probably" another with "maybe", another said no, "due to design and technology's low profile and lack of staff knowledge".

When asked about the degree of high and low attainment they are aware of in design and technology, five replied that they did not know. One felt that there was a wide gap between higher and lower achievers. One said "I judge the children on how independent the children are and how creative their ideas are." Five of the sample described a narrow spread with only two or three pupils seen as higher and lower attainers "one or two pupils are above and a similar number below and the rest hovering in between". One teacher gave a higher proportion of pupils "10% of the class in each category". Two felt there was a limited amount of higher achievement with a higher proportion exhibiting lower achievement one teacher referring to what they felt were obvious "poor scissor skills". Another felt that at Key Stage One there was little spread evident. Overall therefore there seem to be suggestions here that the spread of achievement and some indication that the spread of achievement may be screwed toward lower achievement.

A question focussed on the amount of assessment they conduct of pupil's design and technology work. Most responded that it was conducted at the end of each unit of design and technology work or at the end of each term, one teacher spoke of assessing design and technology twice each year, another said that she hadn't as yet, one candidly admitted that there was no formal assessment in place and another that she completes it at the time but it's a "bit hit and miss". Some of the teachers mentioned how they go about assessment in design and technology but this was limited to the following: making notes in lessons, end of topic evaluation, noting progress during lessons. Asked about how recently they had looked at the design and technology NC levels (DfEE/QCA, 1999) they admitted that is was rare, if ever. Responses included "not recently", "never", "can't remember" and "on my PGCE training". These responses about assessment almost certainly reflect the status of design and technology in some schools, illustrated by the extent to which aspects of English and mathematics dominate the curriculum. Levels of confidence and subject knowledge of primary school teachers in design and technology may also influence. If there is a problem with assessment of design and technology this might mitigate against teachers' capacity to identify high attainers in design and technology and teach the subject in a way which would facilitate high attainment, for example, teaching aspects of design and setting challenging problems.

Interesting responses resulted from two questions which asked about core subjects and about design and technology. Firstly whether the teachers felt they could describe above average achievement in English and maths for older primary pupils. Eight said yes, five said no and three responses were nil.

As a group the teachers were happier in the following question to attempt to describe above average attainment in design and technology at Year 6. This question elicited the most varied responses including ones referring to skills: "skills"; "able to use own skills and apply them"; "application of knowledge and understanding and skills to new situation", "creative thinking skills", "annotating diagrams", "good finish", "producing good quality pieces of work", "clear planning", others referred to knowledge: "application of knowledge", "understanding and skills" and several to design: "ability to design for a purpose and critically evaluate it; "pupils are able to design for specific purpose independently", "reflective evaluation and ability to give appropriate suggestions for future improvements", "creative ideas", "changes designs when not suited to purpose without prompting"; "understanding of criteria", "probably those able to identify and plan to design features", "be willing to change design and carry out evaluations well". A final set of responses referred to a capacity to work more independently including "more independence" (x2), "taking things further", "working beyond the brief", "ability to solve problems". As well as five nil responses one teacher was not sure and another said "I couldn't". It was clear that two of these teachers felt unable to do this and that whilst others were cautious several ideas about what higher attainment might be. Their responses reflect a view one might hold about attainment above the norm observed in primary schools. They included some of the language which is used to describe Level five (DfEE/QCA, 1999) e.g. planning, application of knowledge, critical evaluation but also language and ideas which are broader but perhaps equally valid e.g. independence, creative, good quality, clear. It may be that the constrained language of level statements for assessment, are themselves a barrier to these teachers.

A question linking to the above then asked what the teachers felt was critical about the transition from Level 4 to 5 elicited less responses. Aside from four teachers who responded "no" and seven nil responses teachers echoed the language of the previous question in reference to skills and independence "able to use own skills and apply them", "modifications and justification"; "to use a wider range of designing and making skills to produce a finished product fit for purpose"; "independent research"; "ability to improve on own work", "recognise where improvement can be made"; "understanding of purpose"; "Using own initiative"; "more independence" (x2). Perhaps the clearest of them here is independence which is probably a generic aim for most age ranges but which is certainly applicable in design and technology and particularly so to pupils who might be higher attainers at this stage.

Design and technology in England began its eighteen year history being lauded as part of the original broad and balanced National Curriculum (DfEE/QCA, 1989). Following serious difficulties encountered by non specialist primary teachers, the subject was remodelled (DfEE/QCA, 1999). The National Curriculum (DFEE/QCA, 1999) itself has been progressively sidelined or undermined by strategies, extras, initiatives and forms of accountability which have focussed attention on literacy and numeracy squeezing curricular time available.

Why ask the question in the title of this paper? The fact that Ofsted have made assertions about perceived improvements is reason enough to seek to clarify the situation. Perhaps most important is that design and technology is a worthwhile subject and pupil achievement in it ought to be the highest it can be. There appear to be a mixed picture in which national inspection summaries claim some improvements whilst repeatedly referring to limited teacher knowledge, shortcomings in school planning for design and technology and of assessment of the subject. Comments reported here from teachers suggest that there may be a considerable difficulty with pupil achievement; difficulty promoting it and difficulty recognising it. Much of this difficulty stems from a crowded timetable, a poorly trained professional body of teachers and aspects of school accountability which focus on high stakes assessment of aspects of English and mathematics.

Where there is limited time for design and technology one might ask whether there is sufficient time for higher attainment in design and technology to develop; for higher attainment to evidence itself or for teachers to observe it. With a design and technology curriculum founded on the present version of the National Curriculum (DFEE/QCA, 1999) and for some years dominated by the QCA scheme (QCA, 1998) we must, where achievement appears limited, question the suitability of this basis for developing higher achievement in the subject. As we move towards a period of change where schools begin to move to theme based and/or skills based curricular (Rose, 2009) will these developing alternatives be an improvement? How will an already weak subject unable perhaps to develop high attainment, be transformed without considerable emphasis on teacher development?

The worth of primary design and technology is recognised my many (Barlex, 2003; de Waal, Ofsted, 2008) it is a subject which contributes much to personal achievement in skills and knowledge and understanding. It is a subject for boys and girls and a subject, which allows other subjects to be utilised and further developed. Society needs people who are confident and effective in the designed and made world and as part of that it requires the very best in this field to achieve and make their own unique extra contribution.

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Critical Pedagogy as a way to Close the 'Gender' Gap in Design and Technology Education: Disseminating the Progress of the UPDATE Project: A European Union Funded Longitudinal Research Study

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Abstract

This paper follows on from our paper "Exploring issues related to gender in primary technology education: Introducing UPDATE: A European Union funded three year longitudinal research study" that was presented and published in the proceedings of the last CRIPT conference held in 2007. For a more detailed understanding of UPDATE project, we recommend that readers may wish to refer to that paper initially; we do not have the space to offer the same amount of detail in this presentation.

UPDATE stands for Understanding and Providing a Developmental Approach to Technology Education and is a European Union funded project which started in January of 2007 and will complete in December 2009. The constitution of the project team is a European consortium of sixteen institutions from eleven different countries. The University of Jyväskylä in Finland acts as the Coordinator of the project.

The project consortium has created a unique developmental approach for technology education. Compared to many other projects that have tried to involve girls in technology, the UPDATE approach includes a strong focus on early childhood and primary education, phases in which attitudes are most often formed. From this understanding, it is becoming too late to start to try raising the interest of girls at secondary or later stages of education. Findings from the project suggest that with new, improved technology education practices it is possible to make technology and science more attractive for young people, promote their interest, and encourage critical and creative ways of thinking from the earliest stages.

As part of the rationale behind the project, the empirical research undertaken has been informed by contemporary literature. This paper will report specifically upon a review of the literature concerning issues related to gender in technology education and the concept of critical pedagogy.

Introduction

There are, and have been for some considerable time, many debates about the differences between female and male. These debates have, prior to the rise in feminist literature, tended to depict a society that is "male-dominated, male-identified, and male-centered" (Johnson, 1997: 5). In this patriarchal society, "the dominant message is that the human experience equals the male experience" (Kesselman, 2003: 9). Patriarchal societies are, moreover, predominantly hierarchical in nature (Kirk, 2009: 5), and any patriarchal hierarchy is, by definition, predicated upon a male power base. It is thus socially constructed and political in nature.

The patriarchal society is, according to Lerner (1986), not something that has evolved as a single event in history, nor indeed, is it a recent phenomenon. She argues that the:

> *"period of the 'establishment of patriarchy' was not one 'event' but a process developing over a period of nearly 2500 years, from app. 3100 to 600 B.C. It occurred even within the Ancient Near East at a different pace and at different times in several distinct societies" (8).*

If Lerner is correct, and we have no reason to dispute her claim, patriarchy has long been embedded in our psyche and therefore will be difficult to change. An important question to consider then, is whether we need to change it? Is that not just the way things are? Not according to Kirk (2009). In her recent book 'Gender and Information Technology', she convincingly sets about demyth-ifying some commonly held perceptions relating to gender. One of the myths she discusses constellates around the notion that "it's just the way things are" (5). This can be translated into the commonly held perception that 'technology, being a rational subject domain, is directed towards boys who are perceived to be: rational; aggressive; confident; dynamic; strong; hard; and task orientated. It is not for girls who are, on the other hand, perceived to be: emotional; submissive; manipulative; passive; weak; soft; and relationship orientated, and that is just the way things are'!

Given that we accept that the cultural shape of societies is influenced by many factors, societies are nevertheless "comprised of people and people participate in creating their societies" (ibid: 5). Moreover, societies in the modern world are structured around social institutions such as "law, medicine, business, language, education, and media [and it is] these social institutions that teach the values of the dominant culture" (ibid: 5). Formal education follows a similar structure to that of a patriarchal system: it is hierarchical and male dominated (in terms of power). It is rule driven and rational. Pedagogy within this system is based upon dominance rather than partnership. Policy dictates that schools should be accountable and young people are ranked according to 'ability'. Performance outcomes are given preference over learning outcomes. Design and technology education in particular tends to be vocational and task orientated rather than relationship orientated.

In this respect, schools become akin to machines that have, as their primary function from a policy makers' perspective, the production of a future workforce. These attributes are characteristic of a patriarchal system; education is a machine where people, both students and teachers, have prescribed roles; they are essentially cogs in an epistemology machine. Lines (2007) offers an interesting perspective on the process of education as a machine:

> *"It is not difficult to imagine the processes, forces and movements in education as machines. The practice of education, that is, formalised teaching and learning*

operates through contingencies of interest, of curriculum policies, assessment regimes, structured learning systems and instructional pedagogies that combine in order to process student learning according to established levels and standards. Education has certain 'industrial' characteristics that stand out: the actions of teaching and learning are repetitive (regardless of student difference); learning is organised around clearly defined templates of action; there is an obvious alignment with dominant functions informing pedagogy – for instance curriculum policy directives; and there are also specific areas of control or focus points that tend to dominate emergent forms – more particularly assessment systems that shape, format and generally mould and pattern criteria driven [performance] outcomes" (Lines: 3).

Attempts to redress this imbalance have, in the past, placed an emphasis on the notion of equality. This is made manifest in the way that design and technology is now open to both sexes whereas in the not too distant past, boys studied technical subjects while girls studied domestic science. This followed from early feminist arguments that "focused upon the unfairness of the fact that women [are] excluded from some central activities crucial to humanity – the defining activities of modern political identity – which men appear to be granted by natural fiat" (Chanter, 2006: 8). However, postmodern thinking takes a different view. Chanter poses the question that if women are to be given equality with men, or boys in this case, then what boys are they to be equal with? Certainly not "oppressed, disenfranchised, or disadvantaged [ones]" (ibid: 8). Both Murphy (2006) and Paechter (2007) argue that technology education spaces in schools are not only masculine preserves but trades-based vocationally- orientated, working-class, masculine preserves. Girls, we argue, do not necessarily want equality with boys in this sense. They do, however, want to be involved in a more broadly defined design and technology education curriculum that considers more reflective dimensions, such as values and social contexts, located within the technology domain.

Some suggestions based upon a review of the literature for the UPDATE project

A review of literature undertaken as part of the UPDATE project has revealed that whilst biological sex may differentiate between the concept of male and female (and even that is problematic if we consider issues related to transgender), the concept of gender itself, is socially constructed. This being so, it can be socially re-constructed.

Given that the dominant orthodoxy in terms of pedagogy (particularly in design and technology education) is patriarchal, behaviourist, inauthentic and prescriptive (Dakers, 2006), there exists a need to change pedagogy to something that will empower females. The UPDATE project suggests that this is best undertaken as early as possible.

Lunt (2009 in-press) suggests that we need to move away from a pedagogical model that is prescriptive towards one in which more account is taken of the learners' own perceptions about technology. However, she suggests that studies relating to children's perceptions about technology are relatively few in number, particularly when the perceptions of younger children are taken into account. In addition, she refers to the few empirical studies that indicate, in line with Murphy and Paechter above, that children do tend to perceive technology education as more functionally orientated. Issues relating to values and social contexts do not appear to be given any place in the primary school learning space.

Lunt goes on to argue that research into education has moved, over the past fifteen years, from considering the learner as a passive recipient of knowledge to one in which the learner has a greater degree of agency. She makes a case for the emergence of 'pupil voice' and even goes so far as to suggest that children should be afforded some space to "criticise the dominant [patriarchal] power structures". She suggests that children in the elementary sector do appear to enjoy technology education, however, enjoyment notwithstanding, she does express serious concerns that the delivery of technology education in the primary sector appears to emphasise the "practical rather than reflective dimensions of technology education". Lunt's research also reveals a need for more authentic learning experiences to be embedded into the learning space. These experiences, she concludes, need to involve "wider learning objectives, such as developing a critical understanding of the technological world and its impact on how we live our lives". She goes on to advocate a technology curriculum that involves the development of a technological literacy, a literacy that empowers learners by engaging them in a dialogue about issues relating to ethics and sustainability.

The literature considered in the UPDATE project endorses the views expressed by Lunt and, by way of a paradigm shift from the status quo, critical pedagogy may offer a model more orientated towards the dialogic form of pedagogy advocated by Lunt.

Critical Pedagogy

Paulo Freire is considered by many to be one of the most influential thinkers in education. His thesis has been described as a humanist form of education where not only has the learner agency, the learning itself is considered to be meaningful. A philosophy of critical pedagogy has emerged out of Freire's theories of education. Some of the major recurring themes to be found in his corpus include his long-held disdain for any pedagological framework considered and practiced as a transmission of knowledge from active teacher to passive student, which is essentially behaviourist in nature. He refers to this style of teaching as the 'banking' concept. In his own words, he articulates this now famous metaphor as follows:

"Education thus becomes an act of depositing, in which the students are the depositories and the teacher is the

depositor. Instead of communicating, the teacher issues communiqués and makes deposits which the students patiently receive, memorise, and repeat…In the banking concept of education, knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing…The more the students work at storing the deposits entrusted to them, the less they develop the critical consciousness which would result from their intervention in the world as transformers of that world (Freire, 1970: 53-54)".

Freire sees this transmission style of pedagogy as essentially domesticating students or inculcating them into a pre-established cultural system. Another recurring theme is Freire's notion of the "unfinishedness" of the human person. Here, Freire argues that education, or learning, or 'formation' as he calls it is more than, and must be "more than a question of training a student to be dextrous or competent" (Freire, 2001: 22).

The significant thing about Freire is that teaching and learning is not a one way process. It is social in its nature and thus, political. Those teachers who stand opposed to this ontology, whether implicitly or explicitly, fail to acknowledge that teaching and learning is a dynamic process that cannot be reduced to some static set of rules and procedures. Teaching and learning, like technology itself, is not neutral, and is, consequently, subject to interpretation. Design and technology classrooms that fail to recognise this die as spaces that foster creativity and intellectual development. They become, as Shor (1992) articulates, "delivery systems for lifeless bodies of knowledge" (20). Shor goes on: "Instead of transferring facts and skills from teachers to students, a Freirian class invites students to think critically about subject matter, doctrines, the learning process itself, and their [students] society…In the liberating classroom suggested by Freire's ideas, teachers pose problems derived from student life, social issues, and academic subjects, in a mutually created dialogue" (25).

Embedding critical pedagogy into design and technology education will not only create a learning space conducive to female learning, it will create a learning space that converts the mere transmission of prescribed technological facts, into a learning space charged with controversy and debate that is both informed by, and meaningful to the participants.

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Notes

We have substituted the term 'performance' for 'learning' as was originally in Lines' quotation. We believe that there is a significant emphasis being given today, to the assessment of performance over learning in design and technology education. What we mean by this is that young people are being assessed more on procedural and developmental knowledge acquisition. This type of knowledge acquisition seeks to establish a grasp of prescribed skills and facts rather than the type of learning associated with critical pedagogy. This type of learning relates more to ethical and political issues and this type of pedagogy, according to the literature, is preferred by girls to that associated with performance.

Cognitive Apprenticeship as a Pedagogical Framework for Technology Education

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Abstract

"Cognitive apprenticeship" is a pedagogical framework proposed by Collins (2006) as a comprehensive learning environment for a range of curriculum areas. It is based on the apprenticeship model of teaching and learning, but extends it to include methods for supporting a whole class to learn from an expert (teacher) through demonstration, coaching, reflection, and exploration, in order to build expertise as a community of practice. This research paper describes the use of the cognitive apprenticeship framework to analyse the practices of teacher and students in a technology unit in a New Zealand primary school. The analysis provides evidence that the cognitive apprenticeship model is a promising approach for choosing and developing effective pedagogical strategies. In this study it is used as a tool to analyse the teacher's strategies, and indicate directions for further development of the technology unit.

Introduction

New developments in technology curricula in New Zealand and other countries have highlighted the need for greater attention to pedagogical strategies for technology education. There is a need in the new curricula for more modern approaches involving "a greater focus on learning goals, creativity, risk-taking and higher order reasoning skills, … experimentation and creativity … and technological enquiry and exploration" (Dow, 2006, p. 313 & 316). There should also be opportunities for the investigation of technological issues and their impact on society (Barlex, 2006). However, a new curriculum does not automatically produce improvements in pedagogy:

> *"Although a number of countries have new and innovative curricula for technology education, in terms of pedagogy, these are clearly too often subverted by teachers' reluctance to change"* (Dow, 2006, p. 312)

Research has shown that many primary teachers are not confident with the content knowledge of technology, and that more attention to content knowledge would enhance their teaching through improved formative interactions (Jones & Moreland, 2004). Another approach is to begin with primary teachers' existing strengths in pedagogical knowledge and examine how these could be re-framed for teaching technology. Primary teachers have the opportunity to draw from a repertoire of pedagogical strategies they have built from theory and practice across a range of curriculum subjects.

Some of the pedagogical strategies that have been recommended for technology education are:
- Project-based learning (Barlex, 2006)
- Problem-solving (Williams, 2000)
- Modelling (Drain & Kissling, 2007)
- Product analysis (Stables, 2000)
- Starting point approach (Good & Jarvenin, 2007)

Most of these strategies have proved to be successful in some aspects, but there is a need for a more comprehensive framework that integrates them and provides a clear relationship between teacher, students, and the outside world of technology and technologists. Cognitive apprenticeship has been suggested as a suitable learning environment for technology education (Duncan, 1996). It is based on the traditional concept of apprenticeship, but extends it to whole class teaching and includes cognitive skills and processes in addition to physical ones (Collins, 2006). Apprenticeship can be viewed as an instructional paradigm whereby "a novice gets to be an expert through the mechanism of acculturation into the world of the expert" (Farnham-Higgerty, 1994).

Cognitive apprenticeship arises from situated cognition theory, which asserts that students learn best when they are immersed in real life contexts and engage with authentic problems (Brown, Collins & Duguid, 1989). Students in a situated learning environment have access to a community of practice of peers and experts. In technology education this engagement in practice would enable students to become part of a community of learning where they could access technological knowledge from other practitioners, both within and outside of the school, and eventually contribute their own knowledge to the community. This community of learning could be developed with the support of the teacher through the cognitive apprenticeship model.

The cognitive apprenticeship framework provides principles that ensure students are supported in their progress from their introduction to the domain of technology as novices, through to exploration and competence. Collins explains that "before apprenticeship methods can be applied to learn cognitive skills, the learning environment has to be changed to make these internal thought processes externally visible" (Collins, 2006, p.48). In technology education many opportunities exist for cognitive processes to be revealed through the ongoing development of technological outcomes (Compton & Harwood, 2005; Kimbell, Stables, Wheeler, Wosniak and Kelly 1991).

The cognitive apprenticeship framework has four dimensions, with associated principles, as shown in Table 1 (over).

Cognitive apprenticeship has been suggested as a pedagogical framework for technology education (Duncan, 1996), but little research has been done to relate it to actual classroom or workshop practice. In this study the cognitive apprenticeship framework was used to analyse the practices of a teacher and her students in a year 5 & 6 New Zealand primary classroom after they had completed a technology unit called Pop-up Books. The unit enabled the class to gain knowledge about the nature of "paper engineering", and the mechanisms of pop-up books, in order that each student could

Table 1: Principles for Designing Cognitive Apprenticeship Environments *(Collins, 2006)*	
Content	**Types of knowledge required for expertise**
Domain knowledge	Subject matter specific concepts, facts, and procedures
Heuristic strategies	Generally applicable techniques for accomplishing tasks
Control strategies	General approaches for directing one's solution process
Learning strategies	Knowledge about how to learn new concepts, facts and procedures
Method	**Ways to promote the development of expertise**
Modeling	Teacher performs a task so students can observe
Coaching	Teacher observes and facilitates while students perform a task
Scaffolding	Teacher provides support to help the student perform a task
Articulation	Teacher encourages students to verbalize their knowledge and thinking
Reflection	Teacher enables students to compare their performance with others
Exploration	Teacher invites students to pose and solve their own problems
Sequencing	**Keys to ordering learning activities**
Increasing complexity	Meaningful tasks gradually increasing in difficulty
Increasing diversity	Practice in a variety of situations to emphasize broad application
Global to local skills	Focus on conceptualizing the whole task before executing the parts
Sociology	**Social characteristics of learning environments**
Situated learning	Students learn in the context of working on realistic tasks
Community of practice	Communication about different ways to accomplish meaningful tasks
Intrinsic motivation	Students set personal goals to seek skills and solutions
Cooperation	Students work together to accomplish their goals

produce a pop-up book for younger children in the school. The technology unit was integrated with an English unit, in order for the children to plan the written and pictorial content to be integrated with the technological design. The teacher planned the technology unit with the following structure (abbreviated):

Pop-up Book Unit

- **Week 1:** Starter activity – photograph one mechanism each from a pop-up book
- **Week 2:** Categorising mechanisms – students sort photos by mechanism type
- **Week 3:** Engineers – a talk by neighbourhood engineers
- **Weeks 4-5:** Modelling – teacher models how to make the mechanisms, students practice
- **Week 6:** Pop-up cards – design the card, make card, evaluate with Plus-Minus-Improve
- **Week 7:** Video – book designer shows how he designs pop-up books
- **Week 8:** Planning pop-up book – discuss criteria, draft on storyboards
- **Weeks 9-11:** Making pop-up book – mock-up, evaluate, make pages, bind book

The unit was planned with reference to the New Zealand technology curriculum of 1999-2009 (Ministry of Education, 1995), which promotes a technological practice approach (Compton & Harwood, 2005; Compton & France, 2007). The teacher in this study decided that the class should complete a series of teacher-directed lessons before engaging in technological practice projects.

Methodology

This research was a case study of a Year 5 and 6 New Zealand primary school class and their teacher during a technology unit. A comprehensive photographic and video record of all activities was made throughout the unit. The teacher's whiteboard was photographed, and also the pages of student workbooks and their finished products. Selected photographs were used for semi-structured photo-elicitation interviews (Epstein, Stevens, McKeever, & Baruchel, 2006) with each child and the teacher at the end of the unit. The data enabled analysis of the activities using the principles of the cognitive apprenticeship framework (Collins, 2006). An interpretivist paradigm was used (Cohen, Manion, & Morrison, 2000; Lichtman, 2006), whereby the researcher combined evidence to interpret the pedagogical methods of each learning activity.

A qualitative analysis procedure recommended by Lichtman (2006) was employed for coding and categorizing the data by interpreting, reviewing and refining, and then developing themes or concepts from it. A matrix was designed as an instrument for analysing the activities of the unit by recording major and minor cognitive apprenticeship principles evident in each activity (see Appendix 1).

Results

The results of the analysis are shown in table form in Appendix 1. This provides evidence that all of the principles of the cognitive apprenticeship framework were present in various combinations

Photo 1

Photo 2

in the activities of this technology unit. However, the distribution and emphasis of the principles varied greatly in the different phases, stages and activities of the unit.

The analysis has enabled the researcher to divide the unit into two main phases – focused tasks – and project tasks. The children's activities were of a more independent and sustained nature during the project phase, and there is a clear change in the pattern of principles revealed by the analysis matrix.

Phase 1: Focussed tasks

Phase 1 introduced the children to the nature of pop-up books as products, and prepared the children to be involved in a community of learning, which can be considered a student community of practice. The teacher planned and directed the activities of phase 1 to meet the learning intentions of her unit plan. She acknowledged that she was not confident of her technological expertise, but she had prepared and practiced sufficiently to demonstrate the activities she considered appropriate for the developmental progression of the children.

The teacher explained in an interview that the main purpose of the starter activity, photographing and presenting pop-up pages (Photos 1 and 2), was motivation, and its effectiveness was shown when several children called their pages "really interesting" or "really cool". The stimulus effect of examining products has been noted by Stables (2000), who suggests a "product analysis" approach that may help to raise the domain knowledge content.

The most extensive stage of phase 1 was a group of lessons where children made pop-up mechanisms from teacher demonstrations (photos 3 and 4). These activities had domain knowledge and heuristic functions, serving to acclimate (Alexander, 2003) the novice children into knowledge of the functions and production of paper mechanisms. To help the children make progress, the teacher adjusted subsequent lessons to focus on increasing complexity and increasing diversity. The children were involved in exploration as a learning strategy, and produced variations based on the initial mechanisms. When interviewed, most children showed that they understood the reasons for these activities, with children mentioning learning "about mechanisms" (domain knowledge), "how to make them" (heuristic knowledge) and "practicing" (learning strategies). Groups showed cooperation by contributing mechanisms to a shared a pop-up page, and the teacher organised expert groups

Photo 3

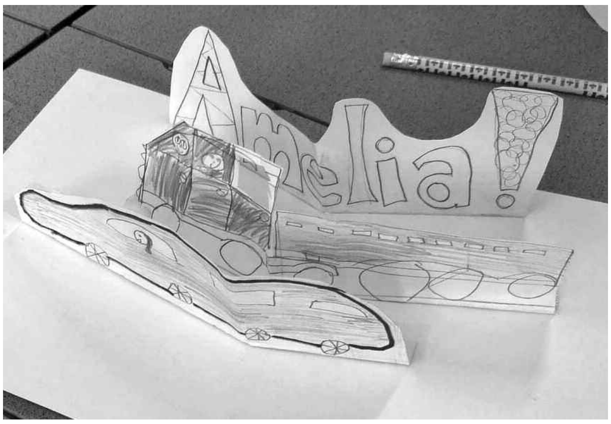

Photo 4

to find solutions to problems and share them with the class as a community of practice. The domain knowledge gained during these lessons was indicated mainly by the progression in the children's ability to make mechanisms and discuss the problems and solutions involved, for example a child said "this was my problem and my idea to fix it".

In a task based on printed instructions, the children found some words unfamiliar to them, so the teacher asked them to use dictionaries to build their terminological domain knowledge before attempting the model-making activity. The combination of text and pictures was then suitable for most children, but some still relied on the pictures:

> *"I found it a good way of working because it showed me what to do"* (Child 1a)

> *"The pictures [were most useful] … the words kind of confused me"* (Child 3b)

The talks by engineers, and the video of a book designer mainly had motivation effects. The children seemed interested in hearing professionals share personal domain knowledge with them. Few connections were seen in the children's projects, but some were able to recall relevant details – such as "Complicated. I think he must have practiced quite a lot" (Child 5d).

Phase 2: Project tasks

In this phase the children worked independently on their own projects, beginning with a small project and progressing to a larger one. They were now each involved in devising a creative concept and carrying it through to a functional outcome through technological practice.

The initial project of making a 1-page pop-up card was an opportunity for the teacher to introduce the children to a design process of plan-design-model-evaluate-make (control strategy) (photos 5 and 6). The children were expected to trial their designs through the medium of paper modeling. Some children said they could have made their card without planning, but most could see a purpose in the strategy of designing before making, which enabled a sequence of global to local skills. Many children showed through their problem-solving that they were developing their own heuristic knowledge, which may explain the absence of a domain knowledge pedagogical focus throughout this phase:

> *"I made it in paper first, just for practice. It didn't turn out well. Because it didn't pop up and wasn't the shape I expected it to be in"* (Child 6b)

In the second project the children designed and produced a 6-page pop-up book. Most children showed clear intrinsic motivation while working independently for several sessions, perhaps as a consequence of the situated learning effect of working on an authentic product for real stakeholders (Turnbull, 2002). In this stage children showed signs of developing a competent stage of expertise (Alexander, 2003) where they could apply their knowledge in practice. They were now able to have technical conversations as a community of practice and cooperate with peers in producing solutions. The teacher was still available in a coaching role for a final check of the paper mockups. The purpose of design drawings and modelling with paper mockups became clear to most of the children:

> *"That's just to help you know what you are going to do in your pop-up book"* (Child 7d)

> *"… if you made a mistake it was only your practice one"* (Child 1a)

Many of the children were able to produce daily journal entries about their progress and their intentions, but some children seemed unclear about the purpose of this. The children also completed evaluation templates, which had a clearer purpose for articulation and reflection:

Photo 5

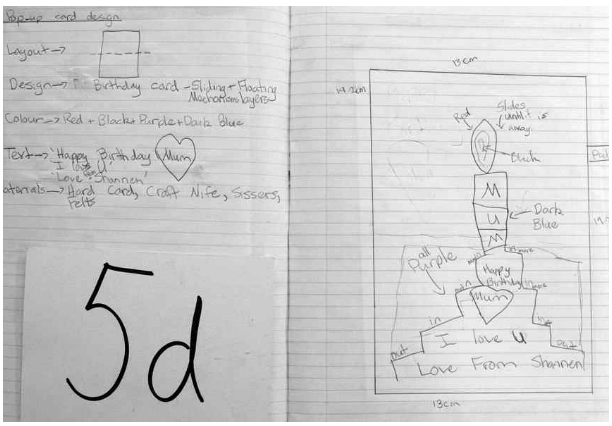

Photo 6

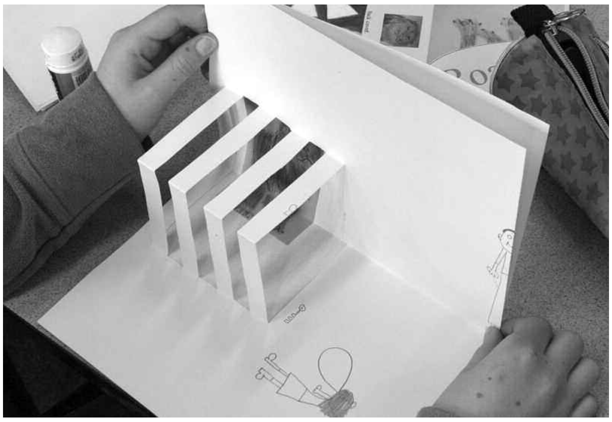

Photo 1

Photo 2

"To say what you think is good about your pop-up book. And to say if you made the pop-up book again what you would improve" (Child 1a)

Findings

The cognitive apprenticeship analysis reveals variations in the principles evident in the learning activities in the unit. The matrix (Appendix 1) reveals that there is a substantial change of pedagogical focus between phase 1 and phase 2 of the unit.

Phase 1 (Focussed Tasks) contains two main patterns:
- Motivation activated to raise interest in domain knowledge
- Modelling by teacher to introduce heuristic strategies and domain knowledge

Phase 2 (Project Tasks) shows two different patterns:
- Development of heuristic strategies through situated learning
- Evaluative activities for articulation and reflection

It can be seen that the pedagogical patterns of the two phases are complementary. This seems to reflect the teacher's decision to ensure the children were thoroughly prepared with knowledge of mechanisms, and skills to make them, before they engaged in independent technological practice.

The teacher considered that the main shortcoming of the unit was time running out at the end of term when many children rushed to complete their pop-up books. The cognitive apprenticeship analysis may be a useful tool for reassessing the balance of time between phase 1 and 2. It may help to identify which cognitive apprenticeship principles were most effective and which can be combined into single activities.

Weaknesses

Some confusion may be caused where the cognitive apprenticeship framework does not align with, or use the terminology of, some other conceptual frameworks. For example, technological content has been categorized elsewhere as conceptual and procedural knowledge (McCormick, 1997), or as physical, functional, means, and action knowledge (deVries, 2003). The way the term 'heuristics' is used in this framework is also different from how much of the technology literature would use it.

Conclusion

The cognitive apprenticeship framework was an effective tool for analyzing this technology unit, and could possibly be used as a planning tool to help refine the unit further. In this case study it provided the teacher with evidence that cognitive apprenticeship principles were already being utilized as a consequence of her own planning decisions, and therefore a baseline exists for further development. More work to align the framework with the terminology and concepts underpinning technology generally, and with the 2007 New Zealand technology curriculum in particular, would enhance its usefulness.

Implications

Identifying a teacher's existing pedagogical methods within a clear framework like cognitive apprenticeship may be a method to provide teachers with confidence that they can utilize many pedagogical strategies when teaching technology. It has the potential to reveal the ways that their strategies can be most purposefully applied in sequences or combinations that are effective for learning technological concepts and procedures, and engaging in technological practice.

Further research is needed to determine whether other primary teachers are also unknowingly employing cognitive apprenticeship principles in their teaching of technology as a consequence of their experience and their knowledge of pedagogical theory. Also, research is needed to determine the usefulness of the cognitive apprenticeship approach in planning a technology unit, and the effectiveness of these principles when they are modified to align with technology curriculum constructs and deliberately implemented in technology education.

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Appendix 1: Analysis of "Pop-up Books" technology unit using cognitive apprenticeship framework

Key:

■ major pedagogical role

▒ supporting pedagogical role

UNIT STRUCTURE				COGNITIVE APPRENTICESHIP: Content				Method						Sequencing			Sociology			
	Stage	Activity	Week	Domain knowledge	Heuristic strategies	Control strategies	Learning strategies	Modelling by teacher	Coaching	Scaffolding	Articulation	Reflection	Exploration	Increasing complexity	Increasing diversity	Global to local skills	Situated learning	Community of practice	Intrinsic motivation	Cooperation
FOCUSSED TASKS	1. Examining pop-up books	a. Photograph pop-up books	1	▒													▒		■	
		b. Present photos	1								▒							▒	▒	
		c. Groups categorise photos	2	▒								▒								▒
	2. Engineers	a. Engineers talk to class	3	▒								▒								▒
	3. Making pop-up mechanisms from teacher demon-strations	a. Make V-folds from demo	2	▒	■		▒	■	▒				▒							
		b. Make V-fold faces	3		▒		▒	■	▒				▒	■						
		c. Groups make V-fold pages	3		▒		▒	■			▒			▒	▒			▒		▒
		d. Make box-fold variations	4	▒	▒		▒	■					■		▒					
		e. Expert group presentations	4	▒	▒		▒	▒			▒		▒		▒			■		▒
		f. Learn to use craft knives	4		▒			▒	■								▒			
		g. Extension mechanisms	5	▒	▒			▒		▒				▒						
		h. Wall display	5	■														▒		
	4. Printed Instructions	a. Make tech vocab list	6	■	▒		▒	▒												
		b. Model from instructions	6		■			▒		▒										
	5. Video	a. Viewing + question sheet	6	▒						▒								▒	▒	
PROJECT TASKS	6. Designing and making a pop-up card	a. Design pop-up cards	6		▒	■				▒						▒	▒			
		b. Make paper mock-ups	6		■	▒	▒		▒	▒		▒	■		▒	■	▒			
		c. Make pop-up cards	7		■									▒			■		▒	
	7. Designing and making a pop-up book	a. Pop-up book criteria list	8					▒									▒	▒		
		b. Daily journal entry	8-10								▒	▒								
		c. Design pop-up books	9		▒	■				▒						▒	▒		▒	
		d. Make paper mock-ups	9		■	▒	▒		▒				■			■	■	▒	▒	▒
		e. Make pop-up books	10-11		■									▒			■		▒	
	8. Evaluation	a. Evaluate pop-up books	11							▒	▒	▒								
		b. Evaluate learning	11							▒	▒	▒								

What's In A Name 'CAPA': A Case of Design and Technology Education in Botswana Primary School

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Abstract

Creative and Performing Arts (CAPA) is a subject in Botswana primary schools, which draws its content from Art and Craft, Design and Technology, Drama, Dance, Music, and Physical Education. Its main aim among other things is to help pupils develop their creativity, aesthetic skills, psychomotor skills and the love for the arts.

In 1993, the second national commission on Education (RNPE) recommended a review of the primary curriculum to incorporate practical subjects. As a result of this recommendation, in 2002 CAPA was introduced.

This paper discusses the philosophical basis of the arts and of technology education. It questions the archaeology and the politics of integrating different subject areas and naming them CAPA. Given the limited content of design and technology in comparison to other subject areas in the CAPA syllabus, lack of design and technology in primary teacher training institutions, limited knowledge and skills by primary school teachers in this subject area, the authors argue that CAPA has come to stigmatize technology education further rather than to promote it. This has serious consequences for future technological literacy in Botswana.

Introduction

Prior to the introduction of CAPA in Botswana primary schools, art and craft, music, and physical education appeared in primary school timetables and taught without a curriculum or guidelines. Design and technology, as a relatively new subject was not included in the primary school timetable and not taught at that time. This, according to Maolosi and Molwane (2007) made the technology education foundation very weak because pupils need to be exposed to different technological concepts and careers at an early age.

In 1993, the second national commission on Education (RNPE) in Botswana recommended a review of the primary curriculum to incorporate practical subjects. As a result of this recommendation, in 2002 CAPA was introduced. Despite this positive development, the introduction of CAPA seem to be marred with political, economical and philosophical issues that threaten to stigmatize technology education further rather than to promote it and this has serious consequences for future technological literacy in Botswana.

Technology education in Botswana primary schools

Compton and Jones (2004) observed that just as different concepts of technology drive different critical agendas, they also drive curriculum development in technology education.

Technology education in Botswana primary schools is offered through CAPA, which draws its content from Art and Craft, Design and Technology, Home Economics, Business Studies, Drama, Dance, Music, and Physical Education. Subsuming technology education in a conglomerate of disciplines with differing epistemological underpinnings could not have happened by chance; it replicates the systems intentions or conceptions about technology in Botswana primary schools.

All the disciplines that make up the subject 'CAPA' are important in their own right, but the study of technology seem to be more important in many countries around the world (U.K, The Netherlands, New Zealand, Israel) where the study of technology is mandatory from primary school up to at least lower secondary school. Could the study of technology be important to these countries and many others but not to Botswana? Or is it just that the study of technology in Botswana is viewed as craft?

In 1996 design and technology was declared a core (mandatory) subject at junior secondary level in Botswana, even though this has not yet been implemented. In this technological era the role of technology education cannot be overemphasised. However, it is surprising that while the study of technology seems to be portrayed as an important subject at junior secondary level in Botswana, it does not seem so at the primary level where it is concealed in CAPA.

As Maolosi and Molwane (2007) observed, technology education has been neglected for a long time in Botswana primary schools. Equally the arts have been marginalized and only taught as enrichment curriculum. The introduction of CAPA, which integrates the neglected and the marginalized subject areas may be seen as a positive development in this regard, but concealing technology under the 'arts' will not bear much fruit. Moreover, there are many other issues posing challenges for these subject areas, some of which are discussed in this paper.

Fundamentals of Technology and of Art

The issue at hand is that for it to survive in the mainstream curriculum, technology education has to have a defined role in the wider agenda of general education in which there is so much competition from other subjects. While some technology educators (Barak, 2008; Wakes, 2008) believe that the role of technology education is to develop students' general higher-order intelephonelectual skills, some (Barlex, 2008; Marc de Vries, 2008) believe that this is a weak justification and does not bring out the uniqueness of technology education. According to Compton and Jones (2004) focusing on the more generic underpinnings of technology is becoming inevitable in ensuring such things as fitness for purpose and assessment of risks as traditional boundaries are crossed in the establishment of new technological outcomes.

Marc de Vries (2008) warned that it is risky to justify the position of technology education in the curriculum on the basis of general concepts and skills because, technology as a domain of knowledge and skills has characteristics that differ from those in other fields. According to Williams (2008), technology education develops students' general higher-order intelephonelectual skills in a particular context which concurrently develops a knowledge and understanding of the technological system.

A sound understanding of technology as a process that involves human decisions rather than natural necessities and the ability to use and critically assess technology is a crucial element of technology education intended to develop an informed, literate citizenship that can make sensible and considered decisions about technological activities in a technological world.

The arts are concerned in some way with capacities such as imaginativeness, creativity and self – expressiveness; these are mostly characteristic features of the aesthetics realm of experience and meaning. Technnology is a human endeavour driven by the overall purpose of intervening in the 'made' world to meet needs and realise opportunities. The arts are forms of human expression and communication in the 'imagined' world. Epistimologically, technological knowledge exists as distinct from, and fundamentally different to art. To bring the two together as one subject is a clear sign of technology perceived in a narrow way of taking a materialist artefactual focus.

According to Baird cited in Compton and Jones (2004), the epistemic criteria for judging technological knowledge should be referenced to the 'made' rather than to the 'natural' or 'imagined' world as is the case of science, and art and music respectively. Baird argues that technology is a situated and purposeful activity embedded in the made world and impacted on by social, cultural, environmental, political, and economic perspectives and contexts at both local and global levels (Compton and Jones, 2004) p.6).

Politicians and many people in decion making positions have a very limited understanding of what technology education is all about. Many perceive it in terms of technological artefacts; computers, cars, telephoneevision, mobile phones and so on. Often they do not see technology in terms of the knowledge and processes involved in creating and using these technological artefacts and in terms of the knowledge and processes involved in evaluating the various implications for society resulting from these technological artefacts and processes.

Challenges facing teachers in teaching CAPA

Maolosi and Molwane (2007), and Phibion (2006) observed the following similar challenges facing teachers in teaching CAPA.

Syllabus

The syllabus is intimidating and heavily loaded with shallow content from each of these many subject areas, resulting in reduced time for each area. The langauge used is above the learners level of understanding. Integration is problematic since these subject areas are separated as modules.

Teacher training

Teachers are not trained to sufficiently handle all subject areas in the CAPA syllabus as some areas (design and technology, and business studies) are not offered in Botswana primary colleges of education (primary teacher trainig colleges). As a result some teachers teach it selectively or not at all. At the moment no inservice training is offered to these teachers.

Resources

The subject suffers from a severe lack of resources (laboratories, books, materials and equipment, and tools) across all subject areas. In this situation those subject areas like design and technology that requires specialist equipment suffer the most.

Conclusion

While the introduction of CAPA may be seen as a well-thought through government intiative which is in line with international trends of providing sound primary education for a literate, numerate and technologically literate society (Maolosi and Molwane, 2007), lack of action, poor implementation and lack of resources may frustrate this initiative.

Over and above all these problems, technology education has been experiencing a decline in enrolment at levels above primary education (Mmegi Online, 2007, Vol. 24 No. 107) and unless something is done the situation is going to get worse rather than better.

Recommendations

Teachers are very important change agents when it comes to curriculum lobbying; without teachers trained to teach design and technology in primary schools, this subject area will remain isolated and maginalized in the already marginalized area of the curriculum. Developing a primary design and technology teacher training programme is now overdue in teacher training colleges, and there is now need to develop an accelerated teacher training programme to prepare teachers for this subject area.

It is hypocritical of government to have design and technonology among the core areas at post primary school level, and conceal it in the midst of the arts at primary school level. We recommend that design and technology should be a seperate subject at primary school taking into consideration that technology alone is such a wide/broad area including food, textile, graphical, materials, systems and Information and Communications Technologies.

Resourcing a technology education programme is a costly undertaking that requires total commitment and technological know-how. It would be irresponsible of government to try to resource primary schools to offer technological studies without first deploying a well trained personnel to teach and to maintain good resource audit records. It is recommended here that the introduction of technology education at primary school or any level at all should be preceded by staff training and not the other way round as is the case with the current 'CAPA'.

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  PATT 20 Conference, Telephone Avive, Isarael


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Design and Technology in a Cross-curricular Future: What Do We Have to Offer?

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Abstract

This paper reports on the first phase of a project investigating the current "state of play" of design and technology (D&T) within a random sample of primary schools in South East England. The involvement of trainee teachers in the project was one of its key elements. The students were equipped with a questionnaire, designed to enable them to interview the design and technology co-ordinator in their second school experience placement school. They also completed a parallel questionnaire, which sought to ascertain their own viewpoints and their reflections on their learning experiences on placement.

The analysis of this data indicates a mixed pattern of design and technology teaching in local schools. As one might imagine, some of the responses from schools and students were impressive and heartening, others less so. In response to the question "If D&T were wiped off the curriculum tomorrow, how would the teachers in your school react?" the responses were as wide as "they'd be outraged!!" through to "I don't think they'd even notice" to "relieved". When we wrote the questionnaire in 2007, we had no idea, of course, of the issues raised by the national reviews of primary education in England or how pertinent to the debate over the future of design and technology some of our questions might be.

Introduction

The context for the research was the trend, now gathering apace, for primary schools in England to be pursuing various forms of cross-curricular teaching. Anecdotally, in conversation with teachers in schools, we had gained the impression that some schools had already moved considerably towards cross-curricular topic working, which they frequently referred to as "the creative curriculum" whereas others are watching to see how this works out in practice in schools in their area. Even amongst those who see themselves as making this transition, a range of approaches are in operation. Some schools have simply made links between different parts of the QCA schemes of work, so that joined-up learning occurs, whereas others see themselves as now "teaching the National Curriculum, not QCA". Other schools define themselves as following a "skills based" approach.

Our intention was that this research would provide us with an understanding of the way design and technology is currently developing in local schools, so that we would be able to make recommendations and provide active curriculum support as the terms of the new National Curriculum become clarified. Our two-year research project has revealed a patchwork of practice across a random sample of schools with whom we, as a university faculty of education, work in partnership. The schools' perception of themselves is as much a driver to change, it would seem, as how the objective viewer might place them.

There have been perennial concerns about the quality of design and technology teaching, especially in primary schools, despite the subject being highly popular with pupils. The media reported, yet again, that Ofsted reports indicated that schools were not providing high quality design and technology for most pupils:

> *"improvement in pupils' achievements in both primary and secondary schools, although at least two thirds of primaries and a third of the secondary schools have still not realised the potential of design and technology to help all learners become confident and capable members of a technologically advanced society."*
> PublicNet (accessed 30/03/2009)

As the new National Curriculum for primary schools in England has taken shape, so the context of our research has become increasingly apposite. As design & technology lecturers with a deep commitment to our field, the authors of this paper feel an increased sense of concern about the future of the subject. We are concerned that design and technology may either be subsumed under generic topic work or be seen simply as applied science. Since this research was conducted, the writing and consultation process of the new National Curriculum for primary schools in England has unfolded. We have watched design & technology be bounced around within the model, from having its own slice of the "pie" to its concepts and processes being separated and scattered across the new Areas of Learning.

Although hands-on learning and practical work in schools will continue, we are concerned for the loss of the essential aspects of design & technology in our primary schools. These include opportunities to design functional products, to demonstrate innovative solutions to human problems, and engage in future-oriented creative responses to possibilities within the made world (Parkinson, 2007). All of these allow children to feel in charge of their own learning and be able to make choices about products and processes, but there is also, as Howe, Davies and Ritchie (2001) uphold, the contribution of design and technology learning to creativity, culture and citizenship.

Research Context

The aims of our research were to discover:

- The extent to which design & technology was integrated with other subjects through project work and how this affected teachers' view of design activity;
- If, where and how design activity was to be found in lessons other than design & technology;
- Were design skills moving out into other areas of the curriculum or (we unfortunately suspected) being eroded as design and technology was being interpreted as "practical activities"?

The paper reports on findings of the first year of a two-year research project (2007-2009) funded through a Research Informed Teaching Grant from the authors' institution. The nature of the funding for this project demanded that:

- Initial Teacher Education students were involved in the research process in order to inform their learning.
- The research directly informed our own practice and so enhanced the experience of all students on our course, not just those involved in the research.

The students involved in the study had all chosen design and technology as one of their two options courses in year 2 of their B.A. (Hons) with Qualified Teacher Status course. In 2008 we had 31 students, through whom we conducted a random survey of 31 primary schools in South East England. The schools were those to which these year 2 students were allocated by our Partnership Office, with consideration for practical issues such as distance from home or transport availability, and not related to the students' option subjects. Thus we had no way of knowing what kind of design and technology teaching experience they would have, if any. We were hoping that one result of being directly involved in research into current practice in schools would be an answer in the affirmative to Davies' (2000) question: *Can Student Teachers contribute to the Survival of Design and Technology in the Primary Classroom?* In fact, in answer to our question as to how much design and technology the children experienced whilst the students were on placement, one student responded: *"only when I did it!"* However, unlike Cross (2006) we did not set out to explore issues relating to pedagogy, although, not surprisingly, our students did make comments about the kind of teaching that they saw.

Figures 1 and 2 show the demographics of the schools involved in the study: the majority being rural schools, with roughly even numbers of urban, sub-urban and mixed. That four of the schools have less than one class per year group reflects the falling rolls within Kent schools that has been occurring for some years and in response the Local Authority has been combining and closing down small rural schools.

All the students were able to find someone to complete the form, although this was not always a design and technology co-ordinator and one student found it really hard to find someone to do so. Most students reported that the questionnaire was easy to complete and that the teachers were most helpful and willing to be participants. Since not all the teachers interviewed were design and technology co-ordinators, they are referred to as "respondents" in this paper. One co-ordinator was sufficiently enthused and supportive to devise her own shortened version to distribute to other staff *"Dear All, L, S's student has to complete a questionnaire as part of her course. I hope you wouldn't mind answering just a few questions…"* and encouraged the student to devise a questionnaire to ascertain the pupils' viewpoints. Another thanked us for such a well structured and though provoking questionnaire and gave us a "smiley". Others, naturally showed less enthusiasm, both for completing the questionnaire and for the subject they co-ordinated.

Figure 1: Catchment Area

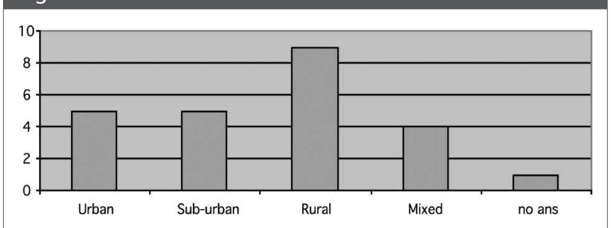
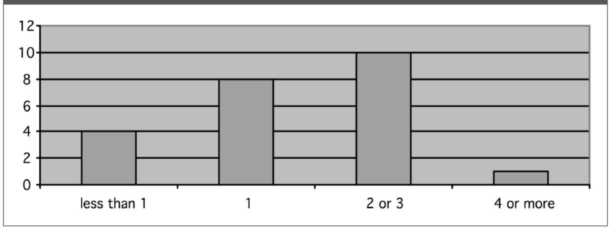


Figure 2: School Size



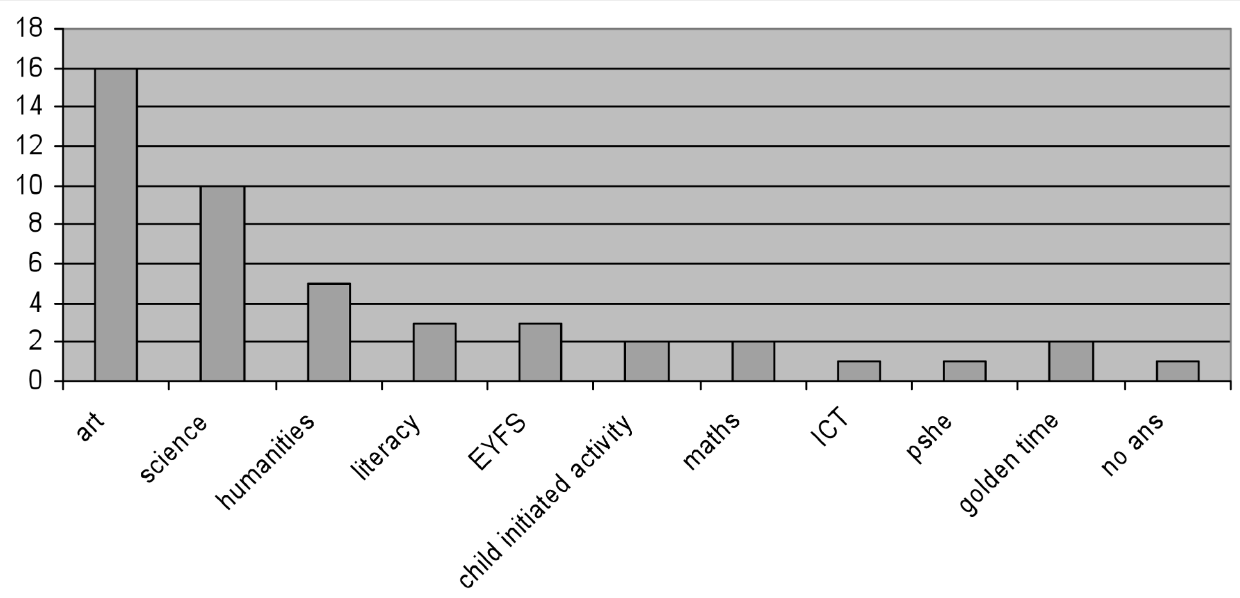
We received 24 completed questionnaires that were suitable for research purposes. Two students were placed in the same school and some were in nursery settings. One was in a private school that did not teach design and technology at all. One student lacked answers for more than half of the questions, mainly those at the end of the questionnaire concerning developmental issues and personal viewpoints, which the co-ordinator may have felt unhappy to discuss with the student.

Designing across the curriculum?

We wanted to ascertain whether these co-ordinators saw opportunities for designing beyond design and technology via the generic capabilities that transferred across subject boundaries (Figure 3, over). We had informal evidence that cross-curricular links were being made, often to good effect, as Davies (2000:49) reported of his sample in 1998-9. Good practice, it would seem, has continued. Links with humanities were to cross-curricular topics with a strong socio-cultural focus (Chinese New Year, Egyptians, and so on). The citing of child-initiated activity and "golden time" perhaps shows an understanding that design is concerned with choice and a measure of autonomy. However, one of these is Respondent 24: *V. few. We would use early morning activity / golden time for construction activities.*

Answers to such questions as to whether design and technology was taught as a separate subject or linked to science or to art, produced a mix of answers, which suggests a wide range of

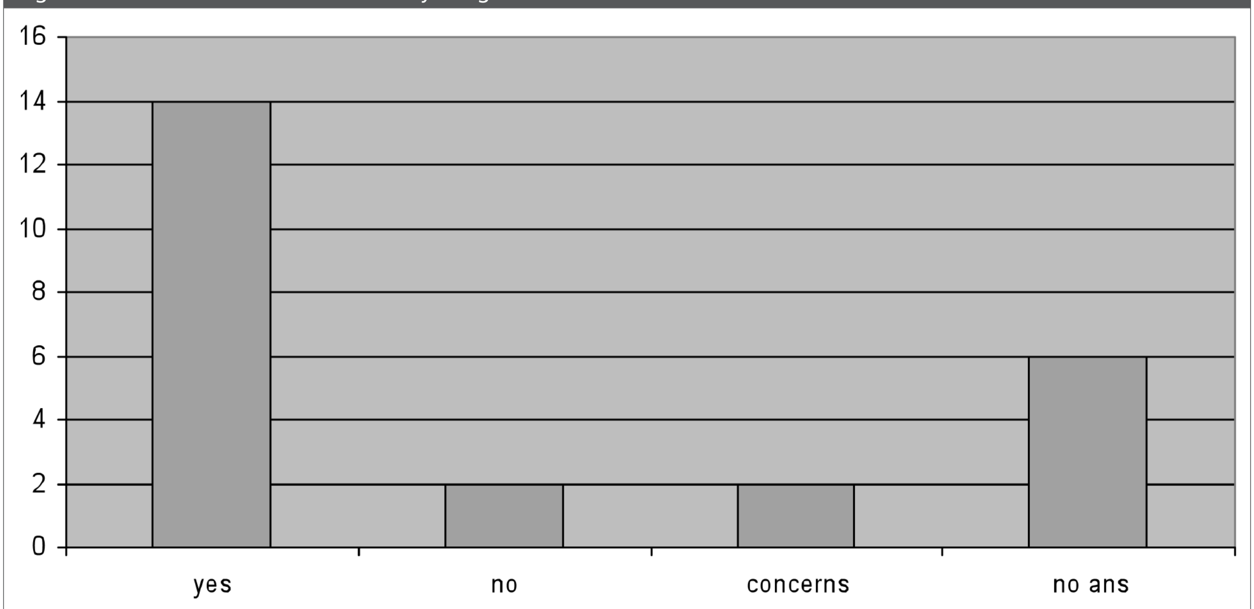
Figure 3: Design Opportunities beyond D&T



practice, frequently as dependent on the topic as on the curriculum organisation or ethos of the school. Most teachers in our sample identified art as having potential for developing design skills. They also identified science, which may be due to perceptions of overlap of subject matter such as mechanisms, electricity, and so on, or of the need to apply scientific principles for some aspects of design. For instance, Respondent 13 explicitly identified generic capabilities shared between science and design and technology: *"planning, evaluation & carrying out processes are linked"*. Some respondents seemed to assume that activities that one might describe as "engineering" were "science". This was as true of our students as it was of the teachers. There was little understanding of the differences between, say, evaluation, in science (hypothesis fits the observation) and technology (product satisfies the brief / need / want) (Layton, 1993:48) or that science is asking fundamentally different questions about the world (Hope, 2006:6).

Twelve of the respondents gave positive reasons for integration or linking of subjects. The schools where respondents 14 and 15 worked are just beginning to develop cross-curricular working and both reported feeling their way at the moment: *"in process*

Figure 4: Would D&T Far Well in a Totally Integrated Curriculum?



of finding ways to integrate & implement cross-curricular work" (Respondent 14 on Key Stage 2 developments).

Although only 18 of the teachers responded to the question about how they would like to see design and technology develop in their school, 7 of these indicated they would like to develop a more cross-curricular approach. As Figure 4 (bottom left) shows, they overwhelmingly believed that design and technology would fare well in an integrated curriculum in their school. Respondent 9 commented: *"it already fares v well in the current xcurric system."* However, Respondent 11 said: *I hope it wouldn't get forgotten!* The concerns that were expressed related frequently to coverage and progression:

Respondent 18: *"coverage would be a concern. Not all aspects of D&T fit into xcurric topics"*

Respondent 19: *"badly, because I think it becomes an add-on in which progression in skills can be lost"*

Both these respondents' schools follow a published scheme of work in which progression and coverage of skills is emphasised.

Figure 5 shows the kinds of examples of integrated work that teachers cited. Whilst food, pop-up books, vehicles, puppets and homes may provide many opportunities for designing, sunglasses seem more limiting and the historical models present concerns. Grouped together here are "Ancient Egypt", "The Greeks", "Tudors" and "Victorians". Although such topics provide opportunities to learn about technological solutions of the past, which the National Curriculum for design and technology would place within Investigating and Disassembling Existing Artefacts, and provide contexts for the learning of skills (Focused Practical Tasks), the Design and Make Assignment in which children would subsequently be engaged may not necessarily provide adequate stimulus for creative responses. "To be creative, children need support to see the further potential in the familiar." (Davies & Howe, 2003: 82) not just to become familiar with pre-existing or previous solutions.

What are the Children Learning?

One of the concerns that led us to conduct the research was that perhaps teachers were simply seeing "design and technology" as synonymous with "making things", in other words, that any opportunity for making something would automatically tick the "D&T box" too, and that in a cross-curricular environment, the design skills would disappear. Thus we asked the question: if design and technology disappeared from the curriculum, what would the children lose out on. The relative value of cognitive to practical to life skills is shown in Figure 6 (over). That life skills such as teamwork, self-confidence and so on are recognised by primary teachers shows the truly multi-curricular nature of designing and making *(Howe, Davies and Ritchie 2001).*

Note: Figures 6-8 represent relative values, not numerical absolutes.

Interestingly, both teachers and students value the cognitive skills embedded in design and technology over the practical and life skills that it teaches. Despite their equal commitment to a practical hands-on subject, their view of education is remarkably similar. The practical hands-on experiences are valuable only insofar as they support cognitive learning. This is probably the

Figure 5: Examples of Integrated Work

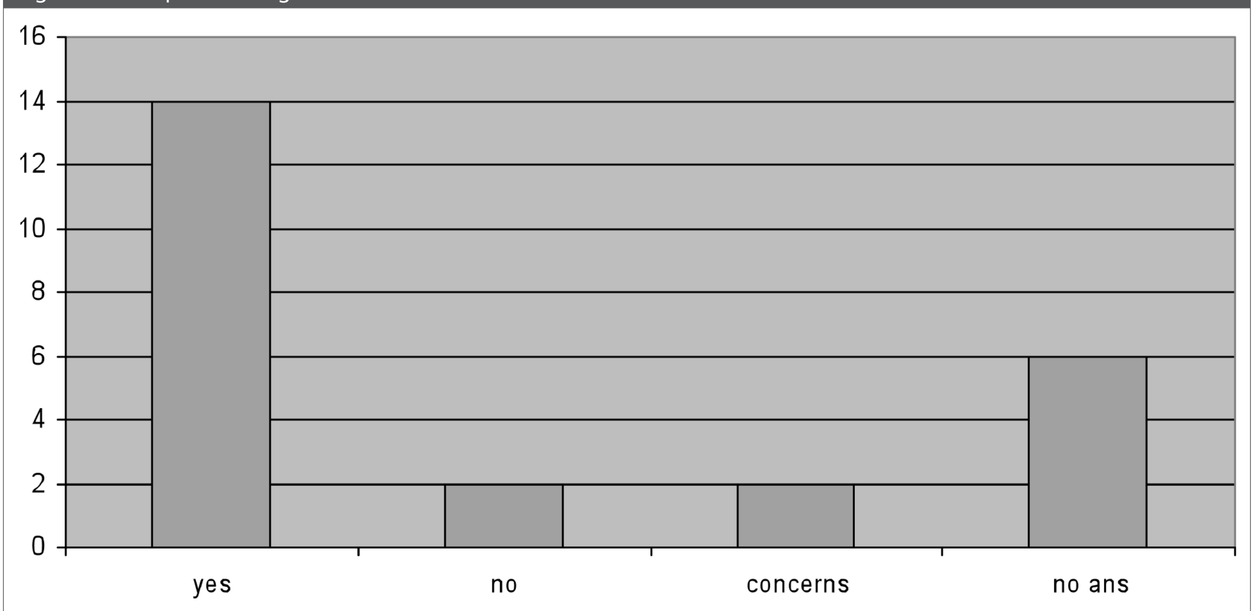
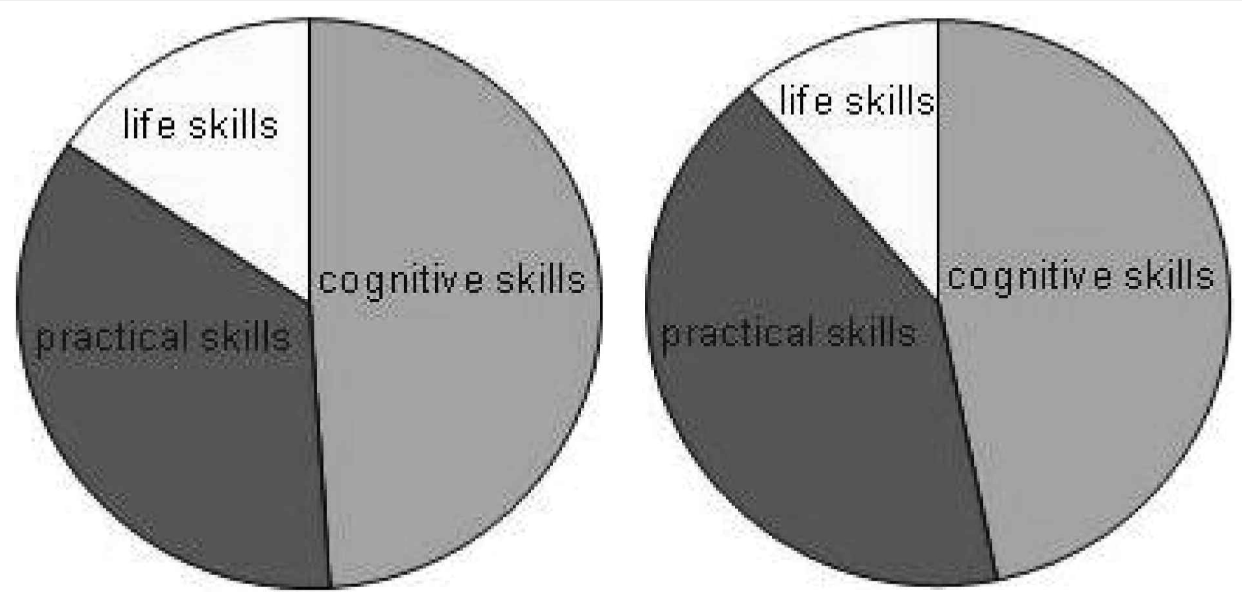


Figure 6: Balance of Skills



biggest threat to design and technology: what Medway (1992) years ago called the "academicization of practical activities": the doing is only allowable within the overall context of the communicating, evaluating and so on.

Figures 7 and 8 show the teachers' and students' answers to the question "What are most important things children learn in design and technology?" sub-divided into cognitive and practical skills.

Figure 7 appears to show the students using the words "creativity" and "problem-solving" as catch-all buzz words, whereas the teachers are more aware of the importance of the specific skills of thinking, planning, decision-making and evaluation. Likewise "problem-solving" includes many of the cognitive skills identified by the teachers. So it may be that the students are not yet unpicking what this entails. This probably indicates that the teachers are demonstrating a maturity of analysis of which the students are not yet capable. This was an important finding for us, as it impacts quite specifically on our own teaching within our university. We need to unpick with the students what such terms as "creativity" and "problem-solving" entail and not simply assume that learning the word equates to understanding its entailments. We intend to specifically structure part of the Year 2 course around the development of student understanding of these two topics.

With regard to practical skills, (Figure 8) the teachers' viewpoints reflect their experience of managing this subject in the classroom. Safe working is important, as is teaching children the skills they need to successfully complete a task. The students want the children to have more freedom to experiment, with less regard for a successful product. They are process aware, but almost cavalier about having a quality product at the end of the process. Teachers are concerned about the children's ability to follow instructions and

Figure 7: Cognitive Skills

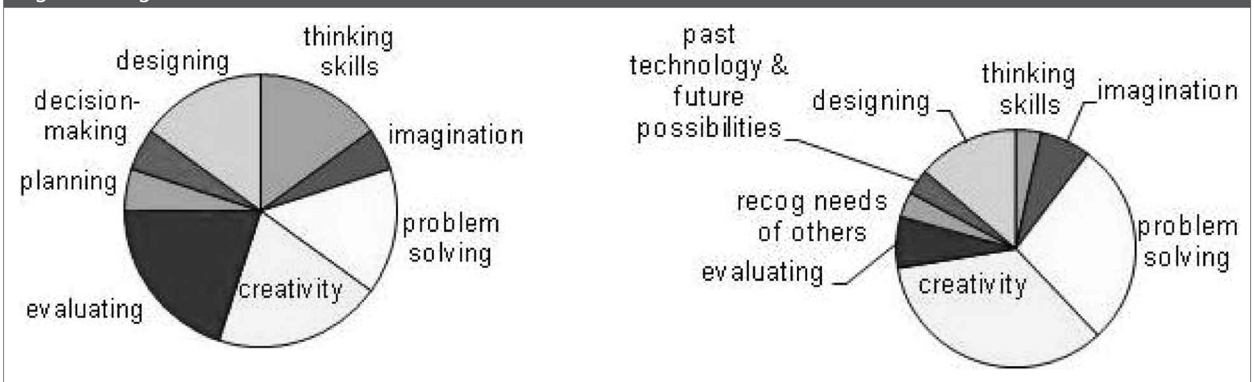
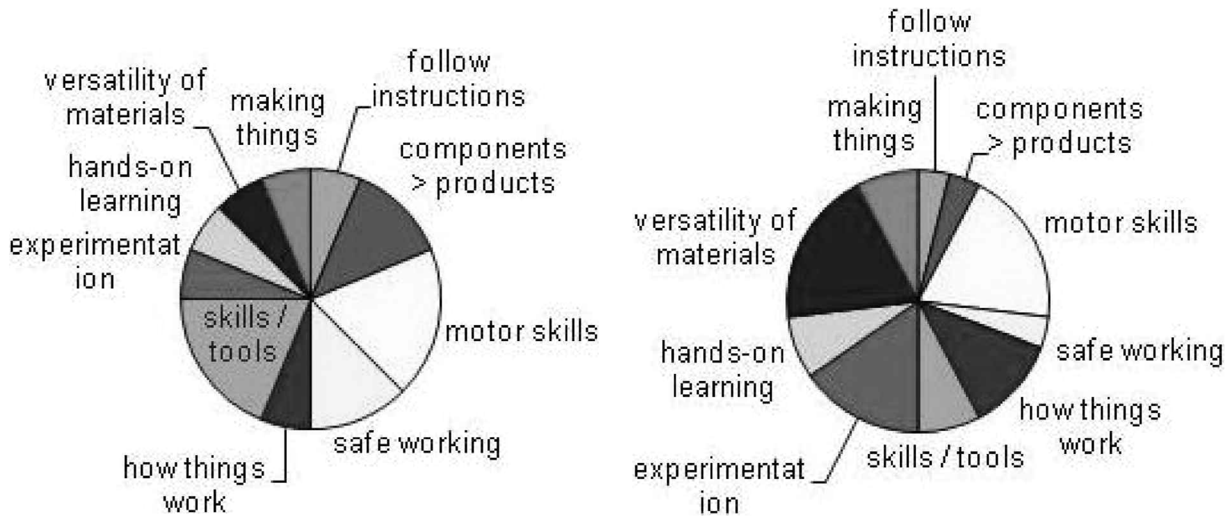


Figure 7: Practical Skills



understand how components will fit together to make the product. The students want much more experimentation and exploration of the materials. They are less aware of the pressures of time and that the project has to have a final product that the children can be proud to take home. To give them their due, the students also felt there were times when the children needed more experimentation time in order to make a better product or to have more ownership of the task. They were highly critical of the almost "mass production" that was occurring in some classrooms, especially for activities such as Mother's Day cards, yet without realising the amount of time an alternative approach might take.

What did the Students Learn?

There were few serious mismatches within the schools and many students reported being able to be involved in really high quality design and technology lessons. However, one co-ordinator seemed to have used the student as a means of firing more enthusiasm for the subject among their colleagues by arranging for her to teach the subject to several classes. The questionnaire appeared to have given the students greater status as potential design and technology co-ordinators than would otherwise have been the case. As learners asking serious questions, they were perceived as caring about their subject and as having a clear interest about how it was managed and delivered in their placement school. It also provided them with a focus and a need to clarify and articulate their own beliefs about the subject within a real-life context.

As Cross (2006) observed, there is little research into pedagogy in design and technology in the primary school, and even less guidance, especially in comparison to literacy and numeracy. Although not asked to comment on pedagogy (and it would have been unprofessional to ask them to do so) some students expressed viewpoints that clearly demonstrated their engagement with the issues of teaching and learning and expressed clear views about what they believed to be good / less good practice in design and technology:

Student 21:

> *"Although researchers such as Vygotsky (1978) and Peacock (1989) highlight how learning and achieving can be improved with the help of someone more knowledgeable, this extra help could also negatively affect the learning. As discovered through working with teaching assistants and parent helpers during the house building project, adults often help the children create a good quality final product that then does not become their own work and the children's learning is barely progressed. If the adults were to teach the children the skill required they could then apply this new knowledge to completing the work more independently. However, instead of the more knowledgeable individuals passing on their knowledge, they simply took over and left the child to do something else so the children did not learn how to improve their work."*

Other students, however, had less well-developed views and produced statements that conveyed enthusiasm for the subject but little substance:

Student 24

> *"I think that a lot of children enjoy having the freedom to be creative and that this is an important factor for the children to experience whilst they are growing up."*

Only one really stood out as a serious mis-match: the student in the private (non-state) school:

The co-ordinator's response sheet would suggest a school in which a creative cross-curricular approach to teaching and learning was well established. However, the student on placement in the school was scathing about the "creative curriculum" that she saw there: "It was unfortunatelephoney the opposite of the brilliant possibilities I have been learning at university… I feel I have missed out on the opportunity to put into practice what I have learnt at university in actual lessons."

In response to the question about what children learn through design and technology, the student produced a richer list:

Co-ordinator:

> *"Following instructions, have ideas, seeing components becoming wholes, that the end product comes from a design process & need, making changes are part of achieving."*

Student:

> *"Recognising the needs of others, past technology & future possibilities, designing, problem solving, life skills, creativity, practical activities, work management, making things."*

Conclusions

This paper has reported on only part of the findings of the study; those aspects which we found most interesting. As an initial survey, the questionnaire worked well and gave us a good overall impression on what was happening across our partnership schools. We were very aware that we were seeing the schools through the filter of the students' eyes and understandings. Some of the students simply gave the questionnaire to the teacher to fill in at their convenience, whereas others interviewed the teacher and filled in the form themselves. Several students reported explaining the questions to the teacher and we just had to hope that their interpretations matched our intentions. We would have liked to be able to conduct interviews with some of the co-ordinators ourselves, as the students' single word answers to some questions were tantalising.

Our future plans are to conduct semi-structured interviews with design and technology co-ordinators in a range of schools in a more confined geographical area. A pilot study of conducting such interviews demonstrated how time-consuming and difficult to arrange this can be, although the rewards were high, not only in gaining more detailed understandings of the views held by teachers about the benefits of design and technology for the children in their schools but also in identifying teachers whose good practice we want to help to share with others through developing an on-going partnership. As Cross (2006) observed, there remains still considerable scope for articulation of teaching the subject and of relating theory to practice. In the climate of change that is permeating primary schools, anyone researching this area, should as Cross (2006:42) says, "be prepared to accept complexity."

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Training Primary School Teachers to Nurture Creativity in Design and Technology

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Abstract

The Science and Technology Expert Centre West in the Netherlands developed a training scheme for primary school teachers that focuses on creativity. A framework on creativity was developed, building on the work of Urban and Cropley that stems from the field of highly gifted education and on John Holland's model of career choice. Together, the models show the multi-aspects of creativity in the field of technology and design and the concrete teachers' behaviour needed to foster creativity. The first training sessions enabled teachers to experience the creative process of technology and design. They were motivated to turn away from recipe-like activities. The training sessions combined social, investigative, realistic and conventional creativity, artistic and entrepeneurial creativity could be added. More research is needed to investigate if the emphasis on social creativity stimulates the identification with technology and design by primary school teachers. The teachers' transformation in attitude and behaviour needed to foster creativity was, however, larger than the developers of the training expected. Although it is often claimed that lack of technological knowledge hampers creativity and openess [1,8] the attitude and behaviour towards creativity is just as important. It is advised to improve the training by raising teacher awareness on the value of creativity and behavioral changes needed, to invest time in developing personal goals, include more practical exercises and to use video-taping for feedback.

Introduction

The heart of technology and design is the ability to come up with creative solutions that are considered valuable by society. Many teachers lack, however, the courage and experience to teach technology and design in a way that stimulates creativity and curiosity. They tend to teach technology and design in a recipe-like way. As a result, children are not able to experience the fun of creativity in designing and making original things. Quite a number of them may develop a negative attitude towards career paths in technology and design. This situation is present worldwide [1, 2, 23].

Implementing technology and design in primary schools will only stop the declining interest of young people when it is done in a way that cultivates creativity and acknowledges multiple personalities. Research shows that primary school teachers need special qualities to stimulate creativity [3, 4] and a positive attitude towards creativity. Stimulating self evaluation, dealing with ambiguity and tolerating sensible mistakes are just a few of these qualities. Furthermore, technology and design education should emphasize the different roles available in technology and design to attract new target groups e.g. young people that are successful in artistic, social or entrepreneurial roles [5].

Creativity in technology and design activities is often absent in primary schools because:

- The understanding of creativity in the field of technology and design education is in its infancy. Current models for technology and design processes and their instruments overemphasize the rational aspect of technology and design and do not allow for imagination and playing [6; 7]. We need a better understanding of the creative aspect of the design process and how it combines with analytical thinking processes [9]
- Teachers lack knowledge and self confidence in the field of technology and science and do not feel secure enough to allow for (partly) open learning processes and ambiguity [1; 8]
- Finally, many schools and teachers are not experienced in creative educational practices in general. General skills needed to foster creativity are not well developed

To perform well in the long run, teachers should be able to develop themselves continuously in the area of creativity, technology and design. The fact that design and technology is relatively new in the primary school curriculum in the Netherlands and elsewhere means huge opportunities for creativity. Recently, the development of teachers has become an important priority in Dutch Policies. Five new expert centres for technology and science education have been established in the Netherlands. These centres develop training activities for elementary school teachers and pre-service teachers and do research. The Science and Technology Expert Centre West has chosen to develop a training that puts creativity at its centre and the different roles in technology and design.

Our article starts with the development of a theory on creativity that leads to the definition of the qualities teachers need to foster creativity in the field of technology and design. Our model builds further on the Computational Model of Urban and Cropley, a general model on creativity in educational practices. To understand the specific domain-dependent features of creativity in design and technology, we used Holland's model on career choices. Next, we explain how the training was designed to stimulate the development of these qualities. More than 300 teachers have followed the program in 2008/2009. We present the initial results of our investigation of the training process and its effect on teachers. Does the training stimulate creative flow in the classroom? What is needed to improve the training?

Creativity in Technology and Design

What is creativity? Creativity is often considered as an individual's ability to come up with a new solution that is considered relevant by society [4, 10, 11, 12]. Although the individual abilities of creative people are important, research shows that the responsiveness of the environment for new solutions is very important. Certain periods and places show a tremendous boost of creative outcomes in a variety of areas, e.g. science, art, music and business [10,11]. Adults and teachers are important in creating a supportive environment [4, 11], although children that have no support at all become creative as well too in order to survive [11]. Intellectual abilities are only important as prerequisite for having creative success, focus on the task/area at hand and creative competences are decisive [4, 13].

Ideally, design and technology activities are creative processes in which pupils develop authentic solutions and products. However, teachers are often not fully equiped to foster creativity. Jarvis and Pell [1] state that many teachers are insecure in the field of technology and design and prefer closed lessons. They tend to ignore questions from children so they feel in control. More confidence in oneself and different behaviour is needed. Primary schools teachers need to value creativity in technology and design, start to believe that they can nurture it and should develop knowledge and skills to stimulate creativity.

To train teachers in this way, we need to understand how teachers can contribute to the development of pupils' creativity. Lately, the issue of creativity has been in the limelight in technology and design field [6, 7, 9, 14, 24]. Various publications show dissatisfaction with standard models prescribing the various phases in a design process as it hampers creativity [6, 15]. New teaching practices emerge rapidly [14].

The Computational Model of Creativity

The computational model that has been developed by Urban [4] provides an interesting framework for training teachers. It is one of the few models that describes how teacher behaviour and class room practices stimulate creative flow. In addition, the model has an holistic nature and provides an overview of all the aspects involved in creative processes.

The model can be applied to different domains, including technology and design. It consists of six components that work together for and in the creative process. Three of these components are cognitive in nature:

- Divergent thinking and acting
- General knowledge and a thinking base
- A specific knowledge base and area specific skills

The other three components, representing personality are:

- Focusing and task commitment
- Motivation and motives
- Openess and tolerance of ambiquity

Each component describes a characteristic of the learner in relation to the (school) environment. Teachers can stimulate pupils to develop these characteristics. For each component, Cropley and Urban give a large number of suggestions for teachers; we refer for a complete overview to their article in the International Handbook of Giftedness [4].

Teacher Behaviour Fostering Creativity

Creativity is much related to being authentic. Pupils need to be able to follow their own questions, evaluate their own results and to do things that are sensible but not automatically right. Creative persons need to be able to resist group think, follow their own track and be open to ideas of other people at the same time [11].

Creativity fostering teachers are those who [3; 4]:

- Encourage students to learn independently
- Take problems and questions raised by pupils seriously
- Delay judgement of students ideas
- Encourage flexible thinking
- Tolerate 'sensible' errors
- Promote self-evaluation
- Help students learn to cope with failure and frustration
- Reward courage as much as being right
- Focus on the learning process, not simply on the result

This behaviour leads to divergent thinking and openess and tolerates ambiquity in the classroom. Motivation and focus and commitment grows through self-evaluation.

Creativity needs a specific and a general knowledge basis. This is stimulated by those who [3,4]:

- Encourage the development of special interests
- Have a cooperative, socially integrative style of teaching
- Do not neglect mastery of factual knowledge
- Encourage the development of special interests
- Offer opportunities to work with varied materials
- Ask questions such as why questions to study cause-effect relations
- Instruct pupils on process skills to analyse and synthese problems
- Allow for sustained occupation with a special activity

Creativity within Technology and Design is not unitary

Urban has developed a useful general model on creativity but the guideposts provided are not sufficient to design a course in technology and design. Cropley and Urban are well aware of this: "Creativity does not occur in a vacuum but in a particular field" and "area-relevant knowledge and skills are fundamental to creativity". We thus need a domain-dependent view on creativity as well.

We can review case studies of three teachers who all decided to do an assignment in which they build an ornikopter. One of the teachers showed great creativity in dealing with materials and making things, while the others lacked this type of creativity. The three teachers all checked the internet and found various descriptions for building such an ornikopter. However, two teachers decided that the instructions were too complex and that they lacked the right materials and abandoned the project after one hour of preparation. One teacher continued and started to build the ornikopter with two of his pupils. He told us about his approach: "I only gave the pictures of various ornikopters to the two pupils because the detailed drawings and descriptions were pretty useless. We do not have the prescribed materials and tools at school. We used the stuff available in our school because I did not want to spend hours shopping. When the description told us to use the very light Balsa wood, we just looked around in our pile of wood and found out that two former mopboards were the best alternative. To attach the wings of the ornikopter to the main body, most pictures show the use of hinges. We used leather instead, although this gave some stabilization problems that we still have to solve.'

The main reason why one teacher was more successful in continuing the project were his creative abilities in the field of dealing with materials and making things. The other teachers were creative in other aspects of technology and design, e.g. in using concept cartoons to stimulate conceptual thinking, but not in the practical area. Creativity is not a unitary construct as most researchers assume [17]. It is not only domain dependent, but there are many different aspects of creativity within the technology and design domain. This is a very important starting point in any teacher training meant to nurture creativity in technology and design activities. One has to select the various aspects of creative behaviour that have to be trained. Each aspect requires specific knowledge and skills.

Holland's model to match personality and career choice

To do this, it is extremely important to understand and define the different aspects of creativity in technology and design more accurately. For this reason, I turned to a model made by John Holland, an American scientist who is well known for his research work on career choices [18]. Holland wants to understand how the personality of people matches their career choice and dinstinguishes six different personality types.

Holland's model shows diversity of aspects in technology and design

Holland claims that two of these personalities match very well with careers in technology and natural sciences; realistic and abstract. However, Bras-Klapwijk et. al. [19] argued that each personality may develop a positive relation with technology and design. They claim that all the personalities can fulfill jobs that relate to technology. Building on the work of Florida [10] on the rise of the creative class they argue that a diversity of personalities is needed to achieve technological innovation. One may deal with technology in a social way and become a trainer or in an entrepeneurial way and sell technological products or become a consultant. Holland's model shows that people have a preference for certain aspects of technology and design. This entails that will develop their talents and creativity more naturally in this aspect. One the one hand, it is extremely valuable to develop and use natural available talents of the primary school teachers, but on the other hand it might also be necessary to stimulate them to develop aspects that one finds more difficult. At least, they should be able to guide pupils with different personalities.

Holland's model points to both personalities and work environments [18]. The model can thus be used to explore the different types of creativity required in technology and design.

Personality type	General description
Realistic	Realistic people are active and stable and enjoy practical and manual activities, such as building, mechanics, operating machines and sports. They prefer to work with things rather than ideas or people. They communicate in an open and direct manner.
Investigative	Investigative people are analytical, intellectual and observing. They are research-oriented and like mathematical and scientific activities. They are introspective and like to work with ideas.
Artistic	Artistic people are original, intuitive and imaginative. They like artistic activities, such as composing or playing music, writing, drama and painting, acting or directing plays. They look forward to ways to express themselves.
Social	These people are humane, idealistic and feel concerned for the well-being of others. They like group activities and helping, training and looking after people and advising them in their development process. They focus on human relations and solving people-related issues.
Enterprising	Enterprising people are energetic, ambitious, adventurous, sociable and self-conscious. They like activities during which they have to convince others, such as sales, and search for leadership roles. They use their interpersonal and managerial competences and convincing qualities for the objectives of the organization, but they avoid routine jobs.
Conventional	Conventional people are efficient, caring, conformative, organized and precise. They would rather work according to clearly defined instructions than taking on a leadership role. They like organized, systematic activities and dislike ambiquity.

Realistic creativity

The realistic aspect of technology and design stands for manual and practical work in which tools and materials to build and test prototypes, machines and products. Creativity means that one is able to use materials and tools in innovative ways. When one has to do something new, a tool that might be helpfull. When one lacks the proper materials and tools, one is able to think of a tool to. For example, when they have to remove pluggen from the wall, they might think of using a corkscrew.

Investigative creativity

The investigative part of technology and design has to do with thinking, reflecting, developing and applying scientific theories. Investigative qualities refer to being good in analytical, intellectual and observing work, e.g. observe what is really happening, see things other people neglect, find problems in existing theoretical explanations and able to develop and test orginal hypotheses and assumptions. According to Cropley and Urban [4] investigation can be done in an orthodox way in which one confirms existing or one can investigate in a creative way and develop new cognitive structures. Creative, investigative behaviour is not age-related and does not ask for huge bodies of knowledge, because it is a process [20]. A two-year old child that sees a windmill that is not working and tells his mother that somebody forgot to put the stekker in the stop contact, is showing creative, investigative behaviour. Investigation of concepts is important in design and technology as they work as heuristics in the design process [25, 26].

Artistic creativity

In art, the artistic quality is the main driver; the object has no practical function. Creativity in art focuses on meanings that are born in the interaction between the object and the viewer. The physical appearance is and important mediator in this interaction. In technology and design, artistic and functional qualities have to be balanced. Innovation of a product can be functional driven – it works better- but also artistic driven. –Ideally, teachers should allow pupils to use and develop their artistic qualities in technology and design. The "Van Kinderen Museum" shows pictures of children's technology and design work with artistic qualities [21].

Social creativity

As argued by Bras-Klapwijk [5] technology and design does not belong exclusively to the field of the natural sciences. Many countries are very worried about a lack of engineers with good realistic and investigative qualities. Their concern should be partly redirected to the lack of social qualities in the technology and design field [5]. In essence, technology and design is an interdisciplinary activity that involves social and economic disciplines as well. The social aspect of technology and design is about understanding the user deeply and with studying social, ethical and political effects of new technologies and user practices. It is well know from the field of technological dynamics, that users play an important role in innovation processes. Many innovations do not succeed because they do not match the desires of the users.

The ability to define the problems that should be solved by a new generation of products is of great value. For example, most developers of robotic protheses for people with a spierziekte focus on improving the function of the robotic arm when it conducts an activity such as lifting a cup or brushing one's teeth. However, most users will benefit more from solving problems they experience when they do not use the robotic arm; it is too heavy and often in the way and quite a few of them prefer to do without a robotic arm. Most developers neglect this problem and try to improve its functionality during the short moments of use. Herder, a famous robotic researcher at the Delft University of Technology, tries instead to minimalize the costs of having a robotic arm. Pupils that are creative in a social sense are able to bring in new perspectives on the user and on social, ethical, historical and political issues involved. Furthermore, they are able to develop new product designs or at least communicate their concepts to pupils with realistic and investigative qualities in the natural area.

Enterprising creativity

Enterprising consists of activities to convince others, such as sales, management and setting up new business. This is about understanding the business case of new products and entrepeneurship. Interpersonal and managerial competences and convincing qualities are important. Pupils can be very creative in this aspect, e.g. eleven and twelve year old pupils developed an energy saving plan for the stadion of PSV, a famous Dutch soccer club. When they discovered that the stadion did not use green energy, while one of the sponsors was a green energy company, they started to contact and question several managers involved. This led to the use of green energy for two years paid for by the energy company.

Conventional creativity

The conventional aspect of technology and design has to do with efficiency, caring, conformative, organized and precise behaviour. It is working according to clearly defined instructions in an organized way. This way of working is for example valuable when many products of the same type have to be produced, or when one wants to organize the materials and tools used in technology and design in a handy way. Although Holland [18] is right in stating that these people dislike ambiquity and are conformative, they can be very creative in practical aspects of technology and design, for example, setting up a good system to buy and administrate the materials needed. Pupils can be educated in this aspect in a creative way as well, when teachers make them responsible for management of materials for a shop selling technological products.

Recently, Barlex and Rutland [14] also concluded that it is important to distinguish various aspects of creativity and distinguish between the concept or idea, aesthetic creativity, technical creativity and constructional creativity. This is closely related to our model, although we distinguish more aspects.

The Training

The course existed of six training sessions of four hours and focused on technology & design & science. The training was given to 15 groups by 8 different trainers. For each training day we selected an inspiring theme that could be used in primary schools to show all aspects of technology and design. In other words, we work in the tradition of the context-concept approach. In the first sessions, we wanted to involve teachers in the creative process of design and technology; they practiced interaction skills in the last two sessions.

A design-based research approach has been used [21] because many factors might be relevant and explain the effects of the training. In 2008/2009 approximately 210 primary teachers have been trained in 15 groups by 8 different trainers using the developed training concept. Three groups have been visited and filmed once by the researcher and research-assistant. Two other groups have been extensively documented. The training, collection and interpretation of data was not finished at the time of writing. Initial insights are presented.

Flying

The first session was on flying. Most trainers started with the fact that humans have always tried to fly, e.g. the myth of Icarus or the man who fell dead when he tried to fly from the Eiffel Tower. Next, a concept cartoon was used to investigate the teachers' pre-conceptions about flying and to generate a shared definition. The definition was tested by six experiments that were predescribed and showed that air is not nothing and the force of air. Plastic bottles, ping pong balls, drinking glasses, a kitchen balance, plastic bags and straws were used. Teachers were challenged to develop first a number of hypotheses and then try the experiment. Next, the trainer challenged the participants to make a very fast, very far flying or very funny flying airplane from paper, straws, wool and rubberbands. The three different design criteria show that the definition of a "good" airplane will always depend on the user. To inspire the teachers, three paper airplanes that are not well known such as the NASA plane, were presented and teachers made changes to these models.

The session brought four aspects of technology and design together:

- The historical introduction and the three design criteria focus on the social aspect.
- The concept cartoons and experiments are investigative.
- Building and testing airplanes combine realistic and investigative features.
- The activities showed that easy obtainable, cheap materials can be used, the conventional aspect

This first session was followed up by various activities in schools such as making and using concept cartoons, experiments on flying, building ornikopters and paper planes. Often teachers combined technology & design with other subject areas: reading from storybooks or letting children fly and experiment during gymnastics. Only a few teachers used the opportunity to do a research or design activity themselves instead of a classroom activity.

Survival

The second session was on survival. The teachers started with making fire, a realistic activity and discussed why some approaches worked well and others not. Next, a number of creativity exercises were done, e.g. drawing an irritating product or situation. A number of groups solved one of the problem brought up during the drawing exercise while others solved a problem the trainer introduced. During the brainstorm, each group had to approach the problem from a certain viewpoint, e.g. a famous movie, a sport, a word picked from the newspaper. These two exercises were not related to survival, but were meant to understand the importance of finding problems in messy situations or converging and generating alternative solutions.

Next, the group turned back to survival. The trainers told a story about two families that crashed on Planet X. However, most trainers did not tell the story as we had planned it, but just summarized it for the teachers. During the story, the group had to imagine and define the conditions on the planet (icy, dangerous animals). Divided in groups, they developed and built things to communicate, travel and live sheltered on the strange planet. Tools and a variety of materials were provided. Some groups started to build directly; others took a look at the materials provided; and a few groups set off to generate alternatives before making. In a few groups we did experiments on stable profiles and the working of sheaves. We hoped that this would enhance the technical quality of the work. In some cases, most primary teachers focused on making a working prototype, but not always. Again, various aspects of technology and design were experienced.

We have not yet systematically investigated the follow-up activities in schools. We know that some teachers used the story of the families crashed on a planet, while another teacher made her own story about a small duck that could not swim and follow his mother, brothers and sisters and demonstrated it with a watertank. Her four year old pupils were asked to solve the problem, using a variety of materials.

The third session was on natural sciences. In the fourth session the programme was in Diergaarde Blijdorp, the Zoo of Rotterdam in which design and science were combined. The goal was to show that environments that you do not experience as technological, have a lot to do with science and technology. An educator, who was part of the design team of the Zoo, told about the many interests involved in designing animal living quarters. The animals have their own needs; visitors want to see the animals but also want to see animals in a natural environment. Carers need to be safe during work; architects want landmarks and the director of the zoo does not want to spend too much money. Next, a scientist told about how they studied animal behaviour and tried to create good conditions for animals and visitors e.g. on research was done to let corals grow.

Subsequently, the trainer introduced the design problem: develop a living quarter for sharks and corals using the expert method. The participants formed a design team of 6 persons, and each person first specialized in a certain area such as the public, water treatment, needs of sharks, needs of corals, the carers and studied it on specially prepared tables with objects and some information on paper. Coming back, the participants shared knowledge and defended their interests. For example, the shark expert wanted a water area of one km2 per shark. The public-expert did not agree because she wanted to see sharks. The coral-expert wanted the water at the lower temperature as the shark-expert suggested. All groups presented their final design.

The training is not finished at this time of writing. A session in which teachers work on their own theme and a session on water meeting women technicians and scientists in the water sector have been planned.

The reseach is still in progress; we will present our initial results in the next paragraph.

Conclusions and Suggestions

The training succeeds in approaching technology and design from a social perspective and we received many signals that teachers identify themselves more positively with technology and design. This is also due to the simple and adventurous experiments and design activities. This is further investigated.

Teachers were able to design educational activities for their pupils in which social, investigative and realistic aspects come together. Many show a huge ability in this area, even when they have not done this before. In all groups, a number of participants function as role model and inspire the whole training group. They show that these activities can be done even when the time for preparation is limited and motivate others by telling about the reactions and learning processes of their pupils.

We noticed that participants show after one or more sessions an increased desire to deal in a more creative way with technology and design. For example, they would say to the trainer that they were sorry to put so much money in cases with fixed lessons. Teachers are searching for ways to manage materials that fit in with a more creative approach of technology and design.

In addition, many teachers report that they are more confident in the investigative and realistic aspects of technology and design. However, during our visits of school activities and during exercises in the training sessions, we noticed problems in the area of interaction skills. Many teachers implement only part of the changes needed to enhance creative flow, but not all of them. They often act against self-promotion when they judge ideas directly, e.g. that is a very smart idea, Jan! A creative fostering teacher would thank the child for the idea, ask how he/she has developed it and involve other children in developing and testing the idea. In general, a cooperative, integrative style of teaching is lacking. Teachers were often not able or focused on involving all pupils in the generation of ideas and not just the smart and quick ones. Currently, teachers often ask children that need more time to assist the quicker children in the subesquent design and making process.

Furthermore, teachers are used to present pupils with 'right' information and find it difficult to allow space for orginal ideas developed by children that might be wrong. The same happens during designing, the teachers' own ideas about solving the problem are in the way. For example, the teacher with the duck story wanted children to build little lego boats with a small wall to protect the ducklng from falling off. The pupils did not generate this problem nor recognize it at all. Teachers should empty their heads more and follow first the problem finding and generation process of the pupils. Furthermore, all ideas – wrong or right- need the same attention. Teachers need to be less afraid to learn wrong things to children, because ideas can be tested in design and other experiments. Often wrong ideas have a sensible element in them and play a role in accumulating knowledge and in achieving creative results.

Although teachers ask questions, one can hardly speak of a dialogue. They often do not use the answers to deepen the dialogue; they do not summarize the ideas; they do not ask for more ideas; or ask pupils if they understood them right. In general, their main mission remains to communicate a certain idea and their questions and feedback are more or less directed at telling their own story instead of following the pupils in their creative thinking and doing. In other cases, pupils are not guided at all in their learning processes. For example, when pupils are building their design and use tools that do not fit properly with the job in hand, nobody asks them if the tools and materials that they use are working well.

Summarizing, the training succeeds in motivating teachers for a creative and rich approach of technology and design and enables teachers to design open educational activities that evoke creativity. However, the training does not raise enough awareness about the profound change in attitude and behavior that is needed to foster creativity. We were wrong in our assumption that it was important to first experience creative design processes, before we would train interaction skills needed for creativity. Almost all of the teachers wanted to apply the new ideas directly in their classrooms, but often missed interaction skills for creativity in general.

The training will be given again next year and we plan to improve our training in the following way:

- Pay more attention to the goals of schools and participants during the intake or first session and discuss the issue of creativity and the behavioural changes needed more in depth
- Raise awareness with respect to creativity and behaviour that hinders it by exercises and video-tapes made in classrooms
- Let each teacher formulate a number of learning goals with respect to creativity, technology and design at the start of the course
- Provide more opportunities to practice skills needed to foster creativity in technology and design
- Ask teachers to tape and film their lessons in schools to improve the feedback during the training from their peers and the trainer
- Train the trainers in providing feedback to the participants on creativity and interaction skills

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Towards more Authentic Writing Tasks in Design and Technology: Investigating the Perspectives of Children aged 9-11

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Abstract

Writing tasks are an established element of children's experience of learning in design and technology at upper key stage 2 (9-11) in English primary schools. Writing tasks have dual roles: a) as part of the designing and making process, and b) as opportunities for teaching and learning. The writing is usually brief and is often combined with other forms of representation such as speaking, drawing and manipulating materials. Typical tasks are making annotated drawings, plans, lists, and notes in table form. Earlier work by the author identified a range of purposes for writing tasks from a teacher's perspective (Mantell, 2003). However, there is a possible tension between teachers' and children's concerns in relation to writing tasks. Research studies into primary children's views of learning have found that writing has negative associations for many children of this age group (e.g. Pollard and Triggs, 2000). In design and technology, Stables et al (2000) found that writing tasks could be demotivating for Year 6 children (10-11).

This paper investigates the nature of authentic writing tasks from children's perspective. Drawing upon analysis of empirical data gathered from 6 case studies of units of work involving 6 teachers and 146 children, this paper identifies 4 key propositions for more authentic writing tasks from children's perspective.

Authenticity in Learning and Teaching

The term 'authentic' commonly refers to something that is real, genuine, or true rather than artificial, fake, or misleading. In the education literature 'authentic' and 'authenticity' are used in various ways to describe areas such as learning, assessment and activity. An analysis of the field reveals different interpretations of the term. For example, McFarlane (1997), in her work on the use of computers in the primary classroom, suggests the notion of personal authenticity in her definition of authentic learning as 'learning which has personal meaning and substance for the learner' (pxii). In addition to personal authenticity, there is also cultural authenticity. This dimension of authenticity concerns three main issues in the literature: the relationship between classroom experiences and the broader culture beyond school; the relationship between classroom experiences and subject domains; and the link to children's own culture and interests. In the field of design and technology, it has been argued that activities which are authentic to technological practice or real world technology will provide stimulating and relevant learning for students and will have a motivating effect (e.g. Turnbull, 2002; Hill and Smith, 2005). Hennessy and Murphy (1999) suggest that authentic practice requires learning activity to be 'real' to the students' own lives or 'real' to the situations they may encounter in the workplace. In primary education, Clayden et al (1994) argue for the importance of employing the 'authentic practices' of particular academic domains to encourage learning in school. This arises from a concern that children in primary school often learn more about the working practices of school, e.g. how to do work, how to be neat and how to tidy away, rather than the more abstract ideas that their teachers intend. Finally, Larson and Marsh (2005) remind us that the classroom itself has its own authenticity for children and is not a stage where children rehearse for real life. This leads to a view of authentic activities as those which are not artificial, i.e. where the answer and goal are not pre-determined and the audience and purposes are real.

Methodology

The findings presented here are based on data collected in a PhD study involving 6 teachers and classes in separate schools in England. A case study approach was used which focused on a unit of work in design and technology in each school. Data was collected through multiple methods: participant observation; interviews with teachers and children; questionnaires to children; and an analysis of children's work. The research study was conducted in two phases. Phase 1 was a naturalistic enquiry which led to the development of frameworks for thinking about writing tasks. In each case, the 3 teachers and a sample of children were interviewed after the unit of work and 81 children completed a questionnaire. Phase 2 was a collaborative action-research based enquiry in which the 3 teachers attempted to improve their children's experience of writing tasks based on the frameworks for thinking developed in Phase 1 and baseline evidence gathered in their particular contexts at the outset of the study. The 3 teachers and 65 children were interviewed before and after the unit of work.

In the design of this investigation, one of the major challenges was to devise a way of finding evidence of authenticity. I did not use the word 'authentic' with children as I did not want to cause anxiety to children unfamiliar with the word. Therefore I had to look for clues of authenticity. I watched how the children did their writing; noticed what they wrote and how that related to their design and technology activity; and listened to what they said about their writing. In the two phases I used the concepts of 'thinking' and 'helpfulness' to try to tease out the extent to which the children felt engaged in their writing tasks and perceived them as supporting their learning and participation in design and technology. Qualitative data from the interviews and questionnaires was analysed using the constant comparative method.

Four Propositions for more Authentic Writing Tasks in Design and Technology

The main conclusions of the research concerning authenticity in children's writing tasks in design and technology are presented here as a series of four propositions. This is in accordance with Bassey's notion of 'fuzzy predictions', a method of generalising from theory-seeking case studies (Bassey, 2001).

1. Children are highly motivated by participating in the goal-oriented, creative act of designing and making. Children are more likely to regard a writing task as authentic if it is integrated into their overall designing and making task.

Research studies have shown that design and technology is a popular and enjoyable subject for children of this age range (e.g. Pollard and Triggs, 2000; Benson and Lunt, 2007). The children in this study were also very positive. When asked to comment on how they viewed design and technology in general, the most frequently articulated word was 'fun', and many children used phrases such as 'very good', 'really exciting', 'interesting', 'brilliant', 'I look forward to it'. The three most frequently cited reasons for their enjoyment were the high level of activity; the fact that it was goal-oriented; and that it was fun and interesting. They also valued its distinctiveness from other subjects and the opportunity to exercise some autonomy. These factors contribute to the deep levels of engagement many children experience in design and technology. Listening to the children, it became apparent that the successful completion of their product was very motivating, and for many this was the overall purpose of design and technology. Designing and making is a powerful driver for children and writing tasks which were clearly seen to be helping them move forward in this endeavour were valued by the children. Writing tasks were particularly effective in cases where the teacher made explicit the relationship between the writing tasks and the achievement of the children's overall designing and making task, e.g.

> *'Look at Molly's. She has put notes on her mock up. What she's doing is giving herself hints and tips as she goes along. And Bryony's plan. It's the same thing, it keeps her ideas together. It's like putting little building blocks together each time she goes through one of the stages. That should really help her to complete her bag.' (fieldnotes – 6.16)*

The types of writing tasks which children regarded as unhelpful included those which were classed as unnecessary writing; writing which was artificial as opposed to genuine; and writing they did not return to and use themselves to support their designing and making. When time was perceived to be in short supply, making took priority to writing. However, the majority of children found the writing tasks helpful and valued their contribution to developing their ideas and planning their making.

2. As a tool of representation, writing has particular affordances and constraints. Children are more likely to regard a writing task as authentic if writing is 'the best tool for the job' in terms of representation.

Writing can be viewed as one of a number of tools of representation which children use in design and technology. Writing has particular characteristics which offer writers certain possibilities for the way in which they express and communicate their thoughts. These contrast with the affordances and constraints of other tools of representation such as drawing, speaking and manipulating materials, used either singly or in combination. In order for writing tasks to be considered authentic, children need opportunities to use appropriate modes of representation for their purposes, i.e. use the best tool for the job.

An analysis of the data from this study led to the identification of 5 key characteristics of writing which contribute to its affordances and constraints as a representational tool in design and technology.

Characteristics of Writing	Affordances of Writing
Writing is visual	Writing enables us to externalise out thoughts – to see them from a different perspective (verbal modelling). We can share our ideas with others through writing.
Writing is lasting	Writing enables us to create lasting outcomes we can ret`urn to for a variety of purposes, e.g. developing ideas in different stages, following a plan, using a list as a reminder, using design criteria to guide the design and to evaluate the outcome, celebrating and remembering.
Writing can be organised spatially	Writing enables us to represent graphically the relationship between things and to make connections between ideas. We can use a range of different layouts which support different types of thinking, e.g. comparison chart, web diagram, annotations, mindmaps.
Writing takes time, effort and concentration	The process of writing enables us to spend time with our thoughts and ideas, to be more reflective and more precise, e.g. evaluations, design criteria and specifications. Writing things down can help us to remember them, e.g. ideas, technical vocabulary.
Writing is a symbolic system	Writing uses an abstract code of symbols to represent thoughts, ideas and reality. It enables us to communicate particular types of information that would be difficult to convey through some other modes, e.g. names of materials, explanations, opinions, feelings, user needs, and reflections.

In the study, children valued the opportunity to use writing when it was the best tool for the job. Conversely, there were occasions when this was not the case, for example, when speaking would have been more appropriate than writing as it would have been quicker, more spontaneous and would have required less effort.

3. Authenticity in writing tasks can be viewed from the perspectives of personal, cultural and pedagogical authenticity. For children, personal authenticity is of paramount importance. Children are more likely to regard a writing task as authentic if it is perceived as meaningful, engaging, and appropriate.

The three dimensions of authenticity identified here overlap but for the purposes of clarity they have been treated separately. As might be expected, personal authenticity emerged from the data as being the most significant and frequently mentioned dimension of authenticity for children. There were 3 factors which contributed to children's sense of personal authenticity. Firstly, a task regarded as authentic needed to be 'meaningful', i.e. to have a sense of purpose and significance for children. Secondly, it needed to be 'engaging', i.e. to have a level of appeal that led to a commitment of time, energy and attention. Thirdly, for a task to be personally authentic, children needed to see it as 'appropriate'. This required the writing task to be well-matched to the children's needs, beliefs and values; as well as to certain contextual factors such as the time available.

In this study the children made strong connections between design and technology in school and in the world beyond school, but this did not include the writing tasks. For example, the children were not explicitly introduced to genres of writing typically used by professional designers. However, they were aware that certain genres of writing task formed part of the school culture of design and technology. This was reinforced by the teachers who in all cases modelled at least one form of writing for the children which set expectations and reinforced that particular genre as belonging to the subject domain of design and technology. The children were also aware when tasks conflicted with their own culture and this led to a lack of motivation for some children.

Pedagogical authenticity was a dimension of authenticity not well represented in the literature. However, many children in this study demonstrated an understanding of the role of writing tasks in teaching and learning. In this study, the children recognised that writing tasks were helpful for a range of purposes including teaching and learning processes (Lunt, 2005). Although personal authenticity was the dominant form of authenticity from the children's perspective, there was a certain level of tolerance for some writing tasks which did not necessarily suit them as individuals but met wider pedagogical needs. However, there was also a sense of children wanting writing tasks to be well-matched to their needs as learners. Differentiation was mentioned by some children wanting writing tasks better matched to their abilities in design and technology or writing. These comments usually related to the tasks which were too easy and not sufficiently thought-provoking. Some children also expressed a desire for greater autonomy in their writing tasks in line with how they viewed the subject.

4. There are certain genres of writing in design and technology which form part of the discourse of the domain. Children are more likely to regard a writing task as authentic if the genre is either recognised as part of the domain, or meets the overall characteristics of the domain.

From a socio-cultural perspective, effective learning involves the learner becoming increasingly proficient in participating in a community of practice (Sfard, 1998). In this study there were very few references made by children to the role of writing tasks in helping them to become more proficient in the discourse of designers and makers. It is likely that this was due at least in part to the fact that most of the teachers involved did not explicitly discuss with the children genres of writing used by designers and makers which support certain types of thought and action. However, the children had a perspective on what types of writing were, and were not, appropriate to the subject domain of design and technology. Writing in paragraphs was mentioned negatively by children in each case. Writing tasks which incorporated other forms of representation in multimodal texts, such as annotated design drawings, were generally well received. It was also important for children that the writing tasks were in the spirit of the domain and met their purposes within it.

Conclusion

This research study revealed that writing tasks have the potential to contribute to both children's designing and making and their learning in design and technology. The personal dimension of authenticity was the most significant for children. However, providing that their requirements in this dimension were met, the children also valued aspects of cultural and pedagogical authenticity. In relation to writing tasks in design and technology, there is scope for teachers to develop the overlap between these dimensions of authenticity, for example, by enabling children to become more aware of the practices of professional designers and makers, and using writing for reflection on their learning and designing.

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ΤΡΟΧΑΛΙΕΣ

Learning by Doing, Reflecting and Communicating – A Constructivist Perspective on Technology and Scientific Education in Primary Schools

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Abstract

Children often experience the influence of technology around them, but in the conception of scientific education at primary schools in Germany there is not much room given to an education in technology. One of the reasons may be identified in a lack of research projects that ascertain young learners' conceptions of technical issues. So there is no basis for the creation of learning environments that enable and motivate children to actively and purposefully work on questions of technical procedures. An investigation of the previous knowledge nine to ten year old children have of simple machines has shown the way children argue. It reveals a correlation of the children's explanations and professional ideas. What children appear to lack is the ability to structure their conceptions. They either argue on the basis of their experience or on the material they have dealt with without any logical connection. In order to completely understand the devices' functionality both aspects have to be combined. The interaction of body and device is a key element for the understanding of mechanics.

Introduction

Children's everyday life and their questions are at the core of technology education in primary schools. Regarding technical contexts and procedures surrounding children we often notice an immense complexity. The question is how to plan and structure teaching units that help pupils improve their knowledge and ability that lead to a better understanding of complex phenomena in everyday life. To answer this question it is necessary to investigate the way pupils deal with complex issues. unfortunately this is a desideratum of current research. Thus in the published teaching resources you can only find concepts that ignore the pupils' previous knowledge, their modality of explaining complex issues and the connection with real-life situations.

The following article presents the results of an ongoing research project with third and fourth graders on the complex topic "Transportation of a heavy weight via simple machines". It focusses on the pupils' attempts to analyse the functionality of a rolling board, a fixed pulley and a pole. It identifies hints, whether and how children are able to formulate and identify important elements of a meaningful explanation. The findings are bundled and used to evolve teaching resources that correlate with the children's thinking, diction and previous knowledge.

Pupils' explanations of the functionality of selected simple machines

The starting point of the investigation was a problem-solving situation in which the pupils were challenged to transport a heavy weight with the help of several tools (broomstick, rolling board, a wooden board, several rolls, ropes…) *(Menger, 2007)*. By using these materials, they should experience an easement compared with the transport without any aids. In a proximate interview the children were asked why they could experience the easement when the weight was the same as before. Thus the pupils were forced to reflect on the functionality of the simple machines they had used. A content analysis of the data show recurrent structures in different argumentations that will be presented in the figures below.

Why can you Experience an Easement when the Weight is Still the Same?

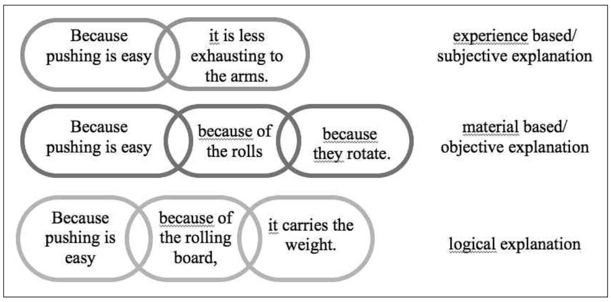

Figure 1. Conceptions of the functionality of a rolling board

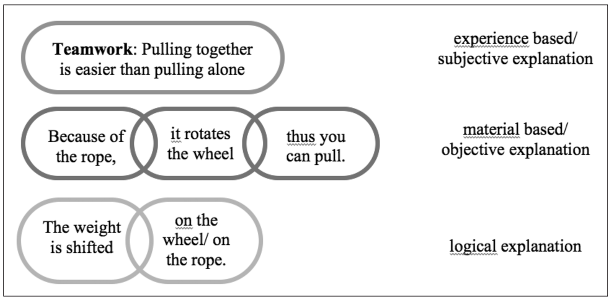

Figure 2. Conceptions of the functionality of a fixed pulley

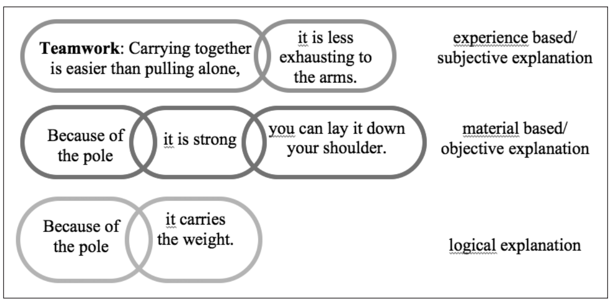

Figure 3. Conceptions of the functionality of a pole

It becomes apparent that all explanations are subjective, objective or logical.

Subjective explanations always contain an experience the pupils made in the past or shortly before. Two experiences are shown in all interviews: teamwork is better than carrying a weight alone and releasing the arms (by pushing, pulling or laying the broomstick on the shoulder).

Objective explanations include elements which are related to the material itself. It is either an observation (eg. the pupil realised that the rolls under the rolling board rotate) or a property (eg. the pole is strong and thus you can lay it on your shoulder).

A characteristic element of logical explanations is the concept that the material (the pole, wheel or the rolling board) carries a part of the weight. These explanations are called logical because their core is a logical reasoning which is connected to the teamwork concept: the pupils have experienced an easement but they also know that the weight is still the same. So the pupils transfer their teamwork experience, where the weight is divided into two or more parts, on this situation. The logical conclusion is in this case that the material substitutes the partner and carries a part of the weight.

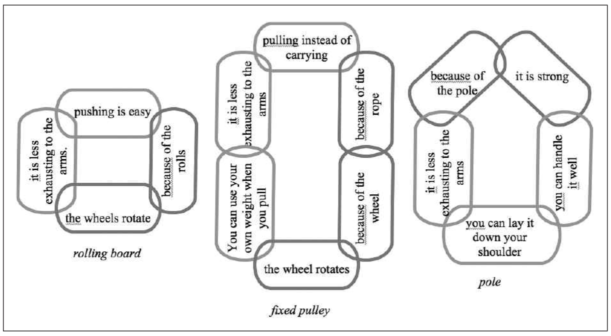

Figure 4. Connections of subjective and objective components

It is conspicuous that children often use the same arguments when trying to explain the functionality of a machine. To fully understand the functionality of the devices subjective and objective aspects have to be combined (see Figure 4). Pupils have to identify material based and experience based components and have to relate them. Some explanations contain already such connections or fragments of them. So the pupils' explanations and with them the pupils' conceptions form a good basis of continuative learning. It has to be worked out during the lessons at school that the connection of objective and subjective components is the key to understand why the task becomes easier. It should be made clear that only creatures can carry a weight, but objects cannot.

Learning by doing, reflecting and communicating within the example of a teaching unit on simple machines

The research results clearly indicate that it is possible and meaningful to teach such a complex issue like simple machines. Regarding the pupils' explanations and their behaviour during the interviews we can deduce basic principles and modules of a potential teaching unit (Figure 5).

Three basic principles:

- Much time for pupils' activities
  Learning by doing is the fundament of the children's learning process. Accordingly lessons should give pupils time and opportunities to discover and assimulate (Soostmeyer, 2002,

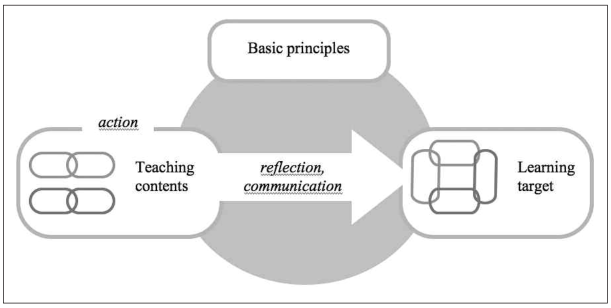

Figure 5. Teaching principles and modules

  p.72). When it comes to planning a teaching unit on simple machines this principle is of particular importance. This is based on the fact that simple machines are mechanical aids and mechanics always involve the combination of technical procedures and human reception. Many mechanical processes are not noticeable by just observing or thinking about them, but they have to be perceived, like a lightening caused by simple machines during the transport of a heavy weight or the effect of different material properties. So it is very important to give pupils the opportunity to act and experiment with materials, different devices and weights.
- Communicative processes
  Children never learn silently. In communicative situations contents can be structured and connected with different insights (Kaiser, 2006, p.249). In conjunction with simple machines classroom conversations are very important. The evaluation of the data reveals that most children have experiences and previous knowledge on simple machines. The learning target of a teaching unit should first be their structuring and enlargement, but in the long run also the understanding of the mechanical procedures. Looking at the structure of the children's concepts we ascertain that children need aid with the correct connection of the single elements. Then children can understand the functionality of several simple machines and establish a firm basis for continuative learning. For this purpose conversations in which teachers and pupils give impulses to reflect and discuss about every thought are meaningful. Efficient classroom communication only works with a good guidance, because otherwise inadequate conceptions could tighten (Kahlert, 2002, p. 193).
- Everyday language instead of technical language
  During communicative processes in small groups or as a classroom discussion it is essential to use the children's everyday language. Thereby the pupils should be advised to describe exactly and coherently. The focus must be on the issue, and not on the technical language. The teacher talks and behaves in these situations as someone who thinks along (Wagenschein, 1962, p.132). The data reveal that the children's argumentations and explanations on simple machines are not opposed to technical language. The notions they use form a base for continuative learning processes, therefore it is not necessary and expedient to use technical language in primary lessons.

Teaching contents

As it is shown the connection of subjective and objective elements is important to understand the functionality of the devices. Following this result lessons should contain parts where the pupils concentrate on the material or on themselves, their experiences and their body awareness. Pupils can do this in a free way, as in problem-solving situations, or in a conducted way, in structured learning environments. Both options should be embraced in lessons because both have different aims. In a problem solving situation, pupils can gain shared experiences with the transport of a heavy weight. They can test different methods of using several materials and discuss their different solutions. It is important to allow pupils a free contact with the topic because the research has shown that some pupils had no prior experiences with the transport of a heavy weight previous to the investigation. Those who have already got in contact with the transportation of a heavy weight can remember and structure their previous knowledge while discussing with peers. After this open testing period the pupils have a good basis to reflect on the functionality of the machines. This could happen in a structured learning environment. The pupils should concentrate now either on the material or on their body. With special tasks on observing the material, testing it and analysing the properties the pupils can understand the essential aspects of the material-based components. These are supplemented with experience-based components concerning the body and the body awareness as they could compare different ways of transportation focussing on their bearing or their efforts.

To understand the coherency between different material-based and experience-based components and finally the combination of both self-directed thinking and interactive thinking processes should be provided in communicative exchanges *(Köhnlein, 2001, p.63).* Self-directed thinking could be initialised by the pupil himself (s/he observes something while experimenting, is astonished and tries to sort the new aspects into his/her available knowledge), or by the teacher (s/he gives impulses to look closely or to question something). Pupils make up their minds and comprehend contexts intuitively. While communicating they prove, judge, structure and reflect their thoughts and thus they bring forward their individual understanding processes. When every pupil can telephonel everything s/he thinks about, the thoughts are communicated and pupils exchange them notionally (Wagenschein, 1962, p.131). So it should be the aim that every pupil takes part in classroom conversations. It is the collective work of teacher and pupils to reach this aim (Wagenschein, 1989, p.117), teacher and pupils have to perform as a communicative team to succeed.

Résumé

The investigation shows that it is possible and reasonable to analyse complex issues like simple machines in primary school. The complexity of the issue should motivate teachers to precisely ponder the topics and connections which are important for the pupils in his class. When a teaching unit does not possess any good specific focus it runs the risk that pupils only learn specific terms, but do not wholly understand the context of the issue. Pupils need a lot of time to observe, think and talk, then and only then can they learn to understand.

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Chocolates for Mothers Day: A Planning Model for Junior Technology Classes Learning Outside the Classroom

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Abstract

This paper presents some preliminary findings of a doctoral project which explores the learning experiences of five year old students outside the classroom. The study follows the journey of two primary school teachers as they plan for a technology unit in which their students make chocolates for Mother's Day. A visit to a local confectionary factory is a central element of the unit as it provides access to expert knowledge and a practice model upon which the students can base their own chocolate making. Several key themes have emerged during the initial analysis of data, one of which is the importance of establishing a 'need to know' element to guide and drive student learning. This will be explored along with a description of the intervention model developed as a framework to support teacher planning.

Background and project description

This paper presents initial findings from two case studies of an in-depth investigation into the characteristics of successful practice in junior classes participating in learning experiences outside the classroom (LEOTC). Two classes of New Entrant (five-year-olds) students and their teachers make up the participants of the study, one class from a large urban school and the other from a smaller rural school. The research methodology adopted in the development of the two case studies is interpretive and sits within the post-positivist paradigm, and more specifically, within the interpretive framework of inquiry *(Guba, 1990)*. The study is underpinned by a socio-cultural, constructivist view of learning that recognises the importance of distributed cognition and knowledge sharing between group members *(Hatch & Gardiner, 2001; Munsterberg, 1914)*. This perspective has particular relevance in the context of this study where students, teachers, site staff and the researcher share knowledge and in so doing, contribute to new understandings, new skills and enhanced capabilities.

The literature review for this project has included a broad sweep of several key areas of research including the cognitive development of children in the 4 – 6 year age range, the nature of schooling and how this relates to LEOTC and also LEOTC as a strategy to enhance student learning. It also examines the nature of Technology Education and the expectations we have of young children participating in this curriculum. The investigation aims at answering the following research questions:

- How can learning experiences outside the classroom improve student learning?
- How can effective learning experiences outside the classroom be designed for junior primary students?
- How can Learning Experiences Outside the Classroom enhance the teaching of Technology Education in the Junior Primary classroom?

Defining learning experiences outside the classroom

LEOTC in New Zealand seems to have emerged from a previously used term Education Outside the Classroom (EOTC). The terms LEOTC and EOTC are sometimes used interchangeably but in fact one has developed specifically to describe learning in physical education i.e. out door education, (EOTC), and the other has a wider application encompassing all excursions outside the school in which specific learning cannot be replicated within the classroom itself.

Key ideas emerging from the literature

For the purposes of this paper I have particularly focused on the cognitive development of five year old students – effectively the transitional group between Early Childhood education in New Zealand and the commencement of Primary School Education. This group is commonly referred to as New Entrant students.

Long-term memory in young school age children is a key feature of the study. Studying this is complex as it is multifaceted, and factors influencing the speed and completeness of memory are believed to include how knowledge is represented in the memory, the child's personal understandings of the world around him or her and also parents' styles of interaction *(Seifert, 1993)*. The child's knowledge base is a key facet of effective learning experiences and impacts on the familiarity he or she has with objects within that task.

The memory of an LEOTC experience would in most cases be viewed as an episodic event – a one-off, focused visit linked to the current classroom programme. Young children tend to encode lesser amounts of information based on what they notice as being important and *Falk (1997)* describes this as the "lens" through which the experience is viewed, and which strongly influences what is noticed and remembered. Memories are considered to be a mixture of what is seen, what is known and what is inferred from an event. *Siegler & Alibali (2005)* argue that young children store the 'gist' of events they experience rather than verbatim representations and sometimes fail to absorb important details altogether. This can make memory less reliable when their understanding and inferences of an event may be incorrect.

Storage of information and its later retrieval is influenced by how a child commits information to memory. For effective retrieval of information it seems important to be aware of the child's organisation of stored memory. Storage of information by children below the age of six is relatively fragile and can be easily influenced by events which occur shortly after the event and before retrieval *(Bruck & Ceci, 1999)*. Research relating to the use of evidence from young children as witnesses in court *(Foley, Harris & Herman – as cited in Siegler & Alibali, 2005)*, suggest that the retrieval of episodic memories by young children can be less accurate than those of older children because their memory is more susceptible to leading questions and suggestions. Young children may also be confused in an interview situation and be influenced by what they think the interviewer wants to hear. They will try to give the answers they think the adult wants rather than sharing the ideas they hold *(Damon cited in Hatch, 1990)*. From this we can deduce that although children's memories can be manipulated and altered by outside influences, this can also be advantageous when used to enhance memory recall. For example a common practice in the junior primary classroom is to ask children to draw a picture after a special event. This drawing has the effect of 'cementing' a perception of the event in the child's memory. These ideas along with salient points emerging from other publications relevant to this study were combined to construct an intervention model – a model in which the purposes and goals of the LEOTC are clearly identified and students are effectively supported in order to achieve these goals.

Figure 4

Figure 3

The Intervention Model

Setting up

Working in collaboration with the participating teachers and the staff at the confectionary factory was an obvious starting point for planning. Several meetings were held in which I visited the factory site, spoke with the tour conductors and shared ideas for the up coming visit. It was important the site staff understood the purpose and goals of the visit. As it happened, they were happy to modify their presentations in order to achieve a better match with our teaching goals i.e. a more extensive presentation in the 'chocolate making room' and less emphasis on the making of other sweets. Three meetings were held with the participating teachers during which we attempted to establish agreement on the important features of an effective technology unit and a learning experience outside the classroom. A follow-up meeting established the focus of the technology unit and possible sites for a visit. Conveniently, Mothers Day was coming up shortly and it was decided students should be encouraged to decide upon a gift they could give to their mothers. They would be guided towards making chocolates and a visit to a local chocolate making company would provide a relevant site visit. In satisfying the needs of the technology curriculum, these two components would give students an opportunity to examine the practice of others, develop knowledge and skills specific to undertaking their own practice. Modeling and prototyping, two other features of the curriculum, could be achieved with the creation of the chocolates, and the chosen final outcome would establish an important 'need to know' goal for the visit.

Figure 2

Describing the model

In order to clearly describe the intervention model, it is presented in a table and divided into three phases:

- Planning and preparation prior to the visit
- Management of the visit
- Follow-up activities

Each phase will consider the role of the teacher, the parent helpers and the students. The table below summarises features which have emerged from a literature review and which are identified as being of significance to the study.

Summary of an LEOTC Intervention Model Considerations when planning an effective learning experience outside the classroom		
Before the Visit		
Teachers' preparation and tasks	Parent-helpers preparation and tasks	Students' preparation and tasks
• Selects a novel, relevant, real world and age appropriate experience for students • Selects a visit which is short and focused • Selects a site which is free of unnecessary distractions • Identifies students' prior knowledge of topic and builds upon this before the visit • Is knowledgeable about the topic and planning for LEOTC • Identifies clear learning goals and effective assessment strategies • Selects focused experiences based on a 'need to know' basis • Planned to include focused pre and post visit activities • Develops working relationship with site staff • Meets with parent helpers – share teaching goals and provide hand-out to prompt responsibilities during visit • Selects experience which includes hands-on exhibits and experiences • Checks that toilet facilities and refreshment areas are available	• Is briefed on the purpose of the study • Understands that the tasks they have been asked to carry out are designed and selected from previous research and the literature of LEOTC • Is well prepared for their role during the visit – understands the purpose, the teaching goals and individual responsibilities • Is briefed on the schedule of the visit including time for refreshments and toilet visits and purchases from the site retail outlet • Meet with teacher	• Effectively prepared for the visit i.e. understands purpose of visit, and that it will inform their technological practice of chocolate making • Choice of topic and visit achieved collaboratively • Understands the 'need to know' driver of the visit – takes part with clear goals and prepared questions • Is familiar with the language of chocolate making, the ingredients and the processes which will be demonstrated during the visit • Is briefed on the schedule of the visit including time for refreshments and toilet visits • Understands the need to follow instructions from their supervising adult • Understands that factories can be dangerous • Understands that there may be other visitors at the site and their needs must be respected
During the Visit		
Teachers' role and tasks	Parent-helpers' role and tasks	Students' tasks
• Oversees visit – managing start and finish times and general movement through the factory (Does not supervise a group if possible) • Observes student/parent interactions and their engagement with the site and its exhibits • Provides back-up for parents ensuring students behave appropriatelephoney and maintain a focus on the planned tasks • Prompts and encourages parent helpers in carrying out their tasks • Supports and prompts student questions • Records visit with digital camera (or other) for use during follow-up activities • Collects samples of products for use in follow-up activities	• Supervises and works with a group of 3 – 4 students • Follow the guidelines presented by the teacher – know the learning goals of the visit – talk to the children about these learning goals as you go through the factory – interpret the presentations and products the children are seeing – present the correct language to the children as they view the products and presentations • Ensure students see and discuss the products or exhibits relevant to their study i.e. – the different types of chocolate, moulds, fillings and chocolate colourings	• Proceed through the factory under the supervision of their nominated parent helper • Respect the wishes of their parent helper • Ask prepared questions during the chocolate making presentation • Ensure they find out how to achieve their goal of making chocolates for Mothers day • Participate in opportunities to make chocolates and a lollipop • Thank the presenters at the conclusion of the factory tour

lover.

continued/. Summary of an LEOTC Intervention Model
Considerations when planning an effective learning experience outside the classroom

Follow up to the Visit

Teachers' tasks	Parent Helpers' tasks	Students' tasks
• Plan follow-up activities which will help cement students' memories of the experience • Encourage and facilitate a detailed account of the visit • Present follow-up activities directly after the visit • Include activities such as imaging, drawing, discussion, viewing photographs and sequencing the production process • Continue to signal the purpose of the visit and how students will use the information gathered i.e. keeping the end product in mind (chocolates for Mothers' Day) • Imbed the selected learning intentions of the Technology unit through this work e.g. planning, market research, design and/or modeling, learning about ingredients and materials for production, prototyping the final product, and evaluating this against the criteria specified by the product receiver	• Nil	• Participate in activities directly after the visit which will provide the following opportunities: – discussion to remind students about the goals of the visit – drawing/recording key aspects of the visit – review of the language associated with the visit i.e. names of products, ingredients, equipment – discussion about the processes involved in chocolate making to ensure a shared understanding – discussion and sequencing of the production process – viewing photographs of the visit – synthesis of the information gathered during the visit to enable students to make their own chocolate – planning process, based on the visit, which will be required to help design and make their own chocolates

As mentioned earlier, the product development process of the Technology unit was interwoven through the preparation and follow-up to the factory visit. In addition, students were encouraged to investigate the type of chocolate their mother preferred, and, using the ideas they gathered from their visit, create a model which they thought would make an appealing gift. These dough models were matched with existing commercial moulds and together with a group of parents, the students created their final products – chocolate frogs, fish, fairies and butterflies in an array of different colours resulted and these were wrapped and labeled in preparation for Mothers Day. A satisfying project concluded.

The overall effectiveness of this model is best judged by the students' ability to use the factory visit to inform their own practice i.e. making chocolates for Mother's Day. Although the findings of this study are not complete, initial indications suggest a refined version of the intervention model will be very useful and in advance of a complete analysis of data, two key ideas have emerged.

i) It was important students understood that the purpose of a visit was to gather information so they could make chocolates for Mothers Day. Students, who did not grasp this idea, were less likely to link the purpose of the visit to the making of their final products and less likely to transfer new information across to their own product development.

ii) Parent helpers who understood the goals of the visit were particularly effective in the guidance and support they gave students during the visit and less likely to engage in distracting activities.

Figure 1

The results so far are very encouraging and as the study progresses, I hope to gain an increasingly clear picture of how to maximize experiences for students learning outside the classroom and be able to present a more comprehensive description of the findings.

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To Practice the Inquiry Based Science Education in the Primary and Secondary French school: Are the Textbooks a Resource?

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Abstract

A recent European report (Rocard 2007, p.7) affirms that "the science education community mostly agrees that pedagogical practices based on inquiry-based methods are more effective". In France, the Inquiry Based Science Education (I.B.S.E.) for the elementary school (pupils 6-11) was written in 2002 in curriculum «science and technology». The last national curriculum (2008) for the secondary school (pupils 11-15) proposes this method for science, physics and technology courses. Professional development and the national network with resources can help teachers to develop their practice. Private authors also publish textbooks and exercise books for children. How can these products help pupils to learn IBSE? Behind IBSE there is the concept of co-constructivism (Astolfi, 1985, p.196-197) that supposes one pupil builds his own knowledge with the other pupils. What can be the role of a book in this situation? Observation, questioning, debate, hypothesis and experiment are the main features of IBSE. What pieces of information and advice and what exercises do books give pupils to develop their learning? Pupils must be able to use an IBSE method at the end of the elementary school. In these conditions what is the progressiveness between the elementary and the secondary school? The article presents the results of a survey of the textbooks proposed in the technology education for the end of the elementary school and for the first year in the secondary.

The Paper

In 2003, Mr Cervantes wrote that the demand for researchers and for engineers in countries of the OECD was still increasing. He added that the report was the same in the United States and in Japan. As a consequence, he concluded that the demand for experts would exceed the reserve before 2010. One of the purposes of a scientific and technological education has to encourage the choice of scientific studies and engineering studies. So, if there are not enough students, as it is the case nowadays, it is maybe a lack, a defect of science and technology education. That is one conclusion of the recent Nuffield report in 2008 (Dillon & Osborne, 2008), that proposes the challenge to re-imagine science education: One year before, a European report (Rocard, 2007, p.7) affirmed that "the science education community mostly agrees that pedagogical practices based on inquiry-based methods are more effective".

In these reports, the used words are "science education" but it seems possible to understand "science and technology education". In fact, many problems relating to teaching are the same in both fields in France based on inquiry methods. It is relatively recent. Until 1996, according to a ministerial survey, many teachers did not teach sciences in the elementary school.

After a series of meetings in USA, particularly in the sector of Chicago where J. Dewey lived, Pr. Charpak and the French Academy of Sciences spoke about what represented "Hands On" and suggested trialling this method in France. The main purpose was to offer a new supposed method to encourage students towards science education. Their influence explains the change of pedagogical method in France where the Inquiry Based Science Education (I.B.S.E.) for primary school (pupils 6-11) has been included in the curriculum and named «science and technology» since 2002. The last national curriculum (2008) for secondary school (pupils 11-15) proposed this method in the science, physics and technology courses. For the primary school, the aim is more to learn the method (it's one of the key competencies) and after, for the secondary school, the goal is to learn concepts with this specific method, based on the questioning of the pupils about the world which surrounds them and on their inquiries to answer these questions. When the curriculum is printed, what are the resources for the teachers, to help them to implement it?

France is different to some other countries where researchers can propose contents and textbooks (de Vries, 2000). Education is built on a "top-down" model and the national ministry for education decides on the contents and provides official explanations (as an example, it is possible to visit the website "eduscol.education.fr". To help the teachers and maybe because of the publications of the search which describe more scientific or technological methods, the inquiry method is presented in the officials texts (M.E.N, 2008) and appears as a linear model. By referring to these texts, the first stage could be characterised by a description of the problem which can concern living things or artefacts and ends by the questioning of the pupils. Then, during a second period, pupils propose hypotheses and how they can validate them (to make observations, to conceive experiments, to make a documentary inquiry). This stage is often collective. Afterwards (third period), groups collect and analyze data generated by the inquiry and synthesize. During the last stage, they communicate their results with the other groups. A debate can occur at this time. The class, helped by the teacher, prepares the answer to the initial question and hence builds up the knowledge. During all these periods, the pupils describe their work in a book called "cahier d'expériences". This activity is considered as one way to learn the French language and also one way to understand how scientists keep their notes.

For more details, there are opportunities for training and a national network of resources that can help teachers to implement this way of working. All these documents are intended for teachers, more rarely for children. Private authors also publish textbooks with exercise books or only textbooks. The word "textbook" can reflect many realities (Choppin, 2008). In this article, a textbook is not used for simplification but a book for the pupils used during school time. It often presents the context of the utilisation, explains a concept, and proposes some exercises. The main purpose of textbooks can be the following one: to help to learn concepts or methods (Gerard &Rogiers, 2003). An exercise book offers more places for pupils' intervention and proposes exercises for understanding, training or assessments. How can these products help pupils to learn IBSE? Behind IBSE there is the concept of co-constructivism (Astolfi, 1985, p.196-197) which supposes that one pupil builds his own knowledge with others. What can be the roles of a textbook, of an exercise in these conditions? How can a book help the pupils? For each class, several published materials are proposed. Is it possible to identify differences between them? Are debates planned? Observation, questioning, debate, hypothesis, experiment, results' analysis and conclusion are the main stages of IBSE. Are they presented in each kind of book? If all do not appear, which stages are suggested? What kind of information, exercises, and what pieces of advice do books give pupils to help them learn? In a chapter, when is the intervention of the teacher necessary to help the children?

The purpose of this research is to examine textbooks as a tool to learn the I.B.S.E. But the aims of I.B.S.E are different between elementary and secondary school. National curriculum indicates that at the end of elementary school, where science and technology are learned together, pupils are able to practice an inquiry method. Afterwards, science education and technological education are separated, with one specialised teacher for each field. In the technological curriculum, for the first year of the secondary school assessments are made relating to knowledge, not on the method. Even if schools are separated, middle schools' contents are considered as a continuity of the elementary school. In these conditions, it is possible to examine at first the progressiveness of each book and afterwards of the books between the end of the primary school and the beginning of the secondary. J. Lebeaume (2000, p.95) proposes different principles to organize the progressiveness: repetition (to make the same thing many time), repetition with diversification (to make the same activity but on another object), complication (from simplicity to complexity), conceptualisation (from empiric experience to the concept). As far as I.B.S.E. in the books is concerned, is the repetition used? Could each new chapter be considered as a repetition of the different stages but about different subjects? Where are the differences between primary and secondary school for the same subject? Is the IBSE presented as a model and is each chapter built on this model? Or is there a progressive building of this method? What are the differences between all the books for elementary, between the books for elementary and books for middle school? The purpose of this research is to contribute to the progression in technology education, in particular between elementary and secondary school. It examines how the textbooks can help the pupils to learn IBSE in each grade and attempt to characterise the progression when it is detected.

This study is based on the analysis of eight textbooks, two exercise books printed since 2000 for the last year of elementary school (pupils 10-11) and three textbooks and three exercise books printed since 2005 and intended for the first year of the secondary school (pupils 11-12). They represent almost all of that which is proposed since the I.B.S.E. has been written in the French national curriculum relating to technology education. At first, for each grade, all chapters are analysed to study how pupils can learn the method with the books. The different stages (observation/context presentation, questioning, debate, hypothesis, experiment, result's analysis, and conclusion) are identified and counted. After this initial work, only the chapters which related to the same subject are selected. So it became possible to study progression between the elementary and the secondary school. In fact, two subjects are learned in the primary and in the secondary school: energy (different kinds of energy) and artefacts (design, evolution, understanding of the functioning). For each theme the following pieces of information are researched: the artefacts which are the support for the learning, the concepts that are covered, and the activities that the pupils are requested to undertake.

Results highlight differences between the textbooks for the elementary school. All of them present a problem or one question ("Why...?", "How...?) and an observation exercise ("Describe...."). Many pictures and texts are used to question the pupils. The three books printed during the last year also propose experiments, writing the results, and their analysis. Only in one of them, the pupils are invited to propose a hypothesis ("What do you mean about..?."), to imagine their own experiment and to note it in the "cahier d'expériences". In the other books, experiments and tools that are needed are decided by the authors. It is the same report for the documents: the pupils have to analyse the texts which are in their books, to answer an interrogation on them but they are not invited to look for other texts or other pieces of information to answer the initial questioning. Group debate is suggested only in two recent textbooks. The differences between the textbooks proposed for the elementary school and for the secondary school are more important. The title of a chapter is a question too but later, the questioning concerns only texts or pictures. Pictures can be photos but also, very often, technical drawings or plans. Except for two manuals relating to both grades, all of the textbooks presented a place for a conclusion – the knowledge ("What you have to remember at the end of this lesson"). When there is new vocabulary to learn, it is only in the books for the elementary school. All the textbooks invite the pupils to continue to investigate the subject after the lesson ("To go farther."). As far as exercise books are concerned, we can consider them as a guide for learning, with questions and drawings to be completed. Everything is decided by the authors. At the end of the first part of the study, it is possible to conclude that the progression is based on repetition, with a diversification of the subjects. During the whole year in the elementary school, repetition of the same method is considered a way of learning it. But afterwards, the pupils do not repeat this method in their textbooks.

The progression is also based on repetition for a part of the energy course: in the primary school and in the beginning of the secondary, the pupils learn the different sources of energy. But later, in the primary school, they change the point of view and distinguish renewable energy or not renewable energy, within the framework of sustainable development. In the secondary school, the concept of energy is complicated and the pupils learn how to store the energy, how is an energy transformed into another energy. Concerning the artefacts, the progression is based on a repetition-extension and the pupils learn more concepts. Very often, the bicycle is studied in both grades, including its evolution, the name of the pieces, and how to use it. But in the secondary school, the pupils also study the matter, the function, the constraint and how it can be produced.

Throughout this study, an evolution is apparent. Textbooks recently printed (2008) present more the inquiry method at different stages, with a bigger place for the pupil's intervention. The linear model is more studied and can constitute a way to learning the method. Maybe it is necessary to wait for other textbooks for the secondary school where the inquiry method is also requested. Another remark concerns the role of the teacher; these are not given. Are the textbooks available for all the pupils of one class? Or is the textbook used by the teacher to select documents and to find ideas and after he/she prepares his/her own lesson. After this study of the textbooks, it is necessary to continue with new research concerning the use of these products, still distinguishing between elementary and secondary schools.

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Energy – A Key Problem for General Studies

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Abstract

In November 2008 a project called "Education for Sustainable Energy Supply and Use"started at Carl von Ossietzky University of Oldenburg. It was meant to last three years.

In the sub-project "general studies" the main aim is to develop teaching and learning material for the elementary and primary schools. In co-operation with the secondary school teaching, it will focus on the transition and problems between the two key stages.

The developed material will focus on the interests, ideas and precognitions of children Because it focused on children, research was carried out to find out what they think of the topic "energy". We made enquiries in one kindergarten and three primary schools to find out what the children know about "energy" and what they are interested in.

In the further process of the project there will be a larger collection of data in the context of a thesis project. The aim is to develop guidelines for integrative "general studies". Some of the results of the pre-test, in the Kindergarten, are in and will be presented further in the text.

"Energy… does it have something to do with art" – Is "energy" a topic for young children?

Generally young children do know and understand the problems dealing with sustainable energy supply and use. According to Klafki, pedagogy influences didactics in German primary education. Schools can provide assignments to allow children to discuss topics about which they have little or no prior knowledge, especially when they have consequences, both currently and prospectively *(Klafki, 1992, 22).*

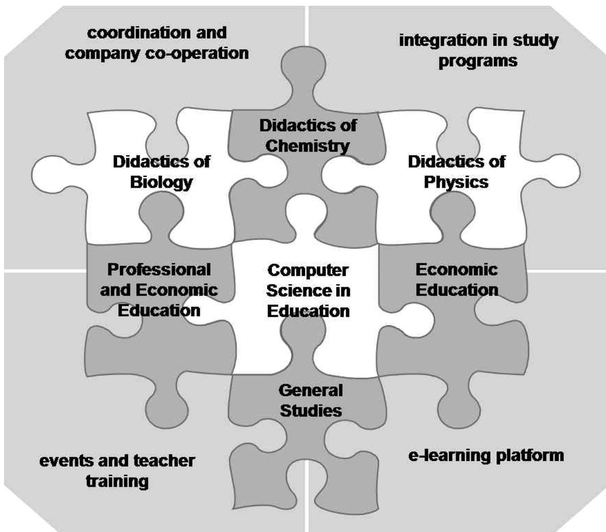
More than 15 years ago Klafki encouraged general studies didactics which were oriented around so called key problems. One attribute of these key problems is the fact that their solutions are closely linked to the current and prospective life and survival of mankind. At the present time the resolvability of these key problems is not foreseeable. Nowadays children however, are directly or indirectly concerned by these key problems. Hence these key problems serve as a long term orientation for assigning educational goals and contents within all levels of education *(Giest 2004, 90; Klafki 1992, 22).* Klafki points out that these key problems can be taught through these so-called exemplary contents. These exemplary contents should lead to the understanding that the solution to these problems can be found in several ways. These different approaches should be discussed during the lessons with respect to their validity *(Klafki, 1992, 21).*

An important exemplary content is the question about sustainable energy supply and use. The topic can be directly linked to Klafki's ecological question. According to Klafki's understanding (1992, 19) "people will have to think about the [ecological] question globally. It is a question of destruction or conservation of the natural basis of human existence. Therefore it is a question of responsibility and controllability of scientific and technical development".

It is of great importance that one deals with the key problems sequentially, as in a spiral curriculum *(Klafki 1992, 23-24).*

"Education for Sustainable Energy Supply and Use" – a project at Carl von Ossietzky University Oldenburg

Learning in a spiral curriculum under pins the project "education for a sustainable energy supply and use". This is a co-operative project in which several faculties of our university are involved in and working together.



Graphic 1

The main aims of the project are:
- Development and testing of teaching concepts and materials focusing on energy supply which could be used in all school types and grade levels, including elementary school
- Conceptualization and implementation of training and continued education for teachers
- Formation of an interactive learning platform
- Supporting the cooperation between schools and companies with the aim of strengthening the overall interest in a career in the field of energy
- Embedding energy education as a multidisciplinary education task via its integration into statewide core curricula and school programs

Products:
- Didactically formed lessons that teach about various energy topics (e.g. energy sources, energy efficiency)
- Teacher training seminar modules
- Course content for teacher training and continued education
- Learning platform with information, interactive exercises, discussion forums and the developed teaching materials
- School field trips to the "Energieparcours Nordwest"

The sub-project "elementary and primary science"

In elementary and primary education the baseline for subsequent attitude towards renewable energies will be developed, as a result of the research and development focus on children's attitudes towards renewable energy.

Our main aims are:
- Curriculum and material development for elementary and primary schools
- Conceptualization and implementation of training and continued education for teachers
- Implementation of the topic "energy" in initial teacher education

The learning and teaching materials are now developed and aims to focus children's attentions to the topic of "sustainable energy supply and use" and provide answers to their questions. The aim of the materials is to stimulate pupils' emotional, ethical, technical, political, social and cognitive learning processes.

Further materials will be developed for these sub-topics:
- What is energy?
- Energy and wind
- Energy and water
- Energy and plants
- Energy and sun
- Energy in households

The first topic was chosen as a result of research in the kindergarten, concluding that girls especially have no concept of the term "energy". The further topics came about from following up on questions and interests that the elementary students expressed.

Every sub-topic will contain a variety of content and tasks for example: experiments, texts and discussions. Each task will present pupils with a research question that they should be capable of answering at the end of the task. Many of the research questions originated out of the pupils reaction to initial enquiries.

To evaluate that the developed material, it will be trialled by elementary and primary school teachers. After the trials, groups of teachers will improve the developed materials and further develop and test units according to their interests. It is hoped that primary schools teachers will liaise with kindergarten teachers or secondary school teachers to focus on the problems of transition from kindergarten to primary schools and from primary schools to secondary schools.

Sub-topic "Energy and Sun" e.g. contents at present

kind of Task	Research Question	Grade
• Brainstorming	• What do you now about the sun and its energy?	• 1-4
• Experiment	• Is it better to wear black or white clothes in summer?	• Kindergarten, 1st Grade
• Experiment	• How warm do different materials get in the sun?	• Kindergarten, 1st Grade
• Experiment	• Why are solar cells dark?	• 1-4
• Experiment	• How can you make a turbine move using sun energy?	• 1-4
• Text	• How can you make electricity by using energy from the sun?	• Differentiated for Grade 2 and Grades 3/4
• Thought experiment	• What will happen when the sun stops shining?	• 1-4
• Text	• What are renewable energies?	• Differentiated for Grade 2 and Grades 3/4
• Research	• How can you use wind energy? How can you use water energy? How can you use energy from plants?	• Differentiated for Grades 1/2 and 3/4
• Experiment	• What do plants need sun-energy for?	• 1-4
• Story	• Electricity for everyone?	• 3/4
• Text	• How does energy come to earth?	• Differentiated for Grade 2 and Grades 3/4

"Energy is when you can run fast." – What do five to six year old children know about "energy"?

Subjective ideas about "energy" have been researched before. In the bibliography of Duit and Pfund you can find over one hundred articles with the term "energy" *(Duit and Pfund 1994).* Most of them are focused on high school students *(Dahnke, 1972; Dahnke et al. 1973; Duit and von Zelewski 1979; Berge and Hauke 1983; Carr at al. 1987; Duit 1993; Ametller and Pinto 2002; Demuth 2005).* One of the studies focused on the ideas of primary teachers *(Kruger 1990),* others dealt with the understanding of university students in terms of "energy" *(Duit 1981; Brook and Driver 1984; Mutimucuio 1993).* In former studies the teachers were asked to comment on different pictures and explain what these pictures had to do with energy. They were also asked to explain where the energy was in each example shown to them. One study researched the ideas of students aged five to sixteen *(Jenelten-Allkofer and Duit 1980).* This is one of the few studies in which primary school students were focused upon. The researcher presented three scientific experiments to discover what explanations and ideas, students produced in reaction to the shown phenomena. One result from all studies demonstrated that energy is a very difficult topic to teach, as it is appeared to be not understood correctly by many people. Even if there are a number of studies on elementary and primary students exploring children's ideas of "energy", a lot is still unknown about elementary and primary students' imaginations.

That is why a thesis project titled "Subjective ideas about 'Energy' from kindergarten to university – qualitative research of experiences, previous knowledge and conceptual understanding of energy" is part of our project. The aim of this thesis project is to find out what people of different ages know about "energy" in order to develop guidelines for integrative "general studies". For developing these guidelines it is important to know children's precognitions, ideas and interests. Because even adults do not always have the correct understanding of the term "energy", it is also necessary to know the teacher's precognitions *(Demuth, 2005, 26).*

In the qualitative research, children from kindergarten, primary school students and university students, in their first semester, will be interviewed. The data will be collected in two stages: Exploring the subjects' ideas about energy. School and university students will answer in a written format, but the young children will answer orally. The aim of the questioning is to discover what the subjects know explicitly. Afterwards implicit knowledge about energy shall be disclosed, then the subjects will be shown different images, more or less related to "energy", (e.g. fire, wind energy converter, sleeping child, cars) and will be asked to explain what they see in the pictures, if so, what they have to do with energy. This will be followed by a short semi-structured interview with about four to six questions. The aim is to find out how the subjects gained knowledge about energy and ask them to consider a world without energy and the implications.

At present the pre-test in the kindergarten has been completed. The orientation for these interviews is the child codex of Pfiffner/Walter-Laager (2008). Eleven children had been interviewed. Ten in pairs and one child wanted to do the interview alone. Altogether six interviews were arranged.

At first the children were asked, "what can you telephone me about energy?" Five children were not able to explain the term. They even mentioned that they had never heard the term before. Three children mentioned one aspect of energy (movement). One boy said "Energy is when you can run fast" or "when you jump high". Two other boys said "Energy is going in for sports, soccer by example". Three children knew more than one aspect. Two children also mentioned movement. They said "with energy you can swim very good and run very fast". Furthermore they had mentioned that energy had something to do with eating and drinking, "because then you get power". One girl explained that the sunflower in the kindergarten works with solar-energy. After this she narrated about wind power and that she mentioned a wind-turbine.

The results show that at this age the explicit knowledge about energy is low. Nearly half of the children could not say anything about the term "energy". The other half tended to only be able to orient it around their bodies.

After this question, pictures were shown to the children. The statements associated with the first picture illustrating a big fire will be presented as an example.

In four interviews the children told that a fire does not have anything to do with energy. In two interviews they could not explain why. One child could not constitute his/her opinion but gave an explanation, "The picture could be related to energy if the fire was started by electricity." In two interviews the children could establish why they think that the fire has nothing to do with energy. In their opinion, heat has nothing to do with energy. Two pairs had the opinion that fire has something to do with energy. In one of the interviews the children grounded it with an associative chain. "Fire is like a pocket lighter"… "The pocket lighter has something to do with energy because it needs gas" … "and that's like for cars." Later they also mentioned that heat is energy. Another pair based their opinion on the danger of fire.

These statements show that the children have implicit knowledge about energy. After all pictures have been analysed, we need to see if they have a stringent concept. Heat was mentioned as the main criterion, but they were discordant whether it is energy or not.

On the second day, the children from one pair were ill, so we could only do five interviews. The most interesting question was the last one "How do you imagine the world without energy?" The first results will be presented here. In all interviews the children consider only two categories: the change in nature and electrical energy. The main aspects which were mentioned in four interviews are in one category "light" and in the other category "people". All children seem to think that without energy the sun will still shine, but there would be no electric light. In one interview they referred to other electrical equipment for example: – a laptop, a microwave and a fridge. The children thought that these could not be used without energy. The children had different points of view how the people will change as a result of no energy. Two pairs of children thought that people will die as a result of no food. One pair developed this idea at the end of their interview. At the beginning they thought there would be only old and poor people. Another pair had the opinion that all people "would turn nasty, forget everything and could not feel anything any more". A fourth pair mentioned that people would not be able to move any more.

This question also helps to show that the children link their ideas about energy to their own bodies as well as the energy around them in the environment. In conclusion, their main thinking is focused on electricity and people.

Regardless to the fact that the transcription of all interviews has not been finished, some noticeable statements can be mentioned at this point. Most children said that "people and animals need energy". They get the energy by eating. All children in this kindergarten were sure that beneficial products have energy but food containing sugar does not. They explained that one gets fat by eating chocolate and one cannot run fast any more. Some of the children only associate electricity with energy. One pair used the term "strongness" instead of energy for food and movement. Nearly all the children associate the term energy with something positive.

Conclusion

A sustainable energy supply and the use thereof, is a key problem of current concern. According to Klafki and the idea of a spiral curriculum, the topic should be engaged early. Current studies show that kindergarten children, even if they do not have an explicit knowledge of the term, already have acquired implicit conceptions when it comes to energy. One can therefore begin to develop a sustainable energy pre-concept even in Kindergarten.

In preschool, and in the first and second school years, this should predominantly take the form of giving children experiences and explanations of common situations in the development of scientific, practical solutions. It is important that the children in these age groups develop both an understanding of, and a definition for, the term "energy", and also for them to develop a positive attitude towards both nature and technology.

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The Position of Food in the Primary School Curriculum: Implications of the Review of the Primary Curriculum in England

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Abstract

This paper reviews the roots and development of food technology introduced as an element of design and technology in the 1990 National Curriculum for Technology in England and Wales. It outlines current government initiatives to encourage primary aged children to eat healthily and develop practical cooking skills. This includes 'Active Kids Get Cooking', 'Food in School' and the 'School Food Trust' programmes The School Food Trust remit is to transform school food and food skills, promote the education and health of children and young people and improve the quality of food in schools.

The paper continues by investigating current classroom practice in food technology through the perceptions of a group of primary initial teacher education (ITE) students. The study explores what they have observed and taught in their school placement schools, what they think children should learn about food and where in the curriculum this should be. The students are asked for their views of the food technology session taught as part of their design and technology at the university. The results are discussed in the context of the current Primary Curriculum Review, led by Sir Jim Rose, and the range of current government food based initiatives. The paper concludes by exploring the implications for the teaching of food in the primary school curriculum and ITE programmes.

Introduction

This paper is in four parts. Part 1 will provide a brief review up to the present time developments in the teaching of food technology in primary schools (pupils aged 5 – 11) in England.

Part 2 will describe a wide range of enhancement and enrichment programmes that have been developed to complement the teaching of food in the mainstream primary curriculum e.g. Active kids get cooking.

Part 3 will report on the perceptions of a small group of primary initial teacher education (ITE) students of the food technology sessions observed and taught in their placement schools, what they think children should learn about food and where this should be in the curriculum. They will be asked for their views of the food technology session taught as part of a design and technology course at the university. This will provide a snapshot of current practice.

Part 4 will discuss the implications of the findings reported in parts 1, 2 and 3 for the teaching of food in schools and ITE courses with reference to the current Primary Curriculum Review.

Part 1

Developments in the Teaching of Food in Primary Schools

The teaching of food as a practical activity for girls has been part of the English elementary state school system since the late 1800s, when it was introduced to raise the living standards of working families and prepare girls for low paid employment (Sillitoe, 1966). Prior to the introduction in 1990 of National Curriculum Design and Technology in England and Wales (DES, 1990), food activities in primary schools were generally limited to 'fun' sessions taught by 'mums'. In the early days of the National Curriculum there was considerable debate about the place of food technology in design and technology (Newton, 1990, Moran 1990), including evidence to suggest that few primary schools made use of food within design and technology (Martin and Coleman, 1991).

Despite these concerns, Ridgewell (1992) reported that primary teachers were using food as a material in their D&T activities and noted that the key concerns raised by primary teachers included food hygiene and the organisation of food activities in a primary classroom. She found that children thought 'food is fun', but that primary teachers needed help with safe food handling and the choice of equipment. One of the major differences between secondary and primary food work was the lack of purpose built primary food rooms, with teachers expected to teach food activities in a multi-purpose primary classroom. Issues highlighted were the need to handle food in a clean environment, short and long term storage of food, protective clothing for children and adults and basic health and hygiene requirements such as 'washing up' equipment.

The concept of food technology was different to activities where children simply learn to cook and follow a recipe. A food technology HMI publication (Office for Standards in Education (Ofsted) 1996) emphasised that in food technology, unlike 'cooking', children design food products to meet specific requirements and that these activities are underpinned by knowledge and understanding of food based on links with science, safe use of basic tools and equipment, hygienic practices and sensory evaluation. The debate about the place of food technology in design and technology continued and in the revision of 1995 (DFE, 1885) it became compulsory for all primary children. The British Nutrition Foundation (BNF) supported a whole curriculum approach for food with specific reference to the subjects of science and technology (Fine, 1994).

By 1996 it was noted that food technology was firmly on the primary curriculum with schools considering how it could be taught in the classroom and treating it in a different way to 'cooking' (Ridgewell, 1996). It can be argued that this slow development of food technology had been compounded in primary schools by five features. One was the low status of working with food in the primary curriculum before the introduction of design and technology. Two, the nature of the work carried out at that time involved following simple recipes under close supervision with little if any expectation of deviating from the recipe. Three, many, if not most, primary school teachers lacked any previous experience of teaching through pupils' designing. Four, there are health, hygiene and safety considerations for working with food in the classroom that do not apply to working with other materials. Five, working with food requires some specialist facilities, which are an added expense (Barlex and Rutland, 2003).

However despite these concerns there was evidence that good practice was developing with food technology units of work and curriculum resources developed to support the teacher. These included the Design and Technology Association's Primary Schemes of work (DATA, 2002) and the Nuffield Primary Design and Technology teaching materials www.primarydant.org Some, but not all initial teacher education (ITE) courses, successfully included food technology sessions (Barlex and Rutland, 2003) and primary practice presented ideal opportunities to link food technology with other areas of the curriculum (Rutland, 2006). It was survey of practice in primary school the range of design and technology resources in schools varied, though facilities for food were generally available. 85% of design and technology sessions, including food technology, were taught in the classroom and only 5% in specialist accommodation (Rutland et al, 2006). A study of the practice of ITE primary students showed how a model for design decisions could be used successfully to improve designing in food technology and reduce repetitive modification of one food product. The use of the design decisions model had widened their choices and provided a constructive tool to guide their independent learning and thinking (Rutland and Miles-Pearson, 2006).

Part 2

In a wider context health eating is seen as an essential element of the government policy document, Every Child Matters (ECM) www.everychildmatters.gov.uk. This aims to ensure the well-being of children and young people from birth to age 19 years, through achieving five outcomes. They are to be healthy, stay safe, enjoy and achieve, make a positive contribution and achieve economic well-being. A fundamental aim of the English government has been the development of whole school food policies for the entire school community and a greater public understanding of a schools' food and drink provisions in general and in the curriculum. Initiatives have included healthier breakfast clubs, healthier tuck shops, water provision, healthier vending and healthier lunchboxes.
www.food.gov.uk/multimedia/pdfs/foodpolicygoverning.pdf .

The project Food in Schools run by the Department for Children, Schools and Families (DCSF) and Department for Health (DH) encourages schools to develop whole school food policies. They can set up local food partnerships, where secondary food specialists train and support their primary colleagues, helping them to work towards the National Healthy Schools Standard. www.foodinschools.org Recently, the Government has announced new standards for school food in all local authority maintained primary, secondary, special and boarding schools, and Pupil Referral Units (PRUs) in England. They cover all food sold or served in schools, including breakfast, lunch and after-school meals, tuck shops, vending machines, mid-morning break and after-school clubs. www.schoolfoodtrust.org.uk

Over the years there have been a wide range of initiatives that have impacted on primary school to encourage children to eat healthy foods and become involved in cooking. The School Fruit and Vegetable Scheme is part of the 'five a day' programme to increase fruit and vegetable consumption, where all four to six year old children in local authority maintained infant, primary and special schools are entitled to a free piece of fruit or vegetable each school day.
www.dh.gov.uk/PolicyAndGuidance/HealthAndSocialCareTopics/FiveADay. After school club provision is found within the Extended Schools agenda. Where pupils are staying at school until 6pm, schools need to provide food and drink and this gives opportunities to promote healthy eating and to provide nutrition education and related activities. Other bodies, including the School Food Trust, play a key advisory role and bring together industry, education and the voluntary and community sectors to encourage schools to trial new approaches to improving school food. www.schoolfoodtrust.org.uk

Let's Get Cooking is a national network of cooking clubs for children, families and their communities across England, funded by the BIG Lottery Fund and led by the School Food Trust in partnership with the Prince's Trust, Business in the Community and Magic Outcomes www.letsgetcooking.org.uk// . Similarly, Active Kids Get Cooking is a very successful scheme first launched in 2006 and formally known as Taste of Success. It is a collaborative initiative with Sainsbury, the Design and Technology Association and the British Nutrition Foundation (BNF). It recognises, supports and promotes excellent healthy eating work and cooking in early year's settings, primary, middle, secondary and special schools throughout the UK (including the Channel Islands and Service Children's Schools).
www.activekidsgetcooking.org.uk/activekidsgetcooking

Methodology

Two research questions drove this study. They were:

- What is the current situation in primary schools regarding the teaching of food?
- What are the implications for the teaching of food technology in design and technology of the current Primary Curriculum Review?

It was decided to investigate the perceptions of a cohort of 86 three year undergraduate BA students with qualified status (QTS) and 24 one year postgraduate certificate of education (PGCE) primary initial teacher education (ITE) students. The 110 students were a sample from 20 groups (20 students) of BA and 10 groups (25 students) of PGCE students, making a total year group of 650 students. The sample were the groups taught their design and technology course of 5 sessions of 3 hours in the first half of the Spring Semester 2009. The sessions were:

- Session 1: Product analysis
- Session 2: Levers and linkages
- Session 3: Textile technology
- Session 4: Food technology
- Session 5: Movement /mechanisms

The students have tutorials during another session.

The data was collected from the students using a questionnaire completed at the end of one of their design and technology sessions. This was thought to be the most effective way with as many people as possible in a short space of time. The questions devised were appropriate to the task at hand and enabled the collect of a combination of quantitative and qualitative data.

The questionnaire contained the following questions:

1. Have you observed any food technology sessions being taught in your placement schools?
   What was the content of the sessions being taught?
2. Have you taught any food technology sessions in your placement schools?
   What was the content of the sessions being taught?

3a) What do you think that children in primary school should learn about food?

3b) In which curriculum areas do you think that they should learn about food?

4 Did you find the content of your food technology session at university informative and useful?

Discussion

In Table 1 it was noted that 58.16% of the cohort of 110 students were able to observe food technology and 41.82% were not. In Table 2 when asked about the food technology sessions they had taught, this balance was reversed with 28.18% able to teach food technology sessions and 71.82% not unable. These findings were disappointing but not surprising in the school placements are not long and observations can be brief, but teaching food technology requires considerable time and effort in the planning and implementation. The number of sessions observed and taught was at its lowest with the older children in Years 5 and 6 and at its highest with the children in the Nursery, Reception and Year 1 classes. This was not unexpected as the student groups taught in the first half of Semester 2 were from a younger age group specialism.

The range of products observed for nursery children in Table 1 was wide and varied and they were expected to learn how to follow instructions and measure. Healthy eating and hygiene were mentioned, as was teaching science through design and technology (liquids and solids). In the sessions taught by students in Table 2, the range of products was smaller, as would be expected with only 28.18% of the students able to teach food technology sessions. However, it was encouraging that the skills taught to the nursery children were more complex and included experimentation, taste testing and making decisions with links made to a story, for example 'Oliver's Fruit Salad'. The knowledge cited included the properties of foods, different cultures, changing ingredients and what happens in the oven. The students would have had more ownership of these sessions because they planned and taught them. It can be argued that this enhanced rigour was because of understanding and knowledge gained during the student's design and technology course of designing and making with a range of materials, including food. In Table 2 of the taught sessions for the older year groups (Years 3, 4 and 6) links and themes were more varied. They included for Year 3 Tortilla Wraps linked to the Aztecs. In Year 4 a Roman Feast looking at foods that were available to eat at that time, such as grapes, honey, rabbit, goat and fresh vegetables. A theme of World War 2 in Year 6 looked at food rationing, foods such as Bubble and Squeak and growing your own foods in the garden or allotment.

There were some good examples of links with science in Table 1 and Table 2 with examples in nursery of learning about liquids and solids, the effect of heat in Year 4, the concept of irreversible change through scrambled eggs in Year 6 and how yeast makes bread rise in Year 5. In Table 1 the observed skills taught were simple, such as following a recipe, writing instructions and cooking. In Table 2 the taught sessions used more technical design and technology terms such designing for a purpose, changing ingredients and flavour, combining ingredients, experimenting, making decisions and being creative. When comparing the technical language used in Table 1 of the sessions planned and taught by the teacher and Table 2 of the sessions taught by students there was generally a wide use of scientific and technical design and technology language.

In the sessions observed in Table 1 there was repetition across the year groups with Boston Brownies taught to Years 4, 5 and 6. Products linked with Christmas, Easter, Shrove Tuesday and the Chinese New Year Bread appeared in the observed sessions of Table 1 in nursery, reception, Years 2, 4 and 5 but not so frequently in the taught sessions. It was unclear why this was. On closer examination of the types of products taught in the observed sessions, there were inconsistencies in that pizza was observed in nursery, Year 1 and Year 6, though how the pizza were made was not clear. They could have been made with readymade bread roll base in the nursery, a scone base in Year 1

Table 1: Question 1: Have You Observed any Food technology Sessions Being Taught in your Placement Schools

Question 1: Food technology sessions observed by ITE Students

	Nursery	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Products	Pizza Fruit Salad, Gingerbread men Bread Flapjacks Smoothie Chinese New Year Cakes Porridge Chocolate nests Rock cakes Cookies (stained glass) Easter nest cakes Noodles Cornflake cakes Mini eggs Mini Xmas cakes Sandwiches Biscuits Bird food	Pumpkin Soup Fudge Xmas biscuits Valentines biscuits Bread Biscuits Xmas cake Gingerbread men Pancakes	Sandwiches Cakes for Chinese New Year Fruit salad Chocolate Easter Cakes Porridge Pancakes Topping for Pancakes Tortilla wraps Biscuits Peppermint creams – Xmas Healthy pizza Xmas cornflake / chocolate cakes	Kitten cakes Pizza Bread Sushi Easter baking Fruit skewers Salad Cakes Icing biscuits Pancakes Planet pizza Iced cakes Kipper cakes (story)	Apple pies Brownies Apple pies Sandwiches Muffins Xmas cookies Pancakes Burgers Fruit salad Wraps Fillings Fruit kebabs Gingerbread men	Boston Brownies Cookies Banana bread	Bread Boston Brownies Xmas cakes Design and make biscuits Smoothies – experiment Scrambled eggs (science) Buddle & Squeak (history)	Boston Brownies Pancakes Pizza – Xmas Fare Shortbread
Skills	Setting in fridge Baking Follow instructions Melting chocolate Measuring (maths) Tasting	Cooking Cutting, weighing		Following instructions Writing instructions	Following a recipe Working together Cutting Measuring Designing icing	Working together Cutting Measuring Designing icing Following instructions	Writing instructions Working together	Working together Weighing ingredients
Knowledge	Hygiene Healthy eating Science through D&T (liquids/solids) Space theme Easter	Diwali – linked to Art	Healthy eating Link to previous work on fruits Aztecs	Healthy eating Shrove Tuesday Links to literacy	Shrove Tuesday Healthy schools Healthy eating Changing ingredients	Combining ingredients Effect of heat Healthy sandwiches Tasting Heritage week Balanced diet	Links to literacy Science (yeast) Healthy eating Links with PHSE and science Irreversible changes Foods from the garden	Links with maths (shortbread)

Table 2: Question 2: Have you Taught any Food Technology Sessions in your Placement Schools?

Question 2 Food Technology Sessins Taught by ITE Students

	Nursery	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Products	Snacks Chocolate sparklers Fruit salad (Oliver's Fruit Salad) Porridge Fruit skewers Salads Cakes Chinese New Year cakes Pancakes Angel cake Popcorn Biscuits Gingerbread men	Sandwiches	Fruit salad Biscuits Cakes Pizza	Brownies Planet pizza (space project) sandwiches	Healthy sandwiches Tortilla wraps – Aztecs	Roman Feast grapes, honey bread School trip – packed lunch – sausage, soup	Bread	Biscuits Scrambled eggs – science Bubble & Squeak
Skills	Experimentation Describe & taste Making shapes – marzipan Making shapes – marzipan Golden time activity Handling foods Making decisions		Follow instructions Practical skills Making shapes – marzipan Using equipment safely	Practical Writing instructions	Follow instructions Copy skills	Designing of foods Being creative		Designing for purpose, appearance Experimentation Making food from basic ingredients

lover.

continued/. Question 2: Food Technology Sessins Taught by ITE Students

	Nursery	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Knowledge	Good growing foods Properties of foods Healthy foods Properties of foods – porridge Different cultures Healthy choices Measuring – numeracy Consistency What happens in the oven Changing ingredients – science Indian foods		Health & Safety	Links with literacy		Likes/dislikes Foods available in Roman times Rabbit, goat, vegetables Changing ingredients / flavours	Hygiene Purpose of ingredients	Links with science e.g. irreversible change Links with history e.g. rationing and growing food in the garden

and a yeast bread base in Year 6. If this approach was taken by a school in their planning then there would be progression and continuity across the year groups with more complex food technology knowledge and skills covered over the year groups. Otherwise, there would be repetition resulting in lack of progress and low level motivation by the children. Pancakes were observed in the nursery and Years 1 and 6. This raises the question of exactly what the children are expected to learn in the session. They may have been helping an adult in reception and having a 'fun' time but in Year 6 being expected to work with a supporting adult in a much more independent manner.

Question 3a of the questionnaire (Table 3) asked the students what they thought children in primary school should learn about food. The highest response by far for knowledge was healthy foods/eating at 48.86%. This was followed by health and safety of foods at 10.50% and a balanced diet at 6.39%. Regarding skills how to cook simple products/meals was the highest at 31.34% followed closely by basic cooking skills, measuring and making (29.85%). Table 4 summarised the findings of Question 3b which asked the students in which area of the curriculum they thought children should learn about food. The highest response was for science with 27.73% followed by cross-curricular at 24.35% and design and technology at 18.83%. These three were well above the similar responses for other subjects such as history and religious education (RE). Measuring with mathematics 3.25% scored reasonably well. The cross-curricular response (24.35%) was interesting in that the students saw the importance of linking with a range of subjects, though science was seen as of highest importance.

The last question asked the students about the food technology session taught at the university. Overall, they found the one three hour session to be very useful and they related well to how they would teach in schools. They rated highly the activities of sensory analysis or 'taste testing', exploring the effect of changing ingredients and experimenting. They did suggest additional activities that they would like to cover, such as healthy eating and diet and cakes, but there is likely to limitations related to the time available and the requirements of the other specialist areas of design and technology.

A brief review of these findings in the context of the current Review of the Primary curriculum led by Sir Jim Rose is important for the future of the teaching of food in primary schools. The final report (DCFS, 2009) was published on 30 April 2009 www.dcsf.gov.uk/primarycurriculumreview/. It includes the proposed programmes of learning that would make up a new curriculum and the Essentials for Learning and Life that will be developed throughout. Recommendation 5 (DCSF,2009) is that the content of the primary curriculum should be organised as it is now under knowledge, skills and understanding but structured as six areas of learning to enable children to benefit fully from high-

Table 3: Question 3a: What do you think that Children in Primary School Should Learn about Food?

	Number of responses	% responses		Number of responses	% responses
Knowledge			Skills		
Healthy foods/eating	107	48.86	How to cook simple products / meals – toast, pizza, desserts, bread, salads, pizza 10	21	31.34
Health and safety of foods	23	10.50	Basic cooking skills, measuring and making	20	29.85
A balanced diet	14	6.39	Experimenting and combining ingredients	7	10.45
Food groups and nutrition	14	6.39	Safety with utensils	5	7.46
Where food comes from	12	5.48	Being creative	2	2.99
Hygiene	9	4.11	How to cook healthy meals	9	13.43
Foods from other cultures	7	3.20	How to follow instructions	1	1.49
What foods are made of	6	2.74	Evaluating and modifying	1	1.49
Properties of foods	4	1.83	Tasting foods – sensory evaluation	1	1.49
Greater understanding of their bodies	3	1.37			
Healthy life styles	3	1.37			
Storage of food	2	0.91			
Costing	1	0.46			
Ethics of food	1	0.46			
Food miles – sustainability	1	0.46			
Food science	1	0.46			
Health risks	1	0.46			
Total number of responses	**219**	**100**	**Total number of responses**	**67**	**100**

Table 4: Question 3b: In which Curriculum Area do you think that they should learn about food?		
Subject/area	**Responses**	**% Responses**
Science	70	27.73
Cross-curricular	75	24.35
D&T	58	18.83
PHSE	20	6.50
Geography	16	5.19
RE	14	4.55
PE	13	4.22
History	11	3.57
Maths – measuring	10	3.25
Art	6	2.95
Literacy	5	1.62
English	4	1.30
MFL	2	0.65
ICT	1	0.32
Numeracy	1	0.32
Citizenship	1	0.32
Creative curriculum	1	0.32
Total	**308**	

quality subject teaching and equally challenging cross-curricular studies to improve the continuity of learning from the Early Years Foundation Stage (EYFS) to Key Stage 3. It is noticeable that in the area of learning scientific and technological understanding *www.dcsf.gov.uk/primarycurriculumreview/downloads/scientific-and-technological-understanding.pdf* food is omitted when children 'explore and investigate different materials' when designing and making (p3). Though, they should investigate the properties of everyday materials such as ingredients (p4). It is in the area of learning understanding physical development, health and wellbeing *www.dcsf.gov.uk/primarycurriculumreview/downloads/understanding-physical-development-health-and-wellbeing.pdf* that children should know that 'healthy living depends upon a balance of physical activity, nutrition leisure, work and rest to promote well being' (p2). In addition, it is recommended that the new primary curriculum should have a more integrated personal development framework (DCSF,2009, Point 11). An example of the key skills and essential knowledge in this overarching framework are nutrition, food preparation and healthy living.

The views of the students were that healthy foods and healthy eating, safety of foods and a balanced diet were important and that children should know how to cook simple products/meals using basic cooking skills and measuring and making. In the current design and technology programmes of study primary children can design and make in the context of food technology and link this to learning in science about the properties and behaviour of ingredients when combined and cooked. The students in this study recognised the importance of science and that cross-curriculum dimensions provide an important context for the teaching of food. In the present Review it stated that cross-curricular studies help children have a better understanding of issues such as health and well-being and provide opportunities for them to use and apply what they have learned from the discrete teaching of subjects (DCSF, 2009, Point 25).

Conclusions

At the time of writing it is unclear where food will be taught in the new primary curriculum. There appears to be some conflict between its acknowledged importance for key skills and essential knowledge in a personal development framework, its contribution to healthy living and well being in the learning area of understanding physical development, health and wellbeing and its contribution to investigating the properties of materials such as ingredients in scientific and technological understanding. Food is a very large and importance area of knowledge and understanding for children to learn. To try and locate it one subject or area is clearly unwise. Children can use and apply what they have learnt from science in food technology and other areas of the curriculum. They can explore in science the properties of ingredients to find out where they come from, how and why they are used and how they can be changed in the context of the practical activity of designing and making with food in design and technology. Similarly, scientific knowledge of food groups and nutrition can help children build a secure understanding of healthy eating. The wide range of food related government initiatives described in this paper play an important role in reinforcing this understanding and the development of skills for children. They strengthen children's knowledge and understanding of the balance and range of factors necessary for healthy living and personal wellbeing. There is a need to clarify the contribution of all the areas of learning to the teaching of food, so that teacher can avoid unnecessary duplication and develop synergy between the contributing areas leading to a holistic understanding. This will clearly present a challenge for teacher when planning and implementing their curriculum. It also has implications for ITE as future teachers will need to understand the complex nature of learning about food in the primary curriculum.

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Improving Attitudes to Science and Technology in Dutch Primary Education

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Introduction

The Dutch Department of Education and Science, together with national organisations of enterprises in the technology sector, established a national programme to incorporate science and technology into the curriculum and the organisation of primary schools (ages 4-12). Over 2500 primary schools (a third of all Dutch schools) received a grant of 25,000 euro's, together with substantial support from regional support centres. Within a period of 3 years they have to incorporate science and technology into their everyday school practice. The aim is to bring about a change in attitude towards science and technology in schoolchildren.

The progress of the schools is closely monitored: all participating schools submit their progress in an annual report. Also, each year, schools take part in research into the attitude of 12 year old pupils towards science and technology. The monitoring results are discussed by groups of teachers, aiming to optimise the effect of science and technology education on the attitude of their pupils.

In addition, all schools are visited by an auditor who judges the quality of the implementation. The auditor also collects examples of good and promising school practice, which are then disseminated to all Dutch schools via a website www.wtwijzer.nl. The audit results are used to further improve the attitude towards science and technology in Dutch primary education.

The Dutch Ministry of Education, Culture and Science, the technology sector and trade unions have jointly expressed their ambition to ensure that technology[1] acquires an established place on the curriculum[2]. In 2004 this ambition was translated into a National Plan of Action for the Expansion of Technology in Primary Education 2004-2010, which forms the basis for the implementation of the VTB Programme (Programme for the Expansion of Technology in Primary Education). This programme is founded on three principles: firstly, the idea that children, who are introduced to technology at school at an early age, have the opportunity to develop a positive attitude to science and technology. Secondly, it is assumed that pupils with a positive attitude to science and technology will be more likely to choose science and technology subjects as their education continues. The VTB Programme thus represents a long-term investment in the knowledge economy. Thirdly, the VTB Programme is based on an educational ideal: integrating technology into primary education improves the level of technical literacy in society.

The purpose of the VTB Programme is to ensure that in 2500 primary schools, science and technology is firmly embedded in the teaching, organisation and policy, and that for all Dutch primary schools, access to the information and materials needed to introduce science and technology into the school is made as easy as possible. The 2500 schools were accepted on to the programme in stages, with a number of schools starting each year, beginning in 2004:

Table 1: Participation in VTB Programme		
Cluster 1	November 2004	100 schools
Cluster 2	April 2005	400 schools
Cluster 3	April 2006	800 schools
Cluster 4	April 2007	600 schools
Cluster 5	April 2008	600 schools

Schools taking part in the VTB Programme have three years in which to integrate science and technology into their organisation, curriculum and policy. The VTB schools accept the goals of the VTB Programme to expand science and technology in primary education. These goals encompass the minimal intervention schools require to undertake to integrate science and technology. They conclude an agreement with the VTB Programme of the Science and Technology Platform stating that after three years they will have achieved all the goals.

VTB Programme Goals

Organisation:
- Expansion of science and technology is promoted by the technology coordinator and the teaching staff
- Sufficient time, materials, space and experts are available
- The school has external contacts in the field of science and technology

Curriculum:
- There is a clear progression in the syllabus covering at least two year groups
- The school uses the design loop, visits, guest teachers and Internet
- The school monitors achievement of the goals it has set

Policy:
- The school has established goals
- A syllabus comprising a clear progression is agreed
- Science and Technology figure in the School Plan

The goals are set out in the VTB questionnaire. This electronic questionnaire is completed annually, in April, by the head and/or the technology coordinator (or coordinators) of each VTB school. The goals can also be found on the VTB website www.wtwijzer.nl (only in Dutch), where the knowledge base is outlined.

In order to follow developments in the VTB schools, the VTB Programme has established a system of monitoring and auditing, which also gives schools an overview of their progress with regard to the teaching of science and technology. The VTB Programme monitoring and auditing process encourages schools to take a critical look at their progress, to identify problems and to make improvements. In addition to the electronic questionnaire, schools have access to a further two monitoring tools and a quality audit:

Attitude measurement

In a system introduced in 2008, the attitude of Year 8 pupils (aged 11/12) in all VTB schools is measured each year. The measurement is carried out by their class teachers. The test is available in electronic form from www.vtbportaal.nl and includes a clear guide for the teacher. In January 2008, 27,000 pupils were measured and in October and November 2008, a further 28,000 pupils.

Focus Group Discussions

The results of the attitude measurement and the VTB questionnaire provide input for 'focus group discussions'. In these discussions, which are led by a regional support centre, groups of five to seven VTB schools are brought together to exchange views. They are held at the end of the first and second VTB Programme years. The schools from Clusters 2, 3 and 4 took part in discussions in February and March 2008. These exchanges of views must be attended by the head and the technology coordinator, who may be accompanied by other members of staff. During the focus group discussions the results of the questionnaire and the attitude measurement are compared and an attempt made to identify the key success factors for the effect of science and technology teaching on the attitude of pupils. A digital tool has been developed to help schools reflect on the integration process, both individually and with others. No record is made of the outcome of the focus group discussion for use by the Science and Technology Platform/VTB Programme. It is up to individual schools to take note of any relevant points for their own use and to take back to the classroom any recommendations for further improving science and technology teaching.

Audits

Since 2008, regional audit teams have carried out audits at all VTB schools. The meetings with the first 1200 schools (Clusters 2 and 3) took place in the period from March to July 2008. In 2009, a further 600 schools (Cluster 4) will be visited by an auditor, and in 2010 it will be the turn of the last 600 (Cluster 5). The audit concentrates on the nine goals set by the VTB programme. In addition, particular attention is paid to three areas: ownership and sustainability; attitude and the influence of the VTB Programme on how pupils select education options; differences in attitude between boys and girls.

In order to build up a picture of the situation in VTB schools, the auditors were asked to award a grade for the various elements of the programme. The auditors rated 67 of the 1106 schools unsatisfactory and 4 schools were awarded a 10. The most commonly awarded rating was 7 and the average 7.1. The results show that after three or four years over 70% of the VTB schools have achieved all the goals.

To build up a fuller picture, the schools have been divided into categories. The following eight categories were defined on the basis of the results of previous audits:

- Model schools: schools that have embraced science in technology in a way that results in a clear policy, concrete implementation within a large section of the school and a firm place in the curriculum. They are an example for other schools. However, this does not mean that there is no room for further improvement in these schools. 48 of the 1106 schools were categorised as model schools
- Advanced schools: schools with a clear policy, concrete implementation and sufficient expertise. Science and technology are firmly embedded in the school programme. The auditors considered that 222 schools met the criteria for the advanced school category
- Promising beginners: this is the biggest group. Beginners are schools with a clear aim, who are making good progress with the introduction. They are still looking at additional ways to implement a science and technology programme at school. According to the auditors, 416 of the 1106 schools have reached this stage
- Project schools: these are schools that are working on science and technology as long as funds are available, but which are expected to lose interest once the money dries up. This group has some features in common with the group of 'limited activity beginners'; the difference lies in the attitude of the school. The auditors came across 16 project schools among the schools they visited
- Beginners in the planning phase: the intent is clear, as is the aim, but as yet there has been little concrete activity in terms of introducing science and technology. The auditors encountered 126 beginners in the planning phase
- Limited activity beginners: schools in the initial phase. The school is still investigating the area and has as yet no clear intent or policy and very little actual activity. There are 112 schools in this category
- Exploring beginners: schools in the initial phase, with a limited amount of activity in relation to science and technology, but no clearly defined intent or policy. According to the auditors, 76 schools are in this exploratory phase
- Second attempt schools: these are schools that have done little or nothing in terms of science and technology, but have recently made a renewed attempt. In many cases there were good reasons for being in this situation, such as the only person with any knowledge of science and technology having left the school, or the school having had to concentrate on its survival or a merger. There are 43 schools in this category

Table 2: Average score in the technological areas[3]	Boys		Girls	
	Ave.	(SD)	Ave.	(SD)
Gender-stereotypical attitudes to technology	2.64	(0.88)	1.86	(0.69)
Idea that technology is difficult	1.84	(0.50)	1.95	(0.48)
Understanding of the importance of technology	2.91	(0.47)	2.70	(0.47)
Enjoyment of technology	3.03	(0.44)	2.81	(0.46)
Expectation of a technological education or job	2.41	(0.88)	1.74	(0.62)
Traditional view of technology	3.21	(0.54)	3.18	(0.53)
Broader view of technology	2.73	(0.58)	2.75	(0.57)

Table 3: Average score in the scientific areas	Boys		Girls	
	Ave.	(SD)	Ave.	(SD)
Gender-stereotypical attitudes to science	2.22	(0.90)	1.49	(0.59)
Idea that science is difficult	2.61	(0.60)	2.50	(0.61)
Understanding of the importance of science	2.94	(0.48)	2.81	(0.47)
Enjoyment of science	2.89	(0.64)	2.67	(0.64)
Expectation of a technological education or job	1.94	(0.70)	1.69	(0.61)
Traditional view of science	3.27	(0.47)	3.25	(0.48)
Broader view of science	2.77	(0.49)	2.70	(0.48)

The VTB Programme audit has three important roles. It supports schools during the introduction process, so that the performances defined can be achieved and maintained. It is also intended to monitor the self-evaluation process carried out by the VTB schools. For the programme as a whole, the audit sets out the overall results, which can then be used as the basis for formulating policy recommendations.

Attitude measurement

In January 2008, the VTB Programme introduced its first large-scale measurement of attitudes to science and technology in VTB schools. All VTB schools were offered the opportunity for their Year 8 pupils to take part. Just over 27,000 primary school Year 8 pupils completed the science and technology attitude measuring exercise. Around 4% of these pupils were in special education. The measurement has now been adjusted to take account of this group of pupils.

This exercise measures the attitude of Year 8 pupils at VTB schools to science and technology. The instrument used distinguishes six areas in which pupils can score from 0 to 4 points:

- What pupils think can be included in science and technology (a traditional view versus a broader view)
- The gender-stereotypical ideas pupils have about science and technology
- The extent to which pupils believe that science and technology are difficult
- The enjoyment that pupils get from science and technology
- The importance to society that pupils ascribe to science and technology
- The degree to which pupils expect to choose a scientific or technological job

The pupils' scores for these areas can be seen in the tables above.

The results of the measurement indicate that boys show a far higher level of stereotypical attitudes to technology than girls. Boys also think that girls are not as good at technology as them. Girls are a little more likely to think that technology is difficult, but less likely to think that science is difficult. Boys are more likely than girls to say that they intend to choose a scientific or technological education or job. The location and the type of school also seem to influence the pupils' opinions. Girls in the larger cities are more likely to enjoy technology and expect to choose a technological education or job. They are also less likely than the girls outside the cities to believe that boys are better at science and technology.

The analysis of the first attitude measurement exercise and the VTB Programme questionnaires shows almost no link between the VTB related characteristics and the various areas covered in the attitude measurement. One of the main reasons for this is that attitudes are slow to change. Although the measurement cannot be used to evaluate the VTB Programme, it has other roles. Schools find it a useful means of assessing how the introduction of science and technology has affected pupils. They also think that, when taken in conjunction with the focus group discussions, it offers a good opportunity to reflect on the situation in terms of their own integration process. From the schools' point of view, the attitude measurement is an important means of raising awareness: by participating in the measurement exercise schools are made aware of the attitudes of their pupils and also of the effect of introducing science and technology at school.

For the national organisation of the VTB Programme, the attitude measurement exercise provides valuable policy information, namely, how to have a positive influence on pupils' attitudes. This is then translated into concrete guidance for teachers. In order to ensure a positive attitude, it is important that pupils realise that they are being taught science and technology. An analysis of background information shows that the more hours of science and technology lessons pupils feel they have had, the more positive their attitude becomes. Teachers can also focus more on the social relevance of science and technology and play a role in improving the image of science and technology, and jobs in those sectors, by using male and female role models.

Attitude measurement also raises the problem of gender stereotyping in primary schools. The results show a significant difference in attitudes to science and technology among boys and girls. However, primary education seems to deny the existence of these differences. In some cases, schools have objected to the way in which the questions are worded, where they make a distinction between boys and girls. The audit results also indicate that, in the classroom, the schools observe no difference between the attitudes of boys and girls. For the Science and Technology Platform, these results are a stimulus to pursue research into the differences in attitude between boys and girls, and how teachers can deal with this effectively, so that the attitude of boys and girls to science and technology further improves and they are enabled to make the very best use of their talents in this area.

1 *The Plan of Action refers to 'technology'. In the meantime, the VTB Programme has expanded its aims to include 'science and technology'.*

2 *The VTB Programme is financed by the Ministry of Education, Culture and Science and the educational funds made available by the technology sector. The Platform Bèta Techniek (Science and Technology Platform) acts on behalf of the sponsors as the contact with the VTB Programme.*

3 *The standard deviation (SD) shown in the table indicates the extent of the differences between values, and thus the distribution of the values.*

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  Amsterdam, Regioplan


ΥΛΙΚΑ
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ΣΤΡΟΒΟΛΟΣ

Cows in the classroom? Technology for All

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Abstract

This paper arises out of the South African context where postcolonial ideology has resulted in a desire to reinstate a previously marginalized indigenous knowledge to a position of prominence. However progress in the evolution of the concept of Indigenous Knowledge Systems (IKS) inquiry has been slow. Nel (2005) claims that emotional rhetoric, focus on content knowledge, culture fixing, uncertainties about agenda and methodologies and the inability to mainstream IKS within our educational system have been responsible for this situation.

Very diverse epistemes underlie Western Science and Indigenous Knowledge (Nel, 2005). Modern western culture relies almost entirely on rational and objective methodologies in order to verify and define knowledge. The Western approach to science is secular and according to du Toit has tended to separate "human beings from nature, facts from values, mind from body, subject from object" (2005, p.62). She contrasts this with IKS which she claims "is directly related to the local communities' interaction with their environment, and the knowledge, stories, beliefs, rites and rituals" (2005 p. 56). This poses challenges in trying to integrate Indigenous knowledge into the mainstream curriculum which is founded on the assumptions of the west. There is also a serious lack of support material and direction available to those wishing to implement Indigenous Knowledge into their classrooms and tertiary institutions.

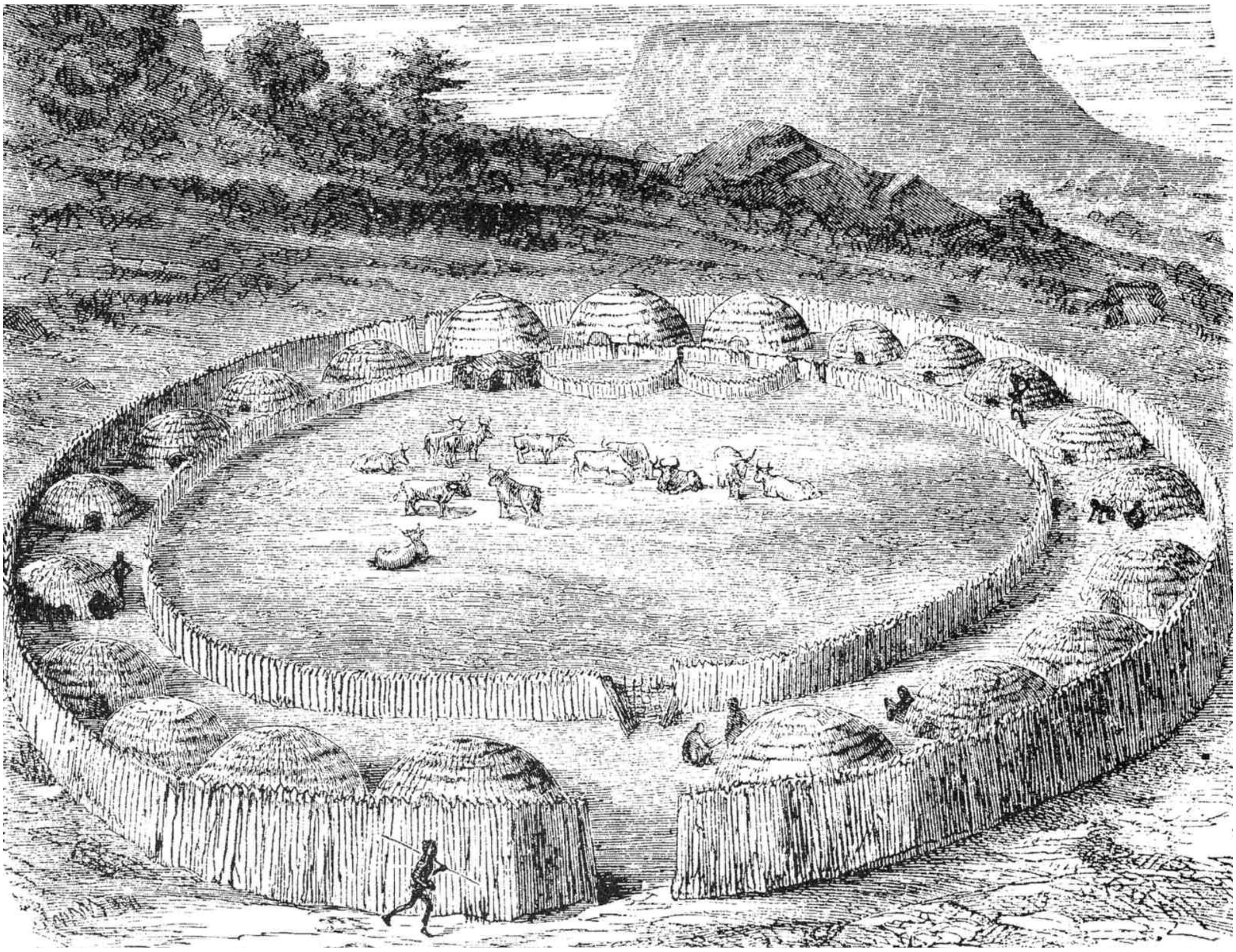
This particular case study "Cows in the classroom?" uses the story of Nguni cattle to explore the two contrasting knowledge systems and find opportunities to integrate indigenous knowledge systems into the curriculum. In so doing I hoped to enhance learner's ways of knowing and also increase their understanding of diverse cultures.

The Role of Cattle in Indigenous Communities

The poet H.I.E. Dhlomo wrote:

> *The cow is … our great means of support. It is our traditional server out of food which we brought with us from the place whence we came out as people. The creation by God is a great miracle here on earth. It is said that one hand washes the other, so it is with the cow and man* (Stuart cited by Poland, Hammond-Tooke and Voigt, 2005 p.10).

(Poland, et al., 2005, p.40)



(Poland, et al., 2005, p.15)

In the traditional Zulu culture there is a deep bond between the herds and the people who cultivate them. Although they have commercial value, their primary value lies in the wealth these animals assume for their owners. Such communities understand wealth in this context, more in terms of status than commercial value *(Doran, Low, and Kemp 1979).* In addition, the cattle play a significant role in spiritual matters. Thus the cattle byre was always situated in the centre of the settlement and encircled by huts. The love indigenous people have for their cattle are evident in the praises and poetry of the cattle names.

This intense relationship with their cattle is known as the cattle culture as it permeated every aspect of life *(Hall 1987).* The cattle provided for a wide range of daily needs. Their milk (processed as amasi) in particular, and meat provided sustenance. Certain animals were trained as draft animals. Hides were used to produce items of clothing, shields, whips, thongs and other items. Dung was used extensively as a plaster (to harden and polish floors, grain pits and other structures) – and also used as manure and fuel. These products and their processes incorporate indigenous knowledge that has been passed down through generations of oral tradition.

The role of cattle in clans' relationships with their ancestral shades (spirits) is a pervasive feature of this relationship. Ancestral graves were located in the cattle byre. Certain cattle were selected, through ritual, as *"inkomo yamadlozi"*. These could not be beaten, slaughtered for meat or sold. Where necessary, cattle were sacrificed to pacify ancestral spirits or in other ritual ceremonies *(Poland 2005).* Not only did cattle thus have significance in religious terms, but also operated as an agent in power relations between individuals and clans *(Hall 1987).* Owners could loan animals to others and used them to perform social transactions such as pay labola.

Poland captures the spirit of the byre in these words:

> *There is a reverence in the place… a fragrant silence when the herd is at pasture, a sense of community and ease when it is kraaled. It is here that the ancestral shades gather, where the cows are milked, where the herd is brought in at night, where the drongo calls, in praise of cattle, from a vantage near the byre as dusk deepens into night (2005 p.10).*

(Poland, 2005, p.72)

The deep personal and emotional character of this relationship between man and beast is also reflected in the wonderful and creative names given to individual animals such as:

> *"inkomo elelemuntu"*
> *– the beast in which there lies a person.*
> *(Poland, 2005 p.72)*

These elements of the holistic relationship between animals and their owners however, contain an innate dilemma for they are in sharp contrast to the impersonal approach associated with breeding as a commercial enterprise. This will be developed later.

Political factors that impacted on the development of Nguni Cattle in South Africa

The first significant impact affecting Nguni cattle occurred in the early 19th century. At this time clans on the Eastern seaboard of South Africa became subject to increasing political pressure because of competition for access to trade with European ships in Delagoa Bay and grazing. The subsequent inter tribal conflict and spectacular emergence of the Zulu kingdom went on to develop into what has come to be called the Mfecane[1]. Military and social changes followed the transformation of the Zulu into a formidable power *(Morris, 1968):*

> *... with great numbers of barracked warriors to feed and provide with war gear, especially shields, strategic expansion of land and cattle became an urgent necessity and therefore decades of stock raiding followed (Poland, 2005 p.13).*

Whilst cattle raiding had always played a part in the traditional economy it now began in earnest. Chaka's herds were extensive and the Nguni cattle were well established and a source of pride. The Zulus remained at the height of their power until they suffered defeat at the hands of the British in 1879. This had a catastrophic impact on Nguni cattle as the royal Nguni herds were slaughtered and the remnant captured *(Poland 2005).*

> *The advent of Europeans in South Africa adversely impacted on the survival of Nguni cattle and, for some time, threatened their existence* (Bester, Matjuda, Rust, and Fourie, 2007)*. Europeans introduced exotic cattle into the country. Because these animals were unsuited to the region and had been bred over centuries for commercial purposes, they required intensive management but nevertheless produced higher yields of milk and meat than the local animals. In contrast, the Nguni were relatively small in size, and were used predominantly as*

draught animals. For all these reasons, Nguni cattle were increasingly perceived as an inferior breed. This disregard for the innate qualities of the Nguni cattle led to the promulgation of an Act in 1934 that empowered officials to inspect cattle in rural areas and to actually castrate any bulls that appeared to be inferior (Bester, et al. 2007). *This act met with such disapproval that it was not applied beyond the first couple of years. Nevertheless it indicates the disdain with which the Nguni came to be held. These views extended to the African people themselves and they began to introduce other bloodlines into their herds. The decline of the Nguni was further hastened by the political events in subsequent years. With the decline of the cattle culture came the threat of the loss of the Nguni cattle themselves and the significant genetic pool that it represents.*

The relevance of the Nguni in the current genetic "Livestock Meltdown" (The "big five"' n.d. para. 1); the animal basis for food security and intelephonelectual property rights

The characteristics of the Nguni have developed over thousands of years as a result of natural selection. They are described as hardy, fertile with short calving intervals and a long reproductive life span. They calve without complications, and are highly resistant to internal and external parasites as well as tropical diseases so require little medication. They are also particularly adaptable and can survive in areas of inferior grazing, excessive heat and humidity (Nguni Project, n.d.). They are also docile which allows for easy handling.

However, these valuable attributes were initially overlooked. They were considered to have no real value as producers of beef or hides and were regarded as inferior *(Bester et al. 2003).* This view developed because the role of cattle in traditional society led to the development of very large herds and resultant overstocking *(Bester et al. 2003).*

This negative conception resulted in the genetic erosion of the Nguni cattle and, as a result, the Nguni diminished in number and their pure genetic stock was diluted with exotic breeds. At one stage there was a possibility that this valuable genetic material might be permanently lost:

We are losing the genetic resources locked up in the world's domesticated livestock at an unprecedented rate. If we are to adapt food production systems to radically changing conditions in the coming decades, animal as well as plant genetic diversity will be critical resources for doing so… (The "big five", n.d.).

With the rapid pace of globalisation, diversity is becoming a thing of the past. This is a threat to food security. It is only recently that scientists are realising the significance of traditional communities' indigenous knowledge about animal breeding and the fact that pastoralists can be considered as guardians of very important and rare genetic resources (Traditional communities' indigenous knowledge about animal breeding, n.d). The importance of this genetic source focused attention on the Nguni cattle and their genetic potential and the role they could play as a commercial breed.

The Revival of the Nguni as a commercial breed

The revival of the Nguni as a commercial breed in traditional communities poses a dilemma, as two different systems of cattle management are evident here. The traditional system is holistic and based on social cohesion whilst the western system is based on an individualistic and capitalistic view. The role of cattle and the nature of subsistence farming in traditional communities contrasts starkly with that of commercial farming. When taken to extremes, problems arise in each of these approaches. Traditional farmers who adhere to the cattle culture, value animals as wealth (status) and are therefore more interested in accumulating large numbers of animals than selling their animals commercially. This raises problems of overgrazing and becomes counter productive *(Doran et al. 1979).* Tribal control of lands limits the potential of individual entrepreneurs. It has been found that traditional stockmen will rather sell one animal with greater market value than two or three others *(Doran et al., 1978).* Thus the quality of the gene pool is depleted. Industrialisation/ Commercialisation taken to extremes, however, results in huge industrial farms, where from birth animals are "dosed, dipped and fed supplements – an entire existence geared towards beef of an outstanding quality" *(IDC, 2007. p.2).* The resultant hormones, antibiotics and other additives may have hidden health hazards for consumers and the environment as well as discomfort for the animals.

The Nguni have now been registered as a breed and a number of successful commercial farming operations have been developed. Whilst it is not possible to completelephoney turn the clock back there is now a concerted effort to restore Nguni cattle amongst poorer subsistence farmers and to bridge the gap between the traditional and western views. This is promoted as a commercial initiative that is based on the desire to alleviate poverty in communities. Whilst the Nguni were regarded as inferior it was often because they lived in the most inhospitable areas. There is now no doubt that where these cattle are given optimum conditions and are well-managed, they have amazing qualities that would render them commercially highly successful *(Bester et al., 2003).*

Projects have emerged to reintroduce Nguni cattle to the resource strapped pastoralists.

A number of challenges emerge. Those identified by Bester, et al., 2003 include:

- Monitoring – without proper monitoring of performance levels of progeny or early detection of problem areas this important initiative would fail demoralising the community and the project's organisers (p.18)

- Lack of grazing management –
- Poor herd management – often as a result of the traditional concept of cattle as wealth that results in non-productive animals not being culled or castrated. These animals continue to form part of the gene pool reducing the positive impact of the selected introduced bulls. *(Doran et al., 1979)*
- Lack of reproductive management and infrastructure
- A lack of record keeping – which is considered unnecessary by traditional farmers
- A lack of control of parasites – due to cost factors
- Community based decisions – are often not commercially driven and reduce the decisions an individual can make which limits the effectiveness of a project
- Land tenure – land is often in the hands of the tribal head that regards his ownership more important than progressive farming methods. Individuals have no say in how it is utilised and therefore this hampers the introduction of new methods

However, in order to ensure the continued commercial and survival of Nguni cattle "the potential for value addition of Nguni cattle products in communal areas of South Africa" *(Mapiye, Chimonyo, Muchenje, Dzama, Munyaradzi, Marufu and Raats 2007 p.489)* have been reviewed. Whilst Nguni are often considered commercially unviable the above researchers note many possible commercial enterprises that could be developed from the Nguni.

In the current market there is a demand for organic meat. Anderson *(as cited by Mapiye et al., 2007 p.490)* refers to: The indigenous methods of dealing with pests appear to be organically acceptable. The Nguni people used indigenous methods that were effective in preventing their cattle from succumbing to the dreaded nagana (sleeping sickness), by making a smoke screen to prevent the tsetse fly from biting their cattle. They also drove out the wild game that was the hosts of these flies. The burning was also effective in that scientific knowledge notes that tsetse flies hide in cracks in the earth and burning would therefore kill these creatures or cause them to flee on the backs of the wild game, *(O'Donoghue 2004)*. Because Nguni cattle are resistant to parasites and are reared from the land they could be developed as a source of organic meat. The fact that they range on the grasslands not only ensures the meat is lean but also improves the protein, energy and mineral content of the meat. *(Mapiye et al. 2007)*.

Hides are also considered for commercial purposes because although they are small the hides are aesthetically attractive and with care can provide quality. (Snags and bites render the skin unsuitable for upholstery). This opportunity has been sought and Daimler Chrysler has committed itself to this project. They have promised to import 40 000 Nguni hides annually to upholster their export Mercedes vehicles *(Mapiye et al. 2007)*. This commercialisation of the Nguni will enhance opportunities for rural communities and the viability of Nguni herds.

Other possibilities include the draught power of the Nguni, milk production, organic manure and dung. The latter is used as fuel, floor polish for huts and is even being considered for the feeding of fish in rural areas *(Mapiye et al. 2007)*.

Thus the revival of the Nguni as a commercial breed is becoming a reality but it is challenged by factors such as the role of cattle in traditional communities. Traditional communities were self-sufficient and did use their herds for these products but only on a subsistence level. Commercialisation will enable these communities to gain added wealth with which to enrich their communities but will require a change of systems.

Indigenous knowledge does have an important role to play in the education of our children particularly as it relates to the self-sufficiency of people and their ability to sustain a livelihood. There is also a need in the modern world to adapt and develop to ensure options for the new generations.

The implementation of indigenous knowledge as it is related to the national curriculum in South Africa.

Dakers, (2005) raises concern about the current rapid technological change that is transforming the world. He believes this causes people to become alienated from the actual world because the focus on modern material 'artefacts' causes them to be blind to the knowledge and processes that create them and to the fact that technologies have implications for society. Indigenous knowledge, which is holistic and related to the earth, helps learners to consider issues of self-sufficiency and sustainability.

However, indigenous knowledge and western knowledge are two diverse ways of knowing and this sometimes makes implementation of I.K. challenging. The western science knowledge is based largely on empirical research to prove hypotheses, and the indigenous form of knowledge that was gained over generations and passed on by word of mouth, is social in nature. Western science depends on careful observation to seek answers for questions posed about the nature of the object or phenomenon. It nurtures questioning and experimentation as a vital form of learning. Indigenous knowledge however, developed as, "over generations of social interaction, the environment changed, as well as ways of knowing what, when and how tasks were to be done", *(O'Donoghue 2004)*. Thus whilst 'why' (the logical) has become the passion of the western mind, practical (social) matters, the 'how', is of vital importance to the survival of indigenous people. Despite these different worldviews the learning areas of science and technology provide opportunities for the successful incorporation and teaching of Indigenous knowledge in the curriculum. This is because in the Technology Curriculum as spelt out in the Revised National Curriculum Statement policy document *(RNCS, 2002),* learning outcome number 3 embraces Indigenous Science and Technology.

The Assessment standards for L.O. # 3 in Technology include:

- The way different cultures have used materials, solved problems and optimised solutions. This also incorporates changes in technology over, indigenous solutions to problems and cultural influences
- How solutions impact on society and the environment
- Bias and ways of addressing bias and the Interrelationships between science, technology and the environment

Whilst note is taken of the nature of western science, the difficulty of incorporating African science and technology rigorously should be noted. Whilst local resources may be available, particularly in rural schools, the holistic nature of Indigenous Knowledge Systems sometimes makes it difficult for those living in urban areas to teach it. Because of the oral nature of indigenous knowledge written material is often difficult to obtain. Many of our current textbooks incorporate very superficial material based on traditional knowledge. The onus is on the teacher to go out and delve for this knowledge and constraints on a teacher often limit these opportunities. The readily available and in depth resources provided by western science result in teachers using western content to teach these learning areas. To counter this deficit, African proponents of IKS need to develop challenging and rigorous material that will satisfy demands for credible material.

Despite the challenges, this paper deals with the incorporation of indigenous knowledge relating to the Nguni cattle and the cattle culture into the curriculum. The importance of observation, questioning and experimentation is also developed to enable learners to compare and study cultural aspects and details in the environment and to develop an understanding of the interdependence of man and nature.

Learners would learn about the cattle culture and the self-sufficiency the animals enabled the Nguni people to have – the way the Nguni people have used Nguni cattle to solve problems and optimise solutions.

The way the lessons are developed and assessed influences the selection of learning outcomes. Thus the suggested L.O.'s covered in the following ideas are not definitive.

The following aspects could be incorporated into the curriculum:

- Aspects such as **processing of the milk** and meat would be incorporated. Lessons would include activities such as the making of amasi (curds). (L.O.#2, processing) Learners would take note of the daily temperature and the length of time taken to produce amasi. They would then design a taste test and test each other's amasi to consider any differences in texture, consistency or taste. (L.O.# 1) Fermentation would be studied as well as the calabash that was used as a receptacle for fermenting the amasi and the reason why it was not washed. (L.O.#3, A. S. 1: How indigenous communities solved problems, and history over time). Design an advertisement to sell your product (L.O.# 1,2 and 3) including communication and graphics
- Ways in which the Nguni solved the need for milk containers would also be explored (L.O.#3 A. S. 1: How indigenous communities solved problems, and history over time). Natural materials such as wood, skins, clay and calabashes would be compared. Factors such as how form fits function would be explored. A visit to a cultural museum could be organised
- Lessons involving the **processing of meat** could focus on preservation (L.O.#2, knowledge and skills, processing and preservation). Learners would take two pieces of stewing meat. The one they would preserve as the indigenous people did by boiling it in salt and then hooking it up. The second piece of meat would act as the control and be hooked up raw. The two pieces would then be left so that the learners could assess the effectiveness of this traditional method of preserving meat. The influence of weather would also be discussed. Discussion of other methods of preservation such as smoking and dehydrating. Examine meat platters as structures that contain and what skills the designers and carvers required. Discussion of the commercial prospects of developing organic meat products from Nguni cattle (Mapiye et al., 2007)
- **Processing of hides**. (L.O. # 2: Knowledge and skills). No blemishes etc. Steps in process and tools used. Sequencing of the process. Examination of a prepared hide noting cut etc.
  – Nguni shields: Methods of use. (L.0. # 1, 2 and 3): Assessing the design of a Zulu shield – noting ergonomics. Making a life-size Zulu shield out of cardboard – noting size and symmetry of shape plus weaving of contrasting hide for pattern. Discovering the pros and cons of using such a large shield. Compare the Zulu shield with that of the Xhosas. How does form fit function? Mathematical concepts are incorporated. Compare with modern methods of processing hides. Artefacts made of leather such as thongs, and whips. What is the difference between hides and leather?
  – Drums: (L.O.# 1,2 and 3): Investigate a selection of drums. Note the materials used and the methods to make these drums. Note the use of the hide. Distinguish what structural features affect the tone of the drums. Design a drum to accompany the Zulu dance group in your class. (Note communication and graphic skills also feature here).
  – Clothing made of skins: Properties of materials and designs. Class creates a display of leather items both past and present. (L.O. # 3: A.S. 1)
- Structure of the kraal: (L.O. # 2 and 3): Note structural formation of huts / materials/ position of byre/ grain pits etc/ graphics/ drawing a plan of the kraal with labelled features and comments. Do you think it was an effective design? Would you change any aspect of it, why? (The investigation and reasoning are incorporated as part of L.O.#1)

- Dung: (L.O. # 2 and 3) As plaster. Visit to Phezulu to note the effectiveness of dung as a plaster and as a floor polish.
  – As a fuel: (L.O.# 2 and 3) Experiments to test the effectiveness of dried dung as fuel. How quickly does it ignite? How long will one average size cow pat burn? Does it provide enough heat to fry an egg? How does it compare with a similar amount of wood?
  – As manure: (L.O. # 2 and 3): Prepare an experiment to discover whether cow manure advances growth. Plant the first plant with manure and the control plant without manure? Measure the growth of each plant over a specific period. Incorporate observation, measuring and recording skills/ communication skills). Discuss organic farming. (Communication skills / group work)
- Draft animals: (L.O.# 1,2 and 3): (Examine the designs of yokes. What characteristics are needed for draught animals? Examine the mechanical aspects of an indigenous plough / wedge. Would it be improved if wheels were added? How would you design an adaptation of this plough by adding wheels? Compare the Nguni ox with a tractor. Think about the terrain, fuel needed, affect on the environment, speed, mechanical advantage
- Horns: (L.O. # 3): Uses. Pipes. For storage. Examining the texture and the effectiveness of horns as weapons for the cattle
- Mini Research Task: (L.O. # 1,2 and 3): Design three questions to ask an older tribal person about any aspects of Nguni cattle or about life in a traditional area and the role cattle play. Record your work in a format that can be displayed. Some knowledge and skills would also be gleaned
- Graphics: (L.O.# 2): Symmetry: Hide patterns. The inkone hide patterns on the Nguni cows have mirror images on the opposite side (Poland, 2005). Graphics and mathematical concepts
- Poetry and Naming of Cows: (L.O. # 1, 2 and 3). Designing and making attractive mini wall charts using Zulu proverbs relating to cows, for example,
  'Ikab' abayisengayo (it (cow) kicks those that milk it). A milker generally knows how to approach each cow that he milks, but, sometimes for no reason, the cow may kick the milker. This proverb arises from the notion that those closest to the powerful and unpredictable are more vulnerable than others (Poland, 2005)
- Gender Issues: Discussion of whether the cow culture raises gender issues and why? (L.O.#3: A.S. 1, 2 and 3) Does this imply that women cannot be pastoralists or work in dairies? Discussions/ models/ charts or role-plays
- Bias: Nguni versus Exotic cattle. (L.O. #3: A.S. 1,2 and 3) Note impact on the survival of the Nguni. Discussions/ models/ charts or role-plays. Genetic diversity…
- Impact on the environment and society: (L.O. #3: A.S. 1,2 and 3): overgrazing / impact of cattle culture/ impact of large commercial farms/ impact of the Nguni cattle projects on the local communities… Discussions/ models/ charts or role-plays.

Thus indigenous knowledge about Nguni cattle has a great deal of potential and could be incorporated into the curriculum in South Africa.

Conclusion

This paper explores the role of Nguni cattle related to their revival as a commercial breed and the implementation of indigenous knowledge as it is related to the national curriculum in South Africa. In the last thirty years Nguni cattle have indeed risen from the ashes. Despite the dichotomy between the cattle culture and the commercial world, the successful development projects in this field suggest that a way forward is possible. The use of indigenous knowledge as an important part of the Technology curriculum, and Nguni cattle in particular, is possible because of the provisions of L.O. #3. and its relevant assessment standards. Implementation needs rigour and careful planning to produce lessons and activities that provide challenge and quality that will truly benefit the learners. Engagement with these issues will enable learners to develop an appreciation of other cultures, their ways of knowing and their solutions to common problems. It is hoped that this paper "Cows in the classroom" will make a difference stimulating others to investigate their indigenous knowledge and to implement it in classrooms in order to enrich their learners.

[1] *The Mfecane was a period in Southern African history (the early 1800's) when tribes from the E seaboard started a chain reaction of conflict that spread throughout most of the interior and into the Northern reaches of the region.*

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In Search of Mechanisms Underlying Motivation for Learning Technology

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Abstract

Today young people – even small children – are active users of modern technology. Computer games, digital cameras and mobile phones are natural elements in children's life. Confronted with, for example, computer game tasks, children can be found sitting for many hours trying to improve their skills in the required areas. What is it that motivates them to make such huge efforts to increase their level of competence and is there something for us teachers to learn from this?

When individuals are faced with tasks or problems the actions that follow are of great importance. How the individual chooses to approach and deal with tasks presented to them leads to consequences for both the individual's personal experience – feelings of success or failure, as well as for the concrete result of the action taken (the aimed result is achieved or not). To develop understanding about why children do what they do in learning situations is therefore an important task for teachers and educators.

Documentation of pupils' actions is a good starting point for obtaining knowledge about what is happening during the process of learning. As a tool for analysing collected documentation I suggest in this paper a pedagogical application of Georg Henrik von Wright's theory of logic of event (von Wright, 1983). This explanatory model considers both the interaction of the individual with the environment and the action of the individual in connection with a particular event or situation.

This paper starts with some comments on findings about attitudes towards technology and the implication of these results in technology teaching. After that I introduce von Wright's theory of logic of events and my pedagogical application of this theory. I also briefly discuss the possibilities of using this model as a tool for identifying and understanding some of the mechanisms behind motivation for learning technology.

Background

The issue of attitudes towards technology has been and still is of great concern to educators and researchers in Sweden. The gap between young people's interest in exploring and using new technology, and the lack of interest among the same young people in engaging in technology education programs and/or choosing a profession in the field of technology, still needs to be explored. One fundamental problem in Sweden is the fact that Technology as a topic is not sufficiently established in our schools (Malm, 2002; Teknikföretagen, 2005). Today we know that many teachers in Sweden are concerned about their own lack of subject content knowledge in Technology and of their limited repertoire of pedagogical-didactic methods that emphasize the special needs that technology teaching requires (Teknik-företagen, 2007).

Attitudes are established early in life. In studies made during the last decade by myself (Skogh, 2001, 2004, 2007) and by others (Murphy & Beggs, 2005, Pell & Jarvis, 2001, and Haworth, Dale & Plomin, 2008) the age of 9-10 seems to be critical. At this age the interest in science and technology has been shown to be high with little gender variation.

In a study of 50 girls' and 50 women's attitudes towards technology that I made some years ago (Skogh 2004) this phenomenon was shown.

The youngest girls in my study (6-9 years) were very open-minded and expressed little prejudice towards technology and appeared receptive and willing to test things that are seen as 'technical'. In these early years the concept of technology/techniques could mean just about anything. This broad and divergent definition of what is technical was less common among girls aged 10 and above and also among the women in the study. For most women, the perception had changed into a more delimited, convergent view of what technology 'is' ('electrical things', 'machines'). The few women in the study who expressed a divergent view of technology had two things in common – they were more technically active than the other women and they also expressed good technical self-confidence.

It seems as if the insight about the multifaceted nature of technology leads to insight about the many ways that technology affects our lives as individuals, i.e. participation in 'the world of technology', which makes technology accessible and important to learn more about. The perceptions of what technology 'is' develops together with our interaction with people around us. For those who can develop their technical skills at home and in school, technology becomes a natural part of life. For those without these possibilities, technology becomes strange and difficult. It is essential that strong efforts are made to capture a young person's needs and wishes in various ways in the field of technical skills and knowledge. What do young people want to know and – not least important – how do they want to learn?

I believe that we have a lot to learn from critically observing children when they are deeply involved in solving a task or problem that interests them or exploring a new device and how to use it. In these situations children show motivation, they express curiosity, they are persistent and they learn a lot. What lies behind their enthusiasm and their behaviour? How could we explain and understand their actions in these situations?

Learning is an Activity

Learning is an activity. In learning technology the strategies we choose and the actions that these strategies result in leads to consequences on a personal level (feelings of success or failure will at some point occur) as well as for the concrete result of the action taken (the result/the function is achieved or not). Developing an understanding about why individuals do what they do in learning situations is therefore of great importance to teachers and educators.

Documentation of learning situations and of learners' actions is a good starting point for obtaining this knowledge. As a tool for analysing collected documentation data I suggest a pedagogical application of Georg Henrik von Wright's theory of logic-of-events (von Wright, 1983). This explanatory model considers both the interaction of the individual with the environment and the action of the individual in connection with a particular event or situation. In what follows I give an overall view of von Wright's model of thought and of my pedagogical application of his theory.

Theoretical Framework – Based on Skogh (2001)

In the essay Determinism and the Study of Man (1983), Georg Henrik von Wright formulates his theory about the logic-of-events. Logic-of-events interpretations are based on the fact that we can learn how to identify determinants of individuals (their intentions and epistemic attitudes, as well as factors and expectations that surround the activity in question). In order to do so we need to create a picture of the individual. Von Wright identifies four different intentions to help us do this: 'wants', 'duty', 'ability', and 'opportunity'.

Intentions to Look For

The intention wants refers to what the individual wants and/or considers him or herself in need of. In a teaching context, the teacher has to convince the pupil that the knowledge and experience the teaching is aiming at is in accordance with the needs and wishes of the pupil. Every pupil's aim and goal is to feel appreciated by the teacher. The way a student works toward this aim will have great impact both in a short term perspective (the on-going educational setting) and for the outcome of future educational settings.

According to such a statement disciplinary problems would never occur but, as we all know, they do. How can this be explained? The answer to this question lies within the actors involved. The aim of both teachers and students – what they both want to achieve – is that the gain from the teaching/learning situation is maximised. Accordingly both teacher and student will act in accordance to the intention 'wants'. The student wants to succeed both in his/her own eyes and in the eyes of the teacher and to avoid unpleasant things like low grades, negative comments from parents, teachers or friends. On the other hand the teacher also will act according to the intention 'wants'.

Not only students but also teachers want to be appreciated by their students, parents and colleagues. If a teacher feels that he or she has failed in some way in accomplishing the aims of a lesson or a sequence of lessons he or she will react in the same way as the students. Both students and teachers are in fact acting in accordance to their own needs and wants. If, for some reason, one or the other (or both) are prevented to act in accordance to their needs someone has to reconsider and find another way of dealing with the situation. To change one's behaviour and to face a situation where you are not allowed to act in accordance to your initial wants is a stressful situation to both actors involved that takes a certain amount of time to solve. The time it takes for actors involved to adjust to the situation and act accordingly leaves an 'open field' of insecurity and it is within this space that disciplinary problems in schools arise. Thus it is of great importance for teachers to convince their students that the teaching is in compliance with the students' needs and wants.

The intention duty refers to the individuals 'internalised' expectation to act in accordance with a defined role – to behave in a certain way. The ways pupils apprehend their role as pupil and learner will affect their way of behaving in the classroom. The role as pupil can change several times during a school day in accordance to the demands of different educational settings (e.g. teachers involved, friends involved).

The concept ability refers to the pupil's individual characteristics in the classroom situation. A pupil's ability is limited both by inherited (intelligence, memory, health, physical strength) and by acquired (learnt) qualities. As we all know wanting to do something is not the same as having the ability do it. In order to try to do something, two things are required: a) that the person thinks that it is possible for him/her to succeed in his ambition to do what ever it is he/she wants to do, and b) that he/she takes suitable initiatives to make it happen.

The intention opportunity refers to both the actual conditions governing the situation and the individual's experiences of these conditions (expectations, resources and the balance of authority). As a teacher you might see a lot of possibilities for a student but if the student herself/himself does not 'see' these possibilities they will not make any sense to him/her.

Von Wright's theory concerns the behaviour of individuals in general, and not the behaviour of pupils in a pedagogical learning situation. In my opinion that leads to the need for extending von Wright's concept of intention. In addition to the four intentions von Wright identifies (above), I add, in my pedagogical application of the logic-of-events, two 'new' pupil-specific intentions. With the help of these new intentions it becomes possible to describe and emphasise aspects that influence the behaviour of the pupil (but not that of the teacher) in the school situation.

Concession is the first 'new' pupil-oriented intention. This intention is tied to the subordinate position of the pupil in the school situation. The intention is formed within the individual and it is meant to describe to what degree the pupil conforms to and subordinates him or herself ('opens up') to the teaching – the degree of concession on the part of the pupil. There might be a number of different motives and considerations behind a pupil's decision to 'play along' (a high level of concession) or to withdraw from the teaching situation (a low level of concession) and it is not always the case that the pupil is actively aware of these reasons. The fact that a student and a teacher are aiming at the same educational goal does not mean that they have the same motive for doing so. It just means that they think that the educational setting serves each and every one's purposes. This example from my own childhood illustrates this:

> *When I was 7 years old I was very enthusiastic when my teacher announced that it was time for reading. I am sure that she thought that I was very interested in improving my reading skills. What she did not know was that I was a rather uninterested learner. What I did like was when we, as a method of learning to read, had to build words with small cards with letters on them (one letter on each card). When the lesson ended we had to put each small card back into place (one special box per letter). This activity reminded me of the woman in our local post office whom I admired very much and who had a job that I desired very much.*

The fact that my 'post office game' and the goals of my teacher happened to be the same was of course a positive coincidence but I am sure that my teacher would not have been happy if she had known the reason why I decided to 'open up' to her teaching. A high level of concession (such as mine) accordingly does not exclude that the learner is critical or uninterested in the teaching.

A low level of concession results in the learner withdrawing him/herself from the teaching. R.S. Peters (1967) describes this partly in his book Ethics and Education:

> *As an activity, education must fulfill three conditions – intentionality, voluntariness, and comprehension – for it involves the intentional transmission of something worthwhile, an element of voluntariness on the part of the learner, and some comprehension by the learner both of what is being learned and of the standards the learner is expected to attain.* (ibid. p.17)

The intention of concession – the learner's willingness to 'open up' to the teaching – represents the learner's ability to call forth voluntariness. The voluntariness a person can raise is thus the consequence of a high level of the intention 'concession'. To the (at first) uninterested learner, the level of concession relates to the learner's ability to overcome his/her resistance towards the teaching.

Curiosity is the second 'new' pupil-oriented intention. Curiosity constitutes an important pedagogic force in the teaching situation. It is in order to emphasise the fact that the inclination to examine and discover 'in itself' the individual (here the pupil) to act, that the intention 'curiosity' is introduced as an intention of its own.

The Concept of Epistemic Attitude

In addition to the intentions mentioned above, the pupils' perceptions of demands of the situation – their epistemic attitude – are also included as an internal determinant. An individual's epistemic attitude is connected to (and dependent on) external stimuli or demands. The epistemic attitude – that is how the pupil perceives and manages the 'demands of the situation' and his or her role as a pupil – is of decisive importance as to how the pupil will 'succeed' in the teaching situation.

External Determinants in a Teaching Situation

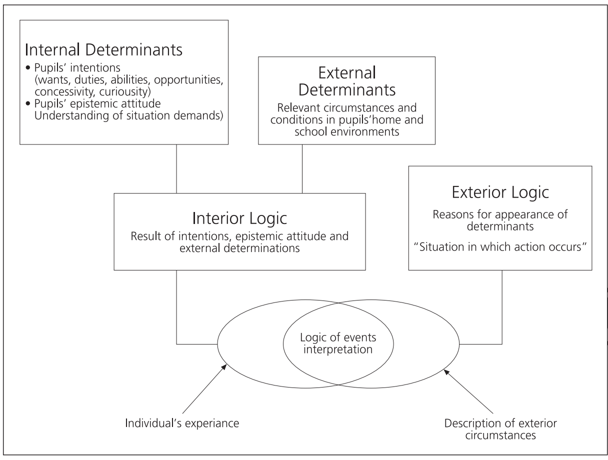
In every school there is continuous interplay and reciprocal action between all the different factors in and outside the school that influence the activities of the school. What external determinants a pupil is going to be exposed to depend on external factors (regulations, social, economic and cultural conditions, the tradition of the school and how it is equipped) and expectations that surround the activities of the institution in question. How the pupil perceives and handles the external determinant is dependent on his or her epistemic attitude. Intentions, epistemic attitude and external determinant constitute the interior logic of an individual's behaviour/actions.

Exterior Logic – The Event's Historical Context

Von Wright also points out the need to describe and explain the situation in which the action takes place – the event's historical context. The more we know about the conditions of the event, the more accurate our conclusions are in assessing the exterior logic of an individual's behaviour. In order to understand the exterior logic of a pupil's behaviour we need to know as much as possible about the conditions of the current educational setting (political decisions, regulations at different levels and/or public debate).

Logic-of-events Interpretations

Logic-of-events interpretations of the actions of individuals can be described as an amalgamation of internal and external determinants (the interior logic) and by the underlying reasons for these determinants (the exterior logic). Von Wright points out that there are combinations of determinants that appear with certain regularity, depending on the situation at hand. Figure 1 shows schematically the different parts and connections of the interpretation process. It shows that a logic of events interpretation/explanation is based on knowledge of both the individual's 'inner life' and the conditions and circumstances that affect the individual in different ways in the current situation – the interior logic as well as on knowledge of the underlying reasons for the determinants (the event's historical context) – the exterior logic.



Overview model of the pedagogical adaptation of von Wright's logic of events

Logic-of-events Interpretations as a Pedagogical tool

By systematically analysing pupils' actions in accordance to the logic-of-events analysis model, teachers are able to acquire a deeper knowledge about their pupils that makes it possible for them to relate their teaching to their pupils' experiences.

The analysis model gives teachers the possibility to discern more general and recurring patterns of behaviour among the pupils – a knowledge that constitutes valuable help when it comes to dealing with future pupils in similar teaching situations. The logic-of-events interpretation model supplies concepts that put words to both the pupil's 'internal life' and the pedagogical situation in question. It highlights not only the effects of the pupils' actions but also of possible reasons for these actions.

The systematic structure of the model brings to the attention of the teacher aspects of the pupils (which are of possible pedagogical significance to the teacher) that might otherwise remain undiscovered and unexploited. Furthermore, every logic-of-events interpretation includes the fact that the teacher must decide how the pupil's behaviour relates to all 'categories of intention' – not only those that the teacher him/herself considers to be the most likely, but also other possible interpretations. The intellectual and mental preparedness that this leads to opens up the mind not only towards the particular pupil in the current situation but also towards other pupils in similar situations. Logic-of-events interpretations of pupils' actions can thus be said to increase awareness of the pupil as an individual and of the pupil as part of a greater context – of the complexity that surrounds every teaching situation. Knowledge and insight about this complexity should be valuable to every teacher and educator

What about the issue of the preferential right of interpretation? How do you know that an interpretation of logic-of-events is 'correct'? Who decides that? As with all interpretations the picture of the analysed course-of-events or actions taken is, in many ways, a mirroring of the beholder (= the interpreter) him- or herself. To interpret pupils' actions, and basing it on the logic-of-events, encompasses a number of subjective considerations. The fact that intentions do not appear in and of themselves, but rather are expressed through those actions in which they initiate, does provide for more than one interpretation. It is inevitable that the intentions that teacher A ascribes to a certain pupil in a certain situation will not necessarily be the same as those of teacher B.

Thus the great benefit inherent in logic-of-events interpretations lies not solely in the individual interpretations of the pupils (it can be dealt with if, for example, a learner's actions in a hypothetical situation are wrongly interpreted as a consequence of the intention needs/wishes instead of curiosity). Rather, it is as a consequence of the fact that the logic-of-events interpretation model provides a set of concepts which describes both 'the inner life' of the pupil and the actual pedagogical context – we are made aware of not only the effects of the actions taken by the pupils, but also possible reasons for those actions. The systematic structure of the model makes the teacher/pedagogue aware of aspects in the pupils' behaviour (which can form possible pedagogical points of connection for the teacher/pedagogue) which otherwise might go undiscovered and unutilised. Furthermore, every logic-of-event interpretation encompasses the fact that the teacher/pedagogue takes a stand in terms of how the actions of the pupil relate to all 'categories of intention' – not only those he/she judges to be the most probable, but also other possible interpretations. The intellectual and mental preparedness which this provides opens up to sensitivity towards not only the individual pupil in the actual situation, but also to other pupils in similar situations.

Logic-of-events interpretations of pupils' actions can thus be said to increase the awareness of the pupil as an individual but also of the pupil as part of a larger context – of the complexity that influences every teaching situation. Insight into this complex issue can be said to constitute a valuable basis for pedagogical work.

Motivation for Learning Technology – What is it?

Learning technology is an activity built on and relying on the active engagement of the individual. To understand the mechanisms of motivation in learning situations you need to understand the actions of learning individuals. Logic-of-events analysis helps you do just that. Another aspect of motivation, not yet mentioned in this paper, is the presence of feelings of confidence or, conversely, lack of confidence in one's capabilities. Von Wright (1983) points out the importance of this factor:

> *To have an intention to do something presupposes that the agent thinks, rightly or wrongly, that he can achieve the object of his intention. What he does not think he may accomplish, he will not attempt either. (ibid. p.48)*

In a study of girls' attitudes towards technology (Skogh, 2001), it was shown that belief in one's own individual capabilities is linked to prior experiences. Most of the girls in the study also agreed that the results of a technological activity had a significant effect on their belief in their own technical capabilities. If something works, then you know that you have 'done it right'; you know that you 'can', and that you are 'good' at what you do.

> *…the feeling of knowing that you 'can' is a result of the opportunities you have had, the willpower you have, what you actually do, and what you in fact achieve.*

… and how can we encourage it?

The answer to the question of how motivation among learners is obtained relates obviously to both teachers and learners. The role of the teachers has been stressed through this paper. What then is the role of the learner? Is it possible to learn how to obtain motivation for learning?

I believe that knowledge about the mechanisms of motivation is essential to both teachers and learners. To introduce the elements of logic-of-events interpretations also to students/pupils (in a suitable manner) could be one way of putting attention to not only the impact of teaching but also to the importance of learners taking an active part in their own learning processes.

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Making a Difference – A South African Perspective

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There is a difference that makes a difference, There is a difference that makes no difference. Weikart D

Introduction

In spite of fourteen years of democracy, our pupils still have feelings of powerlessness with unqualified and under qualified teachers and strong control mechanisms due to vast numbers of children and accelerated urbanization. This means that children are still taught to listen and remember rather than be encouraged to think and reason for themselves. The more they completely accept the passive role imposed upon them, the more they tend simply to adapt to the world as it is and to a limited and subjective view of reality imposed upon them in the classroom. We need active learners if we want to make a positive and lasting difference.

If education is preparation for life, then we should aim to develop the full creative potential and abilities of both children and adults. Because of the demands of our increasingly technological society, the failure of many of our pupils could be described as failure to be taught rather than failure to achieve. If the thousands of children who live at an economic, social and educational disadvantage are to have a fair chance to live and develop their potential, we must think like a pessimist and work like an optimist. In order for children in South Africa to pass at the end of Grade 12, they require 30% in three subjects and 40% in three subjects. In spite of the low requirements, approximately 62% failed. This is certainly an example of **a difference that makes no difference.** ***Education has hardly improved their chances of success in later life. With these abysmal results we are not meeting the challenges of the global economy and are not preparing our children to be citizens of the global village.***

A Difference that Makes A Difference

Dr. David Weikart, founder of the High / Scope Educational Research Foundation in the United States, devised a programme in response to the fact that several early intervention programmes made an initial difference but after several years, there was a fade-out effect resulting in effectively no difference. The High Scope curriculum developers value the child as a constructor of knowledge. The whole programme is organized around Key Experiences derived from Piaget's developmental theory. The teachers thus shifted their focus from asking the child questions to which they knew the answers, to asking them about what they were doing, thinking and intending. They implemented a *Plan-Do-Review* sequence, strengthening feelings of self worth and independence.

This Plan-Do-Review sequence closely parallels *The Design or Technological process* with *Investigating* a problem – *Designing* and selecting an appropriate solution – *Making* a product – *Evaluating* the product – *Communicating* the solution to the problem. I have trained initial teachers and retrained practicing teachers extensively in these two fields. Of all the skills we teach, problem solving is the one thing we can be sure the learners will need as they become an adult. This helps children to:

- Become more purposeful
- See themselves as decision makers
- Become more self directed
- Take control over their own actions
- Think more abstractly and draw on past experiences when planning future ones
- Organize their time and realize there are logical steps to accomplishing a plan
- Focus on the task till completion and
- Evaluate the task

In fact, through the approach where the child or adult participates in his/her own learning, through decision making and problem solving, we can see a positive difference in their understanding and application to real life situations.

Making a Difference in Meeting the Needs of Business

It is almost too late to try and prepare pupils for the real world by offering bridging courses at University. It is even almost too late to attempt to make a difference at Secondary school level. If we are to make a positive and lasting difference, we need to start with primary school children and even preferably preschoolers.

In setting the context for economic growth, we need to examine why Technology training is inevitable and a matter of urgency. South Africa is now part of the global village yet nowhere is Africa's *competitive disadvantage* more apparent than in the area of Science and Technology. We lag behind the developing world in terms of the degree to which its population participates in scientific and technological activities. There is a direct correlation between a nation's wealth and its technical abilities. Over the past five decades many countries including Japan, Korea, Taiwan, Singapore, Thailand, India and Pakistan have made concerted, successful national efforts to promote Science and Technology as a means of improving living standards. Young people are living in a rapidly changing world and need to keep up with technological developments.

Our Gross National Product per capita makes it comparable to Malaysia, Chile and Mauritius, yet our poor skills mix in the labour force is a constraint on economic growth. This is one of the main reasons why South Africa is judged almost bottom out of 53 participating countries in the recent World Competitiveness Report whilst by contrast Malaysia and Chile are right near the top. Both now have more highly skilled populations. The gap between business and education needs to be closed. Technology Education can make a difference.

Defining Some of the Problems

- The present education and training system is designed to meet the needs of an outdated specification and this renders the economy incapable of competing with a workforce that is trained to be self-directed, innovative and reflective.

- South Africa has a low human development index. Our inability to generate an economic growth rate to sustain all of our relevant needs is largely due to the lack of relevant skills. The ability to compete effectively in the global economy is going to depend on the skills of its people
- The information age and the pace of scientific and technological advance means that we are becoming left behind. Lifelong learning is essential to keep abreast of changes in the nature of knowledge and production.

The school system has not appeared to take cognisance of the needs of business in the past. In turn, business has done very little to assist the cash-strapped Education Department. However, if you think education is expensive, try ignorance.

Results of a Survey

A survey of ten companies was made in an attempt to establish the needs of business with regards to the expectations of school leavers in KwaZulu Natal. In addition, the educational component of six of these companies was investigated. (Ter-Morshuizen 1998)

Part 1 consisted of a checklist based on the S.C.A.N.S. (the Secretary's Commission for Achieving Necessary Skills) Report What Work Requires of Schools, Washington D.C. Department of Labour, (1991). It consists of a checklist of 15 attributes, grouped under three headings – Basic Skills, Thinking Skills and Personal Attributes.

Basic skills ranked very high with all ten companies. It was however, interesting to note that Mathematical Skills, Listening and Speaking were rated more often than Reading and Writing. The response should not be over simplified. Reading and writing is still needed in business but in a more covert way, with the foundation of basic skills acquired, transferred to analyzing information and writing reports. Problem-solving was rated top thinking skill by nine of the companies seeing it as very important. This was followed by the ability to learn. Creative thinking, Decision Making and Visualization were rated as very important by seven of the companies. Personal Qualities proved interesting. Only one trait that is rated as very important in all ten companies is integrity. This is a characteristic that is sorely lacking in our country at the present time.

The Role of Technology in Making a Difference

Technology as a Learning Area is defined as:

> *The use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration.*

This gives learners the opportunity to learn to solve problems in creative ways, combine thinking and doing to link abstract concepts to concrete understanding and carry out practical projects using a variety of practical skills of – investigating, designing, making, evaluating, communicating – within authentic contexts. This should create more positive attitudes, perceptions and aspirations towards living in a technological world and choosing technology-based careers. It can be clearly seen that Technology addresses the above required skills of Problem Solving, Creative thinking, Decision Making and Visualisation as Thinking Skills required by business.

There are three generally accepted components of design and technological understanding. These are skills, knowledge and values. In a broad based design approach or a more structured

Results: Checklist of 15 Skill Attributes

Participants were asked to indicate their choice as follows: 3 Very important 2 Important 1 Unimportant			
Basic Skills	3	2	1
Reading – locates , understands and interprets written information	8	2	
Writing – communicates, thoughts, ideas and information	7	3	
Mathematical skills – performs basic computations accuratelephoney	9	1	
Listening – receives, attends to, interprets and responds to verbal messages	9	1	
Speaking – organizes ideas and communicates orally	9	1	
Thinking Skills			
Creative thinking – generates new ideas	7	3	
Decision making – specifies goals, generates alternatives, considers risks, chooses	7	3	
Problem –solving and reasoning – can solve problems and apply reason	9	1	
Visualization – organizes and processes symbols, graphs and other information	7	3	
Ability to learn – uses efficient learning techniques to acquire and apply new knowledge	8	2	
Personal Qualities			
Responsibility – exerts effort and perseverance towards a goal	8	2	
Self-esteem – believes in own self worth and has a positive view of self	8	2	
Sociability – demonstrates understanding, friendliness, adaptability, empathy and politeness	4	6	
Self management – sets personal goals, exhibits self-control and monitors progress	6	4	
Integrity – honesty, chooses ethical course of action	10		

technological approach, the focus is on the intellectual skills involved in designing and making. Knowledge includes not only the practical and manipulative based experiences but also scientific concepts. These provide a sound knowledge base from which to apply to selected problems. Knowledge of materials, motor skills and scientific principles are better defined than the development of intellectual skills. Whether one approaches Design and Technology from a knowledge or a skills base, the component of values usually receives limited attention and the relationship between knowledge, skills and values is usually ill – defined. Design and Technology's relevance to people, the quality of life, social problems and the responsibility to society tends to become submerged. It must not be seen as something impersonal but rather having personal impact. Pupils need to identify or be given social and personally meaningful issues from society around them and then set about finding appropriate technological solutions. An awareness of the importance of values and an understanding of the fact that the design process implies a value judgement in one or more areas, will hopefully help pupils to see that with design and technological capability comes moral responsibility. This can be instilled even in very young children at Primary school. It will provide a necessary and solid base on which to build.

With this in mind, it is essential that we have
- Effectively trained teachers. It is problematic that most teachers who are now required to teach Technology, were not trained in the Learning Area / Subject in their days of their initial training
- Co-operation and collaboration between Education Departments, local businesses and Training Institutions
- Funding to assist in large scale training. The Department of National Education estimates that approximatelephoney 25,000 teachers in KwaZulu Natal and 80,000 in other provinces need retraining in Technology Education

Comments from students who are making a difference

I have been extensively involved in training students in both High / Scope and Design and Technology approaches. The positive responses below bear testimony to the fact that teachers can make a positive difference. Technology Education has produced some very gratifying results amongst both teachers and pupils.

Some comments include:
- I think our lessons in school will improve a lot as we gained a lot of skills on how to think
- I believe this was my very best learning curve in Technology and I hope and trust that other advanced courses of this nature should be offered timorously. Our education system can go very far if the Technology is taught in this fashion
- A very good course which brought back self-confidence and self-esteem
- Now as a Technology educator I am confident about my skills and knowledge
- I go into the classroom a new educator – armed with renewed enthusiasm
- …now I know in this new South Africa, I'm part of the solution and not the problem
- I'm now excited about the place we can take in the community, the way we can help in the evolution of the future South Africans and the responsibility we have to all the under-privileged children in South Africa

Many of these teachers are not only making a difference in their own classrooms, but also in the wider community. They are addressing and inspiring other teachers through networking with surrounding schools, planning lessons together and generally inspiring the learners. Many telephone of going to school early to allow pupils to work on projects, while others have started afternoon Technology clubs. Technology is real, relevant and meaningful in the lives of all our children, starting with the very young and continuing as lifelong learning. Technology Education can therefore be a powerful tool in making a difference.

Conclusion

One can easily be discouraged at the enormity of the task in attempting to make a positive, meaningful and lasting difference through Technology Education. We need to remind ourselves of the words of E. Everett Hale:

I am only one
But still I am one.
I cannot do everything
But still I can do something;
And because I can not do everything
I will not refuse to do something I can do.

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Factors Facilitate a Smooth Transition Between Primary and Secondary Design and Technology (D&T)

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Introduction

I teach in a popular over subscribed college. There are approximately 1900 students on roll from 11-18 years originating from 63 feeder schools.

"Students come from a wide range of socio-economic backgrounds, with more students than average experiencing aspects of disadvantage."
Mason J (2007) OFSTED inspection report

As an academy we have 2 specialisms – art and technology which the college is working hard to develop. Art uptake at Key Stage (KS) 4 (14-16 years) is very high; however D&T does not generate the same enthusiasm. Initially we need to captivate and retain the students' interest at Key Stage 3 (11-13 years) to ensure they want to uptake this subject.

I have re-written the year 7 (11-12 years) schemes of work to incorporate a range of Focused Practical Tasks (FPT) and ensure that these schemes equip students with basic knowledge and skills enabling them to make real progress in KS3, by building on the requisite skills. This follows on from the introduction of the new Design & Technology Strategy and links it with the National Curriculum. However this does mean that we do not assess pupils' strengths and weaknesses to set targets until half way through the year. In addition, in practical areas I have noted that students' previous experience at home or school had not been taken into account – almost assuming that students had developed no knowledge of D&T previously.

Currently we do not have any base line testing in place and it is hard to ascertain the initial ability of year 7's. I am very interested in studying students' transition from primary schools, including any support that could aid this. This would lead eventually to creating an effective base test that would be fair to all students and informative to staff. Students demonstrate varying levels of capability within design technology in year 7, mostly due to the fact that education received at primary schools varies in both skills and knowledge. Developing transition projects/liaisons with primary schools would enable us to build on previous learning and continue to stretch interest and achievement, benefiting both students and staff alike.

As part of my initial research I interviewed a range of year 7 students from varying feeder schools about their Design & Technology experiences, past and present. I then visited some of the feeder schools and interviewed the relevant primary teachers. I will refer back to my findings throughout this essay. It is evident from various interviews that I conduced with my year 7 students, and OFSTED findings, that they both value and enjoy Design and Technology; however as the second youngest subject on the curriculum why do we value it so much, and why should students study it?

I have used Penfold (1988) to highlight the original void that Design & Technology was designed to fill in the curriculum. *'It would give pupils the capacity to adapt, initiate, modify, solve practical problems and make design decisions creatively in a variety of social contexts. Additionally embracing aesthetic considerations and production methods.'* Penfold R (1988)

Another unique quality is that students are often dependant on using knowledge and understanding from other subjects for practical solutions. The more research I undertook, the more support I found, from various researchers confirming how important and stimulating the subject can be. Students are given opportunities to work creatively and collaboratively, to take on challenging processes which encourage high level thinking and generate decision making. They are asked to consider values and emotions in a variety of contexts.

Technology offers students a unique opportunity to learn by physically doing and taking action offering a powerful experience. The skills students learn are empowering, relevant and diverse and as David Spendlove states

> *"…children should learn to take action through working creatively and collaboratively. They engage in processes that challenge them in high level thinking and decision making, considering values and emotions through rich and stimulating concepts."* Spendlove D (2008)

The subject develops cognitive abilities, creativity, practical problem solving and design thinking. In essence the subject allows students to explore the world in which they live, and take ownership of how they can improve it. The subject can be very stimulating and help develop a variety of life skills:

- Vocationally – preparing students for the workplace, the skills learnt within the subject are transferable. A study at Cambridge University by Cave et al (1988) found that employees rated *"practical competence much higher than cognitive abilities and personal qualities."* Due to our economy we have a rise in lifestyle – expansion of DIY and an increased choice from imports – all of these utilise skills learnt within the subject
- Social/cultural – A key principal of the subject is that students take ownership of their world and in doing so seek to improve the world they live in through enquiry and exploration. *"…fashioning well-crafted objects by hand inculcates positive citizenship attributes and values, such as hard work, perseverance, and attention to detail."*
  Rachel Mason and Nicholas Houghton (2002)
- Knowledge – Practical knowledge is integral to life experience *"There is theory in the literature Sternberg and Caruso (1985 Schon 1991) to support the view that knowledge acquired tactically through the hands-on experience of making is central to the acquisition of practical knowledge which is useful in human decision making, both at work and in everyday life."*

It gives children who are low academic achievers, an alternative way of learning by emphasising the importance of hand labour and generates a positive response and visible sense of achievement.

> *"The reason making re-enforces and contributes to knowledge and skills in other school subjects is that it enables them to be demonstrated in a tangible form."* Rachel Mason and Nicholas Houghton (2002)

Gardener believes craft education is particularly conductive to the development of kinaesthetic knowledge because it interprets labour, physical handing of materials and demands exceptional motor control. His theory stresses that we are dependant on them in every form of life which contradicts the basis of our education system. The western society holds linguistic and mathematical intelligences of increased importance as business and academic careers are much more desirable here.

So what do the students think? Year 7's discussed why they think Design & Technology is important; *"D&T helps you with options – and it teaches you lots of different skills"*. In addition students noted how important the skills were as they enabled them to contribute more at home – referring to them as life skills – making them feel more valued and useful. Students commented on how much they looked forward to the lessons due to this practical aspect. Satisfaction in making and it's importance is supported by Dissanayake (1992) *"The pleasure children feel in 'making' as a consequence of a biological predisposition in humans to be makers of tools and to use them to contribute to the prosperity and well – being of society and to leave their mark on the world."* Dissanayake, E (1992)

One student noted how much it had helped him build communication, team work skills, and enabled him to work through failure positively. This concept is something I found extremely interesting especially as students lack of self confidence and reliance on teachers help during KS4 is becoming over whelming. After speaking to more students it is the prospect of failing that is so daunting, and if students were given more opportunities to see the benefit in failing in lower years they would be more likely to take risks and become independent learners.

From interviewing students it became very clear that their D&T experiences at primary schools are all very varied, with some students developing high skills in KS1 (5-7 years) and this not being developed in KS2 (7-11 years) meaning that students became frustrated. One of the year 7 students I interviewed appeared to have learnt exceptional cooking skills at KS1 – but these skills were not built upon until reaching secondary school. The student was clearly upset and felt disadvantaged in not being able to develop skills with her peers earlier. So why are students' experiences so varied? There is one constant – and that is the difference in the primary teacher's attitude and knowledge when teaching Design and Technology.

> *"whilst design and technology should be taught to all primary school children and its value can be identified, it does not follow that it will be taught well or indeed taught at all"*

As a design and technology specialist I feel that developing students' curiosity, problem solving and craft skills are vital in primary school to give students the ability to develop and build on these at secondary schools. Yet surely it is not only the primary teachers' responsibility to develop these skills, especially if they do not know how to teach the skills well. A primary teacher's subject knowledge and understanding shows clear relation to the student's success.

> *"… teachers' subject knowledge was very strongly associated with high standards of pupil's achievement ."* Ofsted (1995)

The question then has to be raised, how confident are primary teachers in their knowledge, understanding and delivery of Design and Technology?

> *"The strategy group identified a serious weakness in Foundation Stage practice. Opportunities to develop children's natural curiosity in the man made world were not being taken due to lack of experience amongst foundation stage teachers."* Barlex D (2008)

The supporting evidence that identifies teachers' lack of subject knowledge is clear – *"Some teachers are unsure what to teach and will if possible, only teach those areas that they feel confident. This can lead to a programme that lacks both breadth and balance."* Clare Benson (2000)

Due to the sheer amount of subjects that primary teachers are expected to deliver in such a pressured and hectic curriculum it is not hard to see why some primary teachers find it hard to successfully incorporate technology lessons. This is frustrating to primary teachers and potentially extremely damaging to primary student's uptake and development of technology.

Contact time in D&T is limited and inconsistent over Key stages 1 to 3 – if students have been entitled their full contact time that can be less than 200 hours. The majority of this will have been delivered at KS1 and 2 – often by non specialists, whilst KS3 can be divided into 5 different materials specialisms. With pressure for students to creatively develop, design and make quality outcomes, with such limited time, it is vital that teachers ensure students are making full use of all key stages. Design & technology is no longer a compulsory subject at KS4 in many schools; without a strong foundation KS4 teachers may find it difficult recruiting students at GCSE. The latest version of the National Curriculum allows genuine freedom encouraging teacher autonomy. However it is still evident that some student's education at KS1 and 2 does not reflect this and teachers cannot see how beneficial and supportive the subject can be. Children benefit from talking about what they are doing – Design and Technology allows students to come up with practical solutions to problems. It is a valuable subject for developing literacy, a large range of skills and concepts are utilised – explaining, evaluating, convincing, communicating ideas, using technical vocabulary, comprehension and synthesis, debating and articulating to mention a few.

Students can use the knowledge and understanding gained, apply it when making, developing cognitive and manipulative skills.

> *"The multidisciplinary nature of the subject provides opportunities for children to apply knowledge and understanding gained in the area of, for example science, maths, language, art and ICT. It is then that they can demonstrate a real understanding of a concept, given appropriate support from a teacher."*
> *Benson C (2000)*

Increasing teacher's awareness and supporting them with strong partnerships can help exploit the true benefits of the breadth of skills that D&T encompasses.

Interpretation of key skills within technology is highly dependant on a teacher's priorities, and, this is reflected in my secondary school where teachers come from a broad spectrum of backgrounds. When I began at my school there was a big age divide between myself and my colleagues which inevitably was reflected in some of our ideals and teaching styles. I became curious when students emerged from lessons with almost identical completed final outcomes indicating restricted work development. I learnt from talking to students that just because a final outcome had been made it does not necessarily mean that the student has progressed. Without clear assessments that clarify success of learning, students can become far too reliant on teacher instruction. I looked over the scheme of work – it showed development in skills improving practical skills by progressing from simple tasks to more complicated ones. However every student created the same thing, and I began to realise that designing and stretching students' creativity was not a priority for the teacher. There appeared to be limited challenge and problem solving for the students as the teacher restricted students choices to a step by step format. I found this to be a common pattern as Jim Morley explains,

> *"Classroom activates, particularly at Key Stage 3, have sometimes been dominated by the need to improve knowledge and practical skills with concessions to the processes of designing being made only by offering limited choices in the nature of the outcome."*
> Morley J (2002)

I asked a teacher in my department how their scheme differentiated and supported gifted and talented students. The response was interesting to say the least – "all students in my lessons are gifted and talented – I don't discriminate." An interesting concept, one which I would love to support, but after watching some of the lessons it was apparent that when more able students had completed the work they were often left to "help other students" often ending up completing work for the student, or becoming de-motivated during lessons – resulting in completing work more slowly. In my interviews with year 7 students all of them supported teachers' approaches at secondary schools, stating that they needed to know and understand the potentials and limitations of a material before they could successfully integrate it into a design. This resulted in a desire to learn new skills and extend knowledge they felt they did not get the chance to develop at primary school. Students' enthusiasm for using larger equipment and developing craft skills is overwhelming. However, so is research that shows designing skills are not as developed as their making skills. Students are aware how learning new manipulative skills would benefit them, and can apply their understanding, reflecting and building the foundations laid at primary school. However if students were also taught how to design and develop creatively, surely this would motivate them to apply these skills and create unique and original work. As most students I interviewed did not like designing I asked why, and it became apparent that they did not understand why they should do it and they did not like it. This was mainly due to the fact they were impatient to get on and get their hands dirty.

After explaining to some new students that it was not just drawing a pretty picture I decided to look into what designing is. The design and technology in education DATE project (1990) described designing as *"the conception and resolution of the future configurations of environments, productions and communication. This refers to all qualities that are designed and not merely stumbled upon by chance or mistake."*

> *"designing involves "imaging" or "seeing in the mind's eye" and then being able to model these images in a concrete way."*

It should combine aesthetics and functional qualities; they should reflect a student's knowledge and experience enabling a student to describe ideas in graphical form. Most importantly designing should not solely be allocated before making and evaluating – developments in designs will happen as students develop their skills and overcome problems and limitations within materials.

As teachers we are constantly asking students to be creative and original in developing their designs. To be creative students need a basic understanding to enable them to think in new ways to combine old and new understanding in a constructive way. After reading various research it was obvious that designing and creativity needs nurturing and developing as much as making skills – ideas are built on foundations of other ideas by facing and embracing challenge, and thinking through solutions creatively, learning and exploring independently. Lawson (1980) argues that designing involves a multitude of elements, and each individual needs to develop at their own pace. It should be *"learnt rather than taught… for it is we, not others, who must design with it."*

Are we as teachers supporting this, building on and developing students' curiosity and ensuring they are "designing effectively"? There is evidence to say no. Chalkley and Shield (1996) state teachers are less skilful in deconstructing designing into elements that can be taught progressively than motor skills and knowledge aspects of design and technology. This makes it difficult to scaffold learning and plan for progression, especially as students are often asked to design something and then make it. This is counterproductive and often means that students are not given the chance to develop ideas, work with a range of materials, disassemble products and develop models to ensure they understand how best to design a final outcome.

McCormick et al (1993) studied students' problem solving processes at Key Stage 3 and how teachers structured the task.

> *"… the design process is highly complex and not easily communicated. Children encounter different problems requiring different approaches, according to the kind of task and the stage reached in its solution… problem solving…may proceed in a very different way to the characterised by a holistic ';design and make process'."*
> McCormick R, Hennessy S and Murphy P (1993)

I cannot help but agree with McCormick following on from my own personal experience as a jeweller. I would not be able to produce an original and quality product if I had to make my initial design. Yet at KS4, examination boards still rely on a systematic design process that is reflected in their assessment specifications. This often means that if a student cannot create one of their 6 initial designs it is harder for them to gain high marks. I think this is counterproductive and can lead to students underachieving and not reaching their potential. I often make students create models initially so they understand potential limitations of their designs and ensure modelling and designing are hand in hand. A clear overhaul of assessment is overdue at KS4 to help students design individually, and allow assessors more freedom to allocate marks to students that creatively and intuitively develop designs rather than making a design that was realised prior to making.

With this in mind, and the fact that in essence we are preparing students for situations that require their initiative and creativity, how can the transition period from primary to secondary be improved? Structuring appears to be key here – if students are involved in identifying a need they are more likely to think of creative solutions to the problem. In essence encouraging them and valuing their ideas to train them to think creatively. In addition students need to develop their ability to use the appropriate tool in a variety of contexts. Some of the students I interviewed were very clear that they enjoyed working in teams in primary schools – sharing ideas, becoming more sensitive and uncritical and ultimately learning from one another, something that De Bono clearly supported. It is clear that some of the primary schools do challenge students, but not all of them increase this challenge by asking students to take into account who they are designing for and adjusting their designs accordingly. Indeed, reflection and developing criteria for a successful outcome often seem like foreign concepts to year 7 students. So when should we start to build these skills into a child's curriculum? Educational psychologist Jean Piaget identifies four mental stages of growth, ranging from learning about the physical world and sensory motor stage, to reasoning intuitively using imaginative play.

> *"It is not until the child reaches the age of twelve to fifteen that he or she can begin to reason logically and systematically, and is able to fully engage in drawing designs…"* Melanie Fasciato (2000)

However if a child has not been taught how to graphically communicate their ideas in the form of designs and taught how to think on paper between the ages of 7 – 12 they have missed massive development stages in their learning. Primary students need to build these skills and focus them in the last year before transition to become more fluent and confident when using them to explain ideas, concepts and developments. There needs to be more training available for primary staff and more initiatives like the designer in residence for primary schools to take part in.

Samuel (1991) recognised that making skills were generally more advanced than their designing skills at KS2. He suggested limiting materials and size when making, and ensuring students were drawing "hidden" parts in their technical drawings. In addition developing 2D skills is important, but without modelling and developing a working knowledge of how a design works where will students develop solutions? Models should empower students to develop and explore possibilities before making, to give students a natural and undaunting progression to develop their design and to take less pressure when "making".

Liddament (1993) suggests that models may be used not only as 'information carriers… *"Clarifying and enlarging upon information', but can also be used to teach ideas, concepts and conceptual relationships that are important in design education."* Liddament T (1993)

This supports how important modelling can be – but it needs to be used in conjunction with development and should be seen as a final outcome.

In reality students use different aspects of the design process, rarely using all of the 'required elements' which often leads to teachers going through the motions in order to 'tick boxes'. Children need to develop cognitive skills initially before designing skills, and this maybe why so many students arrive at Secondary schools with different attitudes towards designing, and a lack in self confidence about their skills. If we are to develop students into designers they need to have familiarity with the process, and play should be an integral part of the process to aid understanding and to develop knowledge and skills. This is especially important at the "concrete operational stage" identified by Jean Piaget. Surely a primary teacher would be better to develop these skills along side a specialist?

Clearly structured FPT's can both challenge and develop student's knowledge and understanding, whilst also developing their skills to create original outcomes. The new KS3 strategy seems to have been developed from a concern about designing skills, and unless successfully interpreted has not been welcomed with open arms. Teachers including some in my department are sceptical of how the strategy will help students to develop the skills to create quality outcomes. Its sole focus seems to be that of highlighting the lack of opportunity for students to produce high level making skills. Yet without the knowledge of what makes quality and appreciation of creativity, students will continue to make well made but simplistic "tables." In essence making and developing knowledge and creative skills are all integrated and is one of Design & Technology's unique strengths. This is backed by many researchers including Barnes 1998 – 'The primary purpose of CDT was to develop design awareness, sharing their environments through deductive reasoning and expressive work, and was not purely practical and utilitarian.'

Successful transition will allow students to develop new and exciting ideas that will start to challenge some of my fellow colleagues, as they see the benefit of successful designing when used in conjunction with development of practical skills.

Ofsted (1996) have raised concerns about continuity and coherence between key stages – especially between primary and secondary schools – as it can hinder a child's progress. From talking to primary school teachers it is obvious they are pressured for students to reach targets that do not hold D&T in high regard, and therefore do not necessarily plan for a student's future development in the subject. The difference in approaches have been highlighted by Kimbell's research

> *" Primary teachers appear to be concerned to allow their pupils to experience technology and to capitalise on their tactic understanding…. Secondary teachers, by contrast, are constantly seeking to make these understandings explicit." p.108*

KS2 appears to allow students to work things out for themselves, to work through uncertainty whereas KS3 project work is much more predictable, perhaps reflecting the teachers' confidence in subject knowledge. Both approaches have shown effective results, but with such a contrast between primary and secondary schools the readjustment in students' learning is surely detrimental to them.

> *"the contrast between a safe, constrained approach to teaching and the ambition and eagerness to experiment, which many children show when engaging in a D and T activity, is sharp."* Sayers S (2002)

So if we want students to continually develop their skills, there needs to be a smoother transition from primary to secondary D&T teaching. We need to build suitable challenge for students that allow them to solve problems with the new knowledge they acquire. In order for students to demonstrate the capabilities they possess, opportunities need to be built in, and deeper experience and understanding of the subject needs to available. However as DT is not a core subject, why and how are we to do this?

> *"It has long been argued that the curriculum is too polarized and that too often children do not transfer or apply their learning within different areas of the curriculum."* Spendlove D (2008)

So how do the government plan to amend this? The most recent biggest influence on D&T is the STEM agenda (Science, Technology, Engineering and Maths) which coordinates a range of different activities that link together to give a more focused approach to learning – often referred to 'Developing complementary dispositions'. Some of the year 7 students I interviewed talked about how beneficial projects were that linked Science and Technology together. They described how they learnt what they needed to know to build a torch and a mechanised car. It was apparent that they were more motivated to learn the theory side of science lessons and adapt what they had learnt into a new context and expand their learning. It is evident that when students are given the opportunity to transfer knowledge from one situation to another – the skills can then be developed and hopefully become second nature to the student. Lawson (1980) made a comparative study of the approaches students used to tackle the same task showing that different approaches can make students think in a variety of different contexts. Science students began by trying to understand the problem, whilst architecture students looked at possible solutions.

McCormick (1999) describes different types of knowledge that pupils acquire *"Procedural knowledge is concerned with how to go about solving problems, whereas factual and conceptual knowledge describes the ideas and information."* p.30

He states that conceptual knowledge will be presented in one form in a science lesson, and acquired in device knowledge in design and technology lessons. The concept of device knowledge which is often used during design and make projects make the subject very flexible in terms of cross curricula links which should be developed further.

With collaborations there is a danger that D&T is just seen as the "making aspect" rather than building on the range of good practices and disciplines that other subjects do not have.

Future Developments

Not all Science can be taught within a design and make context, and so there are limitations with this subject collaboration. In addition for this type of learning to be valuable to the student teachers, they have to be prepared to invest time into planning it properly.

> *"Careful planning and coordination are required to integrate science and design and technology in a meaningful way."* Johnsey R (2000)

At primary level the teacher may have a much better knowledge of what needs to be taught in each of the subjects and consequently can integrate them effectively. At secondary level teachers are often less familiar with other subjects, and although they appreciate the links they frequently lack the necessary sophistication. I feel this is something that primary and secondary teachers could do together as there is a lot of good practice that secondary teachers could learn and a lot of subject knowledge that they could impart in return. Collaborative planning between specialised teachers is essential; however making time for this is a practical implication that most secondary teachers involved in the scheme often feel down hearted about.

Procedural knowledge, which design & technology uses fluently, could be learnt with a variety of contexts; this therefore lends itself to more cross curricula links, and gives knowledge relevance to the real world and could motivate students to learn in more depth. Contextualising learning is vital; the more that subjects can link with the real world the more students are likely to understand and develop the capability to deal with more sophisticated contexts. This is something that Design and Technology teachers are used to doing and then varying the context to suit the relevant developmental stages.

There is increased evidence to show that just completing a transition project for students from primary school to secondary does not make the most of collaboration between schools. Unfortunately primary schools do not have time to develop the skills learnt, as transition projects normally take place after year 11's have left and secondary staff have more free time. What are the benefits of working with primary teachers and students throughout year 6? There are mutual benefits; secondary teachers can build relationships with students and primary teachers to develop understanding of the curriculum. From this increased understanding workshops can be tailored to meet primary teachers' needs, and enable them to develop planning in their own school knowing the activities that are offered. It enables secondary teachers to assess pupil's skill levels and incorporate any areas of weaknesses into their schemes of work. The experience raises the enrichment and achievement of students and increases the participation as the activities are held at college. Also it enables students to explore and develop knowledge and understanding of a range of new materials and techniques. Primary children rely on physical and practical interaction within the context to design and make. Rob Johnsey highlights the pleasure that students get from simply manipulating new material.

> *"Teachers may arrange for children to become familiar with tools and materials so that their novelty does not detract from the design task in hand."* Johnsey J (2000)

This experience could also be extended to include the STEM project and various CAD/ electronic projects and competitions that are available. This would not only excite the students and give them new motivation and appreciation of Design & Technology that will hopefully continue to develop throughout KS3, but also enable the primary teachers to experience how diverse, inspirational and challenging the subject can be.

To increase student enthusiasm motivation and interest at secondary school, we need to value the importance of a successful transition. This needs to be developed, to encompass primary teachers and their skills. Ideally this would take place over the whole of year 6, exploiting the versatile and enriching cross curricular links that Design and Technology can employ, such as the STEM project, to ensure that primary teachers can develop learning whilst back in their own schools. Awareness of the importance of the subject needs to be bestowed to full teaching and non teaching staff including management. This would ensure that primary teachers can improve their subject knowledge through external training and therefore confidence in teaching the subject. Training needs to include both theory practical and graphics training to allow staff to become more fluent, confident and skilled. In addition more funding and awareness of the opportunities that already are available need to be increased. Competitions and experiences should be used to captivate students and keep their interest and enjoyment alive. In the same respect secondary teachers need to take responsibility to maintain this enthusiasm, and to learn from some of the good practice that primary teachers already employ. Collaboration between primary and secondary school is vital to fully exploit a successful transition.

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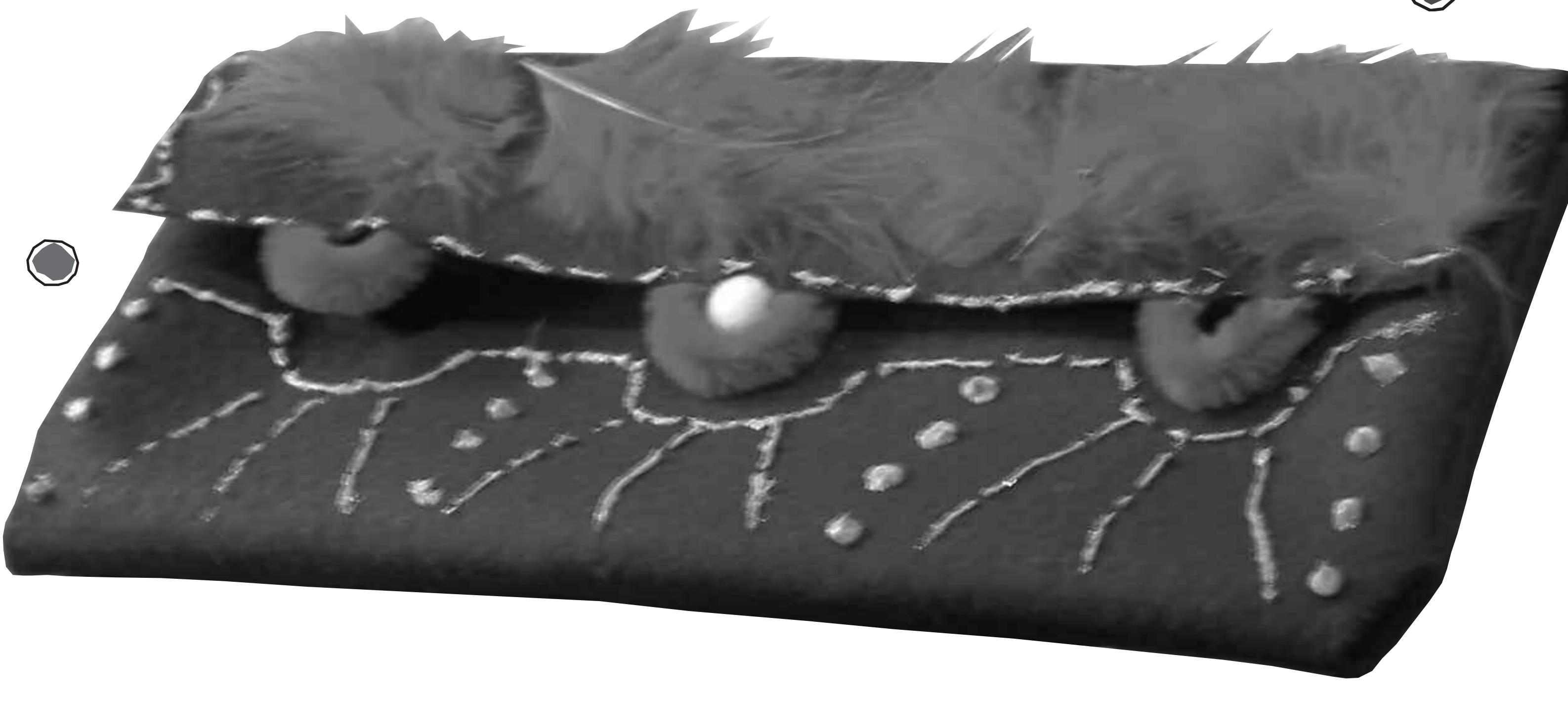
Key Initiatives

The government has funded many key initiatives that are contributing to developing DT, all of which need to be explored further:

- Partnerships beyond the classroom
- Design and Technology Association
- CAD CAM in Schools initiative
- Marconi Electronics and Communications Technology Project
- Food in Schools
- Electronics in Schools
- Nuffield foundation
- Gatsby Charitable foundation
- Design Council
- SETNET
- Engineering Council UK
- Young Foresight
- Arkwright Scholarship
- British Nutrition Foundation
- Engineering Education Scheme
- The Centre for Research in Primary Technology
- Teru Goldsmiths College
- The National Association of Advisers and Inspectors in Design and Technology
- Young Engineers



Birthing Young Inventors at the Southern Tip of Africa

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Introduction

This is a step by step guide to the technological process as done in Bredasdorp Primary School. We encourage our educators throughout the whole school to follow these guidelines in order to expose the learners to (stelephone die leerders bloot) the technological process as a whole. Our primary aim is to make use of materials and objects in our area, as one can then take the learners out to observe the examples in real life and obtain practical experience for their projects, for example on our farms, at our Air Force base, etc. It also gives the learners of all Grades ample opportunity to do research and to interview people in these specific fields. As a school we firmly believe in the words of Walt Disney, "If you can dream it, you can achieve it." By intoducing our learners to this technological process, they will each be motivated to become young inventors and to give their technological dreams wings.

Working Area

Whether the activities are to take place in the classroom or our technology room, layout is carefully considered.

How might the kind of activities affect the type, amount and position of:

- The furniture and storage space?
- Tools, equipment and materials?
- Place to store unfinished work (models, sketches, folders, etc.)
- Display area?

Technology can be implemented with limited numbers of tools and equipment, depending on how the educator organises the learners.

Resources

Good Technology can be taught by using the simplest of tools, equipment and materials. We aim to purchase a fair stock of tools, materials and equipment over a period of a few years, according to available funds at our school, keeping in mind that good tools, well maintained, can last indefinatelephoney. Tools and equipment are checked regularly to make sure they are safe to use.

Sourced items

Many essentials need not be purchased, but can be collected. Sourced items are often found as cast offs from household things

Classroom management and resources: The successful implementation of Technology in our school relies to a great extend on the way in which the classroom is organised or industry, by-products and even wastes from our pupils' homes and industries in our area. Some of these items include waste cotton, toothpaste tubes, toilet roll tubes, used matchsticks, etc. These resources are stored in containers like cardboard boxes, crates, etc.

Storage

Tools and equipment in our school are locked away for safekeeping in our Technology Room . We store the tools and materials in cupboards in this room. The classroom is always locked. We even store one or two items in our safe. Materials that are needed by our educators on a regular basis are easily accessible. Our Head of Technology controls the usage of this room and its contents.

Health and safety

Activities are planned according to the age, level and competence of our learners. The mandatory requirements derived from the Occupational Health and Safety Act (1994) are constantly taken into account. Our learners are made aware of their responsibility for their own safety and that of others and, therefore, the importance of using tools, equipment and materials correctly. All tools and equipment are regularly checked and the necessary maintenance done. Our learners are never left unsupervised in classes.

Learning Outcome 1

Technological processes and skills

The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technologies.

This Learning Outcome offers opportunities for learners to develop their technological capability. To meet people's needs and wants and to solve problems. As a result they will better understand the pressures that operate in the real world of people, products, systems and the environment.

Investigate

Gr. 1 – Investigate: why products are made from certain materials

Gr. 2 – Investigate: Describe the use of various materials and sub-stances in the past and at present.

Gr. 3 – Investigate: Look up the historical content of a given Problem, need or opportunity concerning structures; manu-Facturing; systems and controls.

Gr. 4 – Investigate: Finds out, with assistance, about the back-Ground context when given a problem, need or opportunity including who is it for, what it looks like, what is it for, what is it made of.

Gr. 5 – Investigate: Finds out about the background when given a Problem, need or opportunity and lists the advantages and Disadvantages that a technological solution might bring to People.

Gr. 6 – Investigate: Finds out about the background context when Given a problem, need or opportunity, and lists the advantages and disadvantages that a technological solution Might bring to people and the environment.

Gr. 7 – Investigate: Ways to process products and materials

Design

Gr. 1 – Design: Choose suitable material or substances to make a specific product

Gr. 2 – Design: Select suitable materials or substances to manufacture products, make suggestions how they can solve the problem, or meet a need or opportunity.

Gr. 3 – Design: Suggest various possible solutions, choose one and use freehand sketches to represent it.

Gr. 4 – Design: Writes or communicates, with assistance, a short clear statement for the development of a product for a given purpose.

Gr. 5 – Design: Writes or communicates, with assistance, a short problem, need or opportunity that demonstrates some understanding of the technological purposes of the solution and records two of it to the problem.

Gr. 6 – Design: Writes or communicates a design brief for the development of a product related to a given problem, need or opportunity that clarifies the technological purposes of the solution include two of them to the problem.

Gr. 7 – Design: Writes or communicate a short and clear statement or a design bried for the development of a product or system related to a given problem, need or opportunity using the following design keywords:

- People: age, target market, human rights
- Purpose: functions, what product will do
- Appearance: colour, shape
- Environment, safety, cost and give 2 solutions

Make

Gr. 1 – Make: Make simple products from various materials

Gr. 2 – Make: Explain what will be used and how the product will be made in a safe manner by means of joining (example Join using glue/cellotape/screw/…)

Gr. 3 – Make: Explain how a product can be made in a safe manner

Gr. 4 – Make: Briefly outlines a plan for making, listing the main steps and use suitable tools to make products by measuring, marking, cutting and joining.

Gr. 5 – Make: Outline a plan that shows the steps for making, including drawings or sketches of main parts.

Gr. 6 – Make: Develops plans that detail the making steps, including drawings and sketches that help to clarify the plans. Using suitable tools to make products by measuring , marking out, cutting, shaping, forming and finishing the chosen materials.
Gr. 7 – Develop plan for making that detail recources needed dimenssions, steps, use suitable tools.

All grades should work neatly and safely, minimize waste of materials.

Evaluate

Gr. 1 – Evaluate: Explain and express own feelings concern the product for ex. Cards, booklet,box. Does it work well? What would happen if the product were made of another material?
Gr. 2 – Evaluate: Identify strengths and weaknesses of own products.
Gr. 3 – Evaluate: Strengths and weaknesses of own and of other's products
Gr. 4 – Evaluate: With assistance, the product according to the design brief, and suggests improvements and modifications if necessary.
Gr. 5 – Evaluate: With assistance, the product according to the design brief and given specifications and constaints and suggests improvements and modifications if necessary.
Gr. 6 – Evaluate: Evaluate the product according to the design brief and given specifications and constraints and suggests improvements and modifications.
Gr. 7 – Evaluate: The improved products of materials.
Gr. 4 – Produce simple 2-D sketches with colour
Gr. 5 – Produce labelled 2-D sketches with colours
Gr. 6 – Draw sketches to communicate different information appropriatelephoney and effectively
Gr. 7 – Present ideas using 2-D or 3-D sketches.

Learning Outcome 2 (Gr. 4 – 7)

Technological Knowledge and understanding

The learner will be able to understand and apply relevant technological knowledge ethically and responsibly.

Learning Outcome 3

Technology, society and the environment.

There are three specific areas that will be focused on:

- Indigenous technology and culture
- The impact of technology; and
- Bias in technology

Conclusion

It is a fact that, in light of our current world economy, educators worldwide have a huge responsibility to teach our children to be self providing and become entrepreneurs. Bredasdorp Primary and our educators feel very strongly about this responsibility. This is done, keeping in mind that we are preparing our learners not only to be South African citizens, but world citizens who can effectively claim their ground in the technological challenges of an ever changing world.

Content		
Systems and Control	Structures	Processing
Mechanical systems (including hydraulic and pneumatic systems) Electrical systems	Supporting loads by making products stiff, stable and strong when forces are applied to them	Ways in which materials may be processed or manufactured to improve their properties.

Group Teaching of Design and Technology in an Inner City School

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Abstract

Ofsted continually finds that design and technology is not sufficiently taught in the majority of primary schools. This is due to teachers' lack of confidence and limited subject knowledge. Ofsted (2008) states 'achievement was no better than satisfactory in over two thirds of schools surveyed' (p.9). In order to discover how design and technology can be improved in schools, a school based subject study was carried out, investigating different aspects of design and technology.

Introduction

As part of a Design and Technology module in Primary Education, group teaching took place in an inner city primary school in Birmingham. The school was aiming to raise standards in design and technology. Therefore fifteen student teachers designed and delivered a unit of work to enhance both children's and teachers' understanding and knowledge of design and technology. The teachers in this particular school had little knowledge and experience of design and technology and were keen to find different ways in which the schemes of work could be taught. We adapted a QCA Scheme of work, 'Moving monsters', to make it more relevant to children; two groups opted to use 'Doctor Who' as their focus and one group adapted the unit to focus on animals.

The Project

When working with the class teachers, it was essential that they were kept well informed as to what was going to happen in each lesson. This gave the teachers an opportunity to contribute to the lesson plans, and provide advice as to whether or not the lessons were suitable for their classes as they were more knowledgeable concerning the children's ability in comparison to the trainee teaching groups. Some of the class teachers were keen to

improve their knowledge of how design and technology could be taught effectively. Wilson (2003) suggests, "Pupils achieve their best from a teacher who can teach their specialism to the full and avoid trying to teach when they have limited knowledge" (p.235)

Planning for each lesson brought up a number of problems as the groups that had been organised had a variety of skills and varying strengths Some of the trainee teachers had chosen to specialise in the foundation stage and Key Stage one, while the others had chosen Key Stage 1 and Key Stage 2. There were also disagreements about which aspects of design and technology should be focused on. When discussing planning the trainee teachers that preferred to work in Key Stage 2 often aimed their work at a level which was too high for the class and failed to take into consideration the lack of experience that the children had, while those who preferred the Foundation Stage tended to over simplify the lessons and aimed the lessons at a level too low for the children.

As the children were unknown to us, the first major challenge that presented itself was to consider their ability, knowledge and personalities. It was quickly discovered that the children had little or no experience of design and technology and were keen to undertake the tasks provided. However some children would rush ahead as they wanted to make their final build before

undertaking the key steps in designing. It became quite evident that the ability levels of the children greatly differed in each class; with some children striving ahead with different pneumatic systems while some struggled to make one simple system, therefore the student teachers had to continuously evaluate their lesson plans to ensure all the children's needs were catered for.

The first lesson (IDEAS Lesson) had the children exploring different pneumatic systems; however after a short while the children quickly became bored and wanted to start making. This meant that the lessons had to be changed quickly and redirected, in order to keep the children focused and motivated. It was essential that the children fully understand the theory behind pneumatics before moving on to the next stage. We therefore asked the children to make their own pneumatic systems whilst considering how these could be incorporated into a possible model.

When the children started building their models, the children relied heavily on using masking tape as a joining method, which was due to their inexperience of joining methods. This had failed to be planned for, as the focus of the lesson had been ensuring that the children understood pneumatic systems. Some of the lower ability children struggled when it came to building their models which resulted in a student teacher working closely with this group; however this resulted in work that did not reflect the child's true ability. It is essential that when teaching design and technology that the child has complete ownership of their work as this will let the teacher fully assess what the children are capable of doing.

The final lesson provided the children with the opportunity to evaluate their final models and all children, regardless of their ability were able to carry out this activity effectively. It is important that the children are given time, in order to reflect on their build and compare it to their original design. This let the children have a sense of accomplishment with their finished model, while providing the teacher with a method of levelling the child's work.

Conclusion

Doing this activity gave us an understanding of teachers' attitudes to design and technology; it also enabled us to see different methods and approaches to teaching design and technology. It was a great opportunity to work alongside other design and technology student specialists, as well as giving us an insight to the different aspects of design and technology that are needed in order to teach the subject effectively.

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An Approach to Using Design and Technology as a 'Driver' for an Integrated Curriculum

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Abstract

This case study aims to illustrate one school's experiences in using design and technology as the 'driver' for an integrated curriculum which originally arose following the implementation of Excellence and Enjoyment (2003).

The impetus to re-design the curriculum was two-fold arising from the awareness that the children's levels of achievement in design and technology were low and also that most progressed to a designated school for engineering at Key Stage 3. Therefore the need to raise standards seemed highly desirable.

The case study analyses the approaches taken to achieve the aims by tracking the radical overhaul of the existing integrated curriculum that used a geographical or historical 'driver' to using design and technology as the base.

Early results indicated an increased level of motivation in the children, greater collaboration amongst the staff and a higher quality and quantity of planning. But it also became apparent that there were significant issues to overcome such as staff confidence, curriculum continuity and the realisation that bringing about tangible change was a slow process.

The case study shows how the initial problems were addressed and how the emphasis on design and technology not only raised standards throughout the school but also developed teacher confidence and children's creative thinking ability.

Finally it speculates on future actions and how the current innovations may be developed further.

Introduction

Barnard Grove Primary School is situated in North East England and takes pupils from the ages of 3 to11. An integrated curriculum has been in place since 2005, following the implementation of Excellence and Enjoyment (2003) and the recommendations therein proved critical for the curriculum development that subsequently evolved.

The term 'curriculum driver' was adopted by the school to describe the subject that was pivotal to the planned theme and would establish the links that provided cohesion and connection across the curriculum.

Originally the drivers were usually history, geography or science. Being a statutory subject within the National Curriculum (DfEE, 1999) design and technology (D&T) was planned for but it was felt that the work failed to address the unique features of the subject and frequently resulted in simplistic model making; for example, pupils constructing 'copies' of historical artefacts.

The lack of engagement was also apparent in end of unit assessments where, at best, attainment in design and technology was average (level 4 was the highest achieved by a minority of pupils). Due to most pupils progressing to a specialised Engineering/Technology College this was a highly worrying situation as it suggested that pupils from Barnard Grove would start their Key Stage 3 curriculum disadvantaged in key skills associated with designing and making.

The impetus to raise standards was evident, not only to prepare the pupils for their future schooling and life generally, but to empower them and provide them with the self esteem, motivation and sense of achievement a good design and technology curriculum can provide (Hope, 2004). Other features of a creative approach were also recognised as being important criteria to consider such as taking risks, breaking boundaries, being curious, developing a sense of wonder and being flexible, imaginative and original. (Jones and Wyse, 2004; Howe, Davies and Ritchie 2001). With these considerations in mind a radical overhaul of the curriculum began during Autumn 2008 by using D&T as the driver for the integrated curriculum throughout the school.

This case study tracks the progress to date.

Development of the Curriculum – Stage 1

Following an initial meeting led by the head teacher, whose support was vital, key members of staff (the D&T co-ordinator and the teaching and learning co-ordinator from each age phase) were involved in the planning of the new curriculum. Relatively small changes were initially made because it had been determined though informal discussions that several members of staff were not sufficiently confident in their ability to teach effective D&T.

Work for the autumn term was planned around existing themes familiar to staff but with a shift of emphasis on the driver. For example the theme 'The Rainforest' was retained for years 3 and 4 but instead of pupils focusing on the geographical aspects they carried out a collaborative problem solving activity about what was required for survival in a rainforest environment, shelter being the key concept to explore. Investigating tents on the school field developed knowledge and understanding of structures in order to develop their own ideas with geographical knowledge of the environment being embedded alongside and via the D&T activity. So rather than, as had occurred previously, D&T being a 'bolt-on extra' to the curriculum it was now pivotal.

The other year groups followed a similar pattern of using a familiar theme so that staff would feel less daunted by the change of subject emphasis.

Results for Stage 1:
Methods for data collection included informal questioning and participant observation carried out by the D&T coordinator.

Initial results showed some significant successes and overall it was found that:

- The planning was found to be relevant, detailed and easily accessible
- The planning strategy (DT co-ordinator planned the units with the year groups' Teaching and Learning Coordinators (TLR),) ensured the above and also helped with staff confidence issues when planning lessons in design and technology
- The children's interests were immediately engaged; the teachers found that the children were more involved in the topic
- The children in both Key Stage 1 and 2 all enjoyed the structured D&T lessons
- It helped the staff to assess the children's current attainment levels and flagged up the issues in the teaching of design and technology that needed attention

Areas that required further development included:

- Some staff were not confident enough to use design and technology as the driver; they started with science or history supporting the theme, using the design and technology activities as a unit that ran alongside
- Some staff lacked confidence when teaching design and technology and admitted that they had omitted some lessons
- There was too much planning

Development of the Curriculum – Stage 2

The second cycle of planning moved to a higher level in Spring 2009 and aimed to build on the initial success whilst being aware of the shortcomings. It was decided that the D&T driver model had been successful overall but that the planned work still did not quite meet the ideal of enabling pupils to truly extend their creative thinking ability because the nature of the tasks were still quite constraining. The D&T co-ordinator was acutelephoney aware that by creating more open-ended contexts the feelings of insecurity amongst staff might be exacerbated but felt that the positive engagement of the pupils would act as a motivating force. It was also decided to encourage staff to begin the new theme with a D&T lesson.

Each year group were to engage in a scenario that would support creative, purposeful designing and making whilst also gaining practical skills, knowledge and understanding in specific areas. Planning continued to use the objectives from published schemes as the underlying framework to ensure progression and breadth of knowledge throughout the two Key Stages. Teacher creativity and the willingness to allow structured, but quite open-ended activities to take place in their classrooms resulted in carefully chosen ideas that proved to be highly motivating starting points for cross-curricular work. In Year 3 and 4 the pupils' work was based around the QCA unit Torches and linked to scientific investigative work on electricity.

Collaborative problem solving

Appendix: Example of Planning (Year 3/4)					
Lesson	Links to 'Every Child Matters'	Lesson Objectives (Key Ideas)	Main teaching	Activities	Plenary
1	*Enjoy and achieve Making A Positive Contribution Thinking Skills * Developing Ideas * Applying imagination * Hypothesizing	Children will: * know that torches are designed with the particular needs of the user in mind and that these needs can vary widely. Key Vocabulary: Morse code prototype, design concealed, dossier	Tell the children that an unusual 'Private and Confidential' email has been sent to school for the attention of pupils in Y3 and Y4. Show the children an 'email' from 'MI6 – Her Majesty's Secret Service'. The email goes on to say that MI6 often use Morse Code for the transfer of highly secret state secrets. The email has to detail and include A brief to express the fact that the Secret Service needs a design and prototype for a 'concealed, waterproof signal sender device' and that the children have been selected to provide this prototype and dossier of work. Discuss what the email means, explaining the key vocabulary and be ready to show the children examples of Morse Code (YouTube); http://www.youtube.com/watch?v=7z8yzyKs7GI (This is a video of the Morse code alphabet using sound. Explain how Morse code can also be sent using light). Does anyone know what Morse code is? What is a design and prototype? What does 'concealed' mean?	Are you thinking of any ideas already? Providing the children with 'Her Majesty's Secret Service' headed paper children to jot down their design brief (before the email destroys itself – for National Security reasons). In mixed ability groups children to quickly jot down any initial ideas they may have (on special headed paper). Making sure their diagrams are clearly labelled and annotated.	Children to quickly present their group ideas. Would that work? Is it concealed? What do you think you would make it out of? Does it fulfill the design brief? End the lesson by telling the children that their work is private and confidential, they mustn't tell any of the other classes! Planned Assessment Children will know that products are designed with particular needs in mind

An e-mail arrived in school from MI6 – Her Majesty's Secret Service – commissioning them to design and make a *'concealed, waterproof signal-sender device' for relaying secret messages.'* The pupils engaged with this idea to such an extent that their designs were hidden from teachers other than their own, which made data collection by the D&T co-ordinator very difficult – an unforeseen problem in methodology! Figure 1, plus an example of this planning can be seen in the appendix.

The other year groups pursued units of work with equally motivating starting points:

- **Year 1 and 2** were provided with the brief of developing a vehicle that would reduce traffic congestion and ease parking (a big problem in the school's car park)
- **Year 5 and 6** were to focus on the Tudor period of history which included the more 'gruesome' aspects such as why instruments of torture were used to extract information! Research skills were key to the success of this particular project and pupils were encouraged to investigate the historical events that resulted in the development of a need for instruments of torture. Alongside this they also engaged in activities to develop higher order thinking skills such as discussing present day perspectives of human rights and the concept of developing designs that may not always result in products that benefit society

Results for stage 2:

Initial assessment evidence was collected at the end of March 2009 and showed increased levels of attainment for each year group.

Overall teachers noted on the part of the pupils:

- Greater engagement and motivation and increased willingness to take responsibility for their own work
- Pupils wanted to succeed because they could see the purpose in the work they were engaging with

And for the teachers:

- Planning was more focused and easier to interpret (teachers who felt less confident in D&T found it easier to implement)

Future actions:

Introducing new ideas to a school's curriculum is a slow process. It takes time for teachers to internalize and for initial ideas to develop into working models. It is anticipated that the emphasis on D&T within a topic will, eventually, raise standards within the subject, although this may take time to show up on the assessments. It is hoped that because of good quality teaching and planning in key stage 1 children's skills will be upgraded ensuring higher levels at key stage 2. This will in turn enable the school to design more challenging work. It is also hoped that with more focussed collaborative planning, involving all staff, confidence levels will rise further meaning that children progress to Key Stage 3 with increased levels of prior knowledge and skills and are so better equipped to address their future creative challenges.

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Making the Difference – Working in Partnership

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Abstract

This is a case study of a design and technology (D&T) partnership between a secondary school, a designated Technology College and a feeder primary school. It focuses on how the relationship developed after a "Technology Outreach Teacher" in the secondary school was appointed to work with the D&T subject leaders in the primary school leading to a rise in the standards and competences of children and subject confidence in their teachers.

It offers readers guidance in establishing and replicating similar partnerships and insights into how partnerships can be more progressive. It explains how the partnership required the establishment of mutual trust with support in specifically identified areas of the primary D&T curriculum. Initially the primary projects were evaluated with the class teachers and outreach teacher; improvements were planned and team teaching took place with the outreach teacher taking the lead. Further evaluations and in-service training followed with the outreach teacher taking a supportive or observational role. More recently a whole-school curriculum review was undertaken and planning in D&T took place with the outreach teacher and primary staff working collaboratively.

Background

In 1994 the UK government designated its first "Technology Colleges"; these were primarily established to help resource and equip these schools to deliver the new curriculum area "technology" in the first national curriculum. Initially extra funding was only available to "grant maintained" and "voluntary aided schools" so they could become centres of excellence. Later the initiative developed so that any state secondary school in England could apply for the specialist schools programme and obtain funding matched by private sector sponsorship. The programme widened to other subjects; successful applicants received substantial additional government funding. This funding was to raise standards across the school and develop excellence in particular in the subject specialism and importantly within the local community, primarily in the specialist area.

When, in 2000, Kennet School achieved its specialist status, it already had strong relationships with its feeder schools; and was now able to develop these further using the 'community' budget. These commitments lead to the provision and maintenance of ICT resources, technical support to staff and pupils during class activities and one-off and regular activities at the secondary school in D&T, ICT, mathematics and science. A network of primary d&t subject leaders was established and the secondary school facilitated workshops at the teachers' requests; an equipment loans service was created. Finally an experienced D&T teacher developed work in primary school D&T lessons during the summer term after his teaching timetable was eased by the leaving year 11 and 13 students.

This work eased primary to secondary transition and was appreciated by the children and staff. However many primary teachers doubted their ability to replicate the activities because of their lack of technical knowledge and expertise and access to the specialist tools and materials. The activities did not contribute to pupils' assessment so were not focused on raising standards or attainment levels. Future planning was not based on evaluating the activities as there was no opportunity to do this.

In 2006, the secondary school realised that it could enhance the partnership in D&T by recruiting a "Technology Outreach Teacher" (TOT) – a secondary D&T specialist with primary experience. Uniquely in her first year she had no secondary school timetable and since then no more than three lessons per week; thus she has had a considerable amount of time with a substantial budget to raise standards.

Initially the TOT spent time establishing relationships with the headteachers, subject leaders and other staff in the schools. It was important to identify the characteristics of each school and establish good communication and trust. She had to convince the staff of her genuine understanding of the nature of primary education and her interest in developing pupils' learning (and that of their teachers') rather than imposing a secondary school approach. Sensitivity was required in fitting D&T into the heavy curriculum; teaching the breadth of the subject in an ordinary classroom environment; health and safety and hygiene issues; the budgets required for resourcing, maintaining and storing specialist equipment and materials; the cross-curricular nature of primary school foundation subjects (subjects other than English, mathematics and science); the previous experience of training and continuing professional development (CPD) among the teachers and their knowledge surety; and the flexibility required of timetabling.

In each of the 10 feeder schools the TOT wanted to demonstrate her ability to establish a good rapport with children and her competence as a teacher so she planned and implemented a dynamic cross curricular D&T project that included all the stages of the design process on a subject area meaningful to the pupils. It was called Remember Me (see CRIPT conference proceedings 2007). Simultaneously, she and the D&T subject leaders carried out audits of the curricula, the confidence and competences of staff, the tools and equipment in the schools and the materials (and budgets) available to carry out the curricula. They then embarked on planning further work based on what was already taking place. Parsons Down Junior School was one of the feeder schools in which this work took place and since then a strong working partnership has been established.

right – A successful project, a successful partnership


Maths Words
Of The Week

Parsons Down Junior School

Parsons Down Junior School teaches pupils between the ages of seven and eleven (Years 3-6). The majority of the Year 3 intake transfer from Parsons Down Infant School, with whom there is a long history of partnership. The pupils are arranged in three separate classes in each year group, with no more than 30 children per class. The school has been through considerable transformation since the appointment of a new headteacher in 2005.

The second co-author is now deputy head of the school; at the time the partnership with the TOT started she had just been given the role of D&T subject leader. She had only had 5 hours of formal training in D&T during her BEd at University but as a competent leader was confident in this role. Few of the teachers in the school had experienced more training than this so the school was following the QCA units of work which provided a familiar format and fulfilled the statutory requirements. Since then along with a building programme (including new D&T and ICT suites), we have revised the whole school curriculum and few of our D&T projects resemble the QCA units.

The Partnership at Work – Making the Difference

After reviewing the curriculum the D&T subject leader and TOT identified projects that the teachers felt were problematic. It was of paramount importance to accept that change was not going to happen overnight; and a gradual approach was agreed. Planning meetings took place with teachers in year teams and where necessary, CPD opportunities were arranged to practise techniques; following lessons staff shared reflections and observations on successes and concerns so that plans could be revised. The strategy was to start projects with the TOT leading as demonstration lessons; as the primary teachers' confidence increased team teaching was employed; as confidence developed further the TOT was to take an observational and supportive role. The ultimate aim was to work towards the primary teachers becoming autonomous in their planning and teaching, independent of the TOT.

Carrying out projects in partnership and continual reflective practice proved to be the most significant way of identifying ways forward. Until projects were worked through it was impossible to see where the strengths and weaknesses lay.

This process enabled the identification of further training needs. This was in two key areas, the first being anxiety over using unfamiliar tools and materials, the second being a fear of pupils' autonomy to design and make things that were quite different from one another, requiring the teacher to be able to support a wide range of ideas. The lack of teaching aids and the quality of tools and materials also became clear. Pupils sometimes lacked motivation as they knew that the models they designed and made would be disassembled after the project so that materials (e.g. lightbulbs and syringes) could be re-used. This was where the Specialist School's budget became crucial, tools and equipment were replaced them with that was more suitable; quality consumables were purchased; and stimulating teaching aids were provided for children to explore.

Staff observed that the more purposeful and meaningful projects were the most successful not only in maintaining motivation but also for promoting creativity and drawing out higher order thinking and learning (designerly thinking). An example of this was during a particularly hot summer term in which the Year 6 pupils identified a problem – there was very little shade in the school playground and many pupils complained about overheating during playtime and in outdoor PE lessons. This problem launched purposeful d&t activity: – the pupils thought through the problem in detail, they decided that they wanted to create some shade but there were different areas of the school that required shade at different times; and each of these areas served several different purposes for different children, in lessons and at playtime, also at different times of the year so these activities could be ruined if permanent shade was created; this led them to decision-making – a portable shade system was necessary. This raised further questions – where would it be stored? Who would get it out and erect it? Who would put it away? How long would it take? Through observations and by researching websites the pupils found out about how shade is achieved elsewhere. They experimented individually making small-scale structures out of artstraws and in groups they evaluated the structures – how well they would stand up? How much shade would they provide? How many children could be shaded by the structure? What materials could be used as a canopy over the structure? Would the structure serve any other purpose e.g. for sports or games? Could it work as a shelter from other weather e.g. rain, wind or snow? Would it be strong enough on a windy day? Would it be a hazard for those children playing ball games or with skipping ropes? Would we be able to make it? What would we need to find out? From this they developed the criteria necessary for their shelters and in groups they made decisions about the design of their own shelter. Next they started to make their structures full scale and finally they happily tested them out.

Another problem was identified in the D&T curriculum – the pupils developed a few new skills during a project but weren't necessarily going to get the chance to revisit the skills or even develop them further after the project. Additionally some of the projects undertaken in the older year groups had an unrealistic expectation of pupils' prior experience and knowledge. It was a progression problem. With the "Primary Review" in mind the Senior Management started a whole school curriculum review; changing it to become more thematic. This was an ideal time for the TOT and new D&T subject leader to review and rewrite the D&T curriculum so that it fitted with the chosen themes, was more progressive and allowed pupils more autonomy in purposeful projects. The new plans were rewritten last summer and have been carried out over the course of the year. For example in the Autumn term when the theme was Safety, the Year 4 children thought about safety issues in darkness, particularly as the end of British Summer Time was due and they noticed that the nights were drawing in. The pupils identified road safety as a special concern so they ended up designing and making high visibility and reflective items that would help people and animals be seen, these ranged from badges on hats, collars on dogs, straps on bags, sleeves on joggers' water bottles, bicycle and scooter accessories or multi-functional cuffs that could be used in a variety of ways. The joy of the pupils was visible (and audible) in the evaluative activities when the lights were turned off, then some pupils used bright torches to impersonate road traffic whilst others tested their products by "crossing the road" – sometimes there would be a safe crossing and sometimes there wasn't!

Making More Difference

Staff in both schools are proud of the partnership and the way d&t has progressed but there isn't time to stand still. The partnership is a positive one but there have been setbacks (e.g. continuity and dependency) and there will be more. Since the TOT started working with the primary school there have been three different subject leaders. Each of whom has had different levels of experience. There have also been changes in staff teams so throughout there has been a need to revise plans and repeat staff training. At first it seemed that this frustration slowed progress as reviewing activities for further planning was less relevant, but although teacher training may not always be immediately useful with the long view in mind it will provide each teacher with a wider range of experience and therefore a stronger base in which to gain confidence and understand the experiences of the pupils. As long as the secondary school maintains its specialist status there will be a TOT and the schools will want to continue their strong working partnership to improve standards and transition. This also counters the concern about primary teachers becoming dependent on the TOT for planning and developing resources. Staff changes are bound to occur. The authors hope to develop more CPD with the Teaching Assistants as they provide invaluable support for the teaching staff and they also can play a stronger role with continuity when the teaching staff changes.

Stand alone activities e.g. D&T week workshops still continue. Alongside the primary D&T curriculum these activities are fun and increase secondary school familiarity – easing transition and raising the D&T profile. Transition raises another concern, firstly because so far minimal linking with the infants' school has taken place. The partners are looking to develop a three-way relationship to improve transition and continuity. But more immediately the learning of primary school experience needs to pervade further into the secondary school, it is the TOT's responsibility now to convince the secondary school team that reciprocal learning can take place and standards be raised further by being more aware of pupils' prior experiences.

Playground – A Case Study in Primary Design and Technology in Cypriot Schools

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Abstract

The National Curriculum for Design and Technology (D&T) was introduced into the Cypriot Educational System for the first time in 1989. Technology education became compulsory in primary schools for children of ages 6-12 in 1992. Before this only a relatively small number of primary teachers had experience or training in the subject.

This project is designed to bring together pupils' skills in D&T, Mathematics, Science, and ICT. It is truly cross curricular and was used with classes of Year 5 and Year 6 children but could be easily adapted for any Key Stage 2 (7-11years) children. The project makes children think about their knowledge of pulleys and their application in real life. It is ideal for setting up an exciting fair project with a real purpose and exploring the variables involved.

Background

The Cypriot National Curriculum for Primary Design and Technology (2004) is very similar to the National curriculum in the England and requires that:

> *Pupils should be given opportunities to work with a range of materials and components including stiff and flexible sheet materials, materials that are suitable for making frameworks, electrical and mechanical components and construction kits.*

Before starting practical work pupils are given talks and demonstrations (resources) to help them for the tasks ahead. Preparatory tasks set for the pupils include using particular construction methods as a basis for a simple mechanical toy. They also design something for use in the classroom based on pulleys by searching the internet and working with specialised software on mechanisms called "Mechanical Toys". They collect playground photos and try to explain the use of pulleys. Using Virtual Lamps Electricity software and applying skills from Science, they design simple circuits that can use on their construction. Using Word and Autoshapes they design simple pulley systems. They apply mathematical knowledge about the perimeter of the pulleys to understand the speed reduction. Combining kits and ICT software with parts made from raw materials the project can give to the children a greater flexibility than using kits and software alone and helped avoid dependence on them. Helping children to have a framework structure (design process) in front of them seemed to facilitate the pupils' designing by making the problem more tangible. Creating this tangible 'framework still allows considerable freedom as to what the final artefact would be and the framework could always be modified if necessary depending on pupils' specifications and limitations. Mechanisms for example are demonstrated along with ways to make them in the classroom. Elastic bands as belts prove to be particularly popular ingredients. Belts made from textiles are very successful especially when joined by elastic to create the right tension. These were often run on wooden dowel rollers covered in 'sandpaper' to prevent the belt slipping. Electrics included a variety of classroom made switches and cheap commercial ones. Output devices were buzzers, bulbs, motors and light emitting diodes.

After finishing the project, children can also use a control box ("egg-box") in order to program several factions on their playground (left and right rotation, lights on –off, buzzer on –off etc). Control systems have been recently introduced in primary D&T lessons as an opportunity to meet objectives of the National Curriculum referring to the ability of the children to: program a sequence of factions by using ICT.

The project was run with cooperative learning (CL) groups of 3-4 children and this number worked well with all children being involved in every stage of the design process. This proved to be about the right number – enough for good progress and mutual support but not so many that they got in each others way. The children within their groups can generate a great amount of discussion and design ideas and concepts, social working, cooperation, division of work and learning skills. The evaluation of the finished product within their groups by comparing it to an existing product and then modifying their model in light of their observations leading to an improved design helps pupils to consider how material properties influence material selection and its working properties.

Results

By having all the groups carry the design process out using CL methods and create their final product individually, they have the opportunity to share their ideas, thoughts and results. Because similar outcomes are obtained among the group members, there is greater confidence in the discoveries as they have the opportunity to discuss, for example, why changes to the size of pulleys made a difference to their speed, why a bigger battery is needed for using two outputs instead of one. The goal of these interactions within this activity is to have children reflect upon and analyse their thoughts, ideas, designs and results and connect them to basic scientific concepts. In this sense, D&T and mathematics, ICT and science become intimately intertwined.

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What's in the Lunchbox?
Making a Difference with Technology Education

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Background

Because of the history of Apartheid in South Africa, the current teenagers are the first generation to have the opportunity to be educated together and the freedom to mix socially. Friendships are formed across racial groups, and learners are exposed to eating customs previously unfamiliar to them.

South Africa has become part of the Global Economy, and as a result of this, many global food outlets such as Kentucky Fried Chicken (KFC) and McDonald's have entered the food market. This has resulted in a change in the traditional eating habits of South Africans.

In 2007, the British Council and the South African Agency for Science and Technology Advancement produced a documentary that looks into the food choices of black South Africans. (South Africa-The journey to nutritional health.2007). The aim of this documentary was to reveal why South Africans eat what they do, and included the opinions of some learners, educators and local residents in rural areas throughout South Africa. The adults in the documentary favoured traditional foods, and expressed concern over the eating habits of the youth. In contrast, most of the learners interviewed expressed a desire to eat food from tuck shops and fast food outlets. They felt that there was a stigma attached to eating the healthier food provided by the school feeding programme. There appeared to be an obvious divide between the 'modern" food favoured by children, and the traditional food favoured by adults. In fact, many of the learners interviewed said that they did not like "traditional food", and longed for fast food outlets such as KFC to open in their communities.

Research done by Professor Cameron of Loughborough University in the UK concurs with these opinions. According to this research, diets in post-apartheid South Africa have changed from low-fat high fibre traditional food to a high-fat, low-fibre diet characterised by the "habitual intake of fast foods" (Cameron, 2003).

In this study, Professor Cameron argues that adopting a modern, Western type diet has had a negative rather than a positive effect on the health of South African children. Professor Cameron found that one in five children showed signs of stunted growth, which is a sign of persistent malnutrition during infancy. His research linked stunted growth in childhood with obesity and type 2 diabetes in adulthood. Furthermore, the incidence of diabetes in sub-Saharan Africa is increasing as more and more of the rural population move to urban areas. (Mbanya, J. and Ramiaya, K. 2007.) Clearly there is a need for children to be educated regarding food choices and sustainable nutrition practices.

How Technology Education can make a Difference

One of the problems associated with children's food choices is their need to control themselves and their environment. (Consumer Knowledge Centre, 2009). Children try to establish their independence by making their own choices, often rejecting foods deemed to be 'healthy' by their parents and teachers.

According to Schreiner, 2006:

> *"Science (and Technology) education should develop in the students a sense of autonomy and a feeling that they are personally independent, with the capacity to make their own….decisions and act on them"* (Shreiner 2006).

By allowing learners to design and make their own nutritious lunches, technology educators are not only giving learners this sense of autonomy, but are also allowing them to seek options that are considered to be acceptable to their peers. Technology Education allows for a methodology of participatory action research in the classroom, with projects that are initiated by the teacher, but with decisions that are made by the learners.

I have implemented this method with grade eight and nine learners in South Africa, with a project entitled "Junk food-designing a healthy alternative." This presentation includes visuals of the results.

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Working Together with Primary Schools: A Case Study

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Abstract

This case study outlines one secondary teacher's 'learning journey' at the beginning of her work to make appropriate links with feeder primary schools. She outlines her first project, identifies benefits, and highlights her own professional development opportunities.

Background

I have been working at Charlton School in Telford, Shropshire for three years as a Design and Technology teacher after completing the Graduate Training Programme (a programme that includes 'on the job' training) in another secondary school. I have now taught across nearly the entire range of technology subjects, initially specialising in Resistant Materials and Food, then modules of Electronics and Graphics and now exclusively Textiles.

Charlton School officially became part of a 'Learning Community' in September 2008, although as a secondary school it always had very strong links with partner schools. As a Learning Community Charlton works under 'soft federation' with Dothill Primary School, located a short distance away, the length of a football pitch. It also works closely with six other primaries. The core purpose of the Learning Community is to ensure the very best opportunities for the young people and families it serves.

The Project

In preparation and celebration of the new Learning Community, during May 2008 I invited a group of twenty Year 6 pupils from Dothill Primary school to work on a project designing a logo for the community schools. They initially spent some time in their own classrooms thinking about what a community school meant to them before using mood boards to express their feelings and to act as a starting point for their initial design ideas.

The pupils then visited Charlton School for three consecutive weeks for 90 minute lessons where they recreated their chosen designs on Microsoft Paint before selecting one to convert and save to a "stitch file". They took turns in using the computerized sewing machines to embroider their designs on to a T-Shirt which they took home. I felt this was not only an exciting creative process and a valuable piece of joint working between the schools, but was also an excellent way to introduce CAD/CAM to primary pupils. A further range of investigative activities were offered to the pupils using microscopes to look closely at fibres and fabrics, investigating smart materials and designing a school uniform for the future.

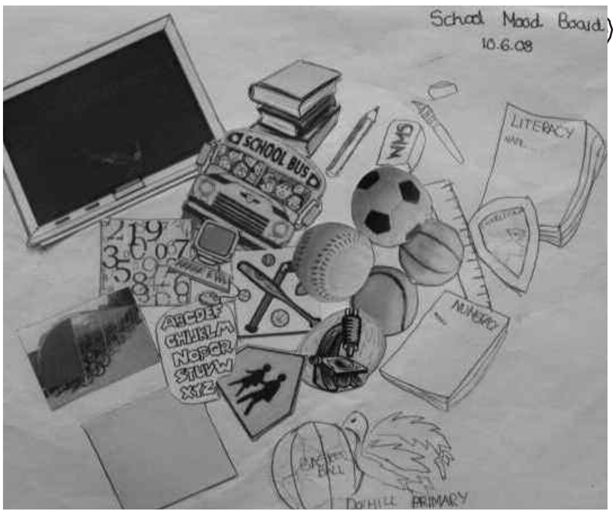
To finish the project from all the finished designs the children chose a 'winner' which was recreated collaboratively by all twenty pupils in a giant woven wall hanging.

The Benefits

Working closely on a joint project with a Primary school has reaped many benefits, not just for the pupils for whom the stress of moving to a much larger school has lessened with the familiarity of buildings and faces, but also for the staff. Exchanging ideas and working practices has proved to be valuable professional development across the key stages. As part of Charlton School's Professional Development Programme I have joined the 'teacher learning community' where many colleagues from across the phases are following Dylan Williams' program 'Embedding formative assessment'. One of the advantages of the programme is that we are given the opportunity to observe good teaching practices in the primary school.

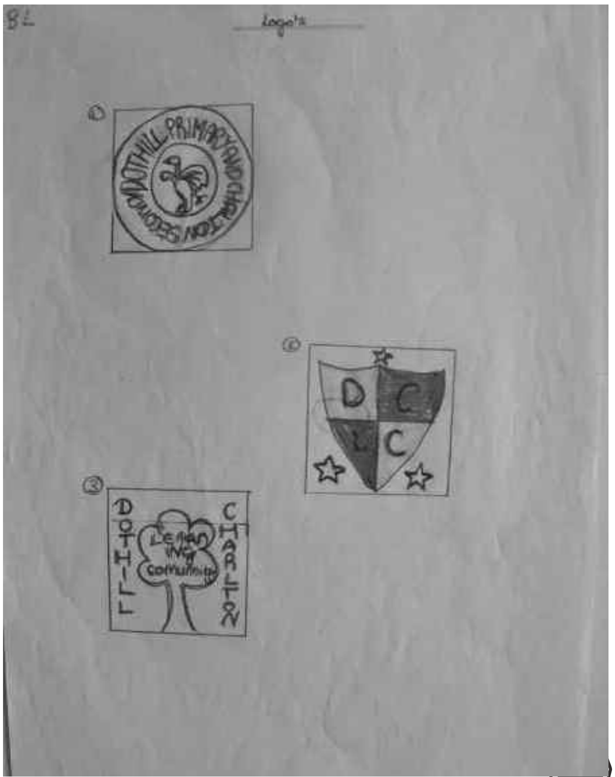
Developing my knowledge and understanding of primary practice

Following on from the work that I did in summer 2008, my line manager brought to my attention details of the Birmingham City

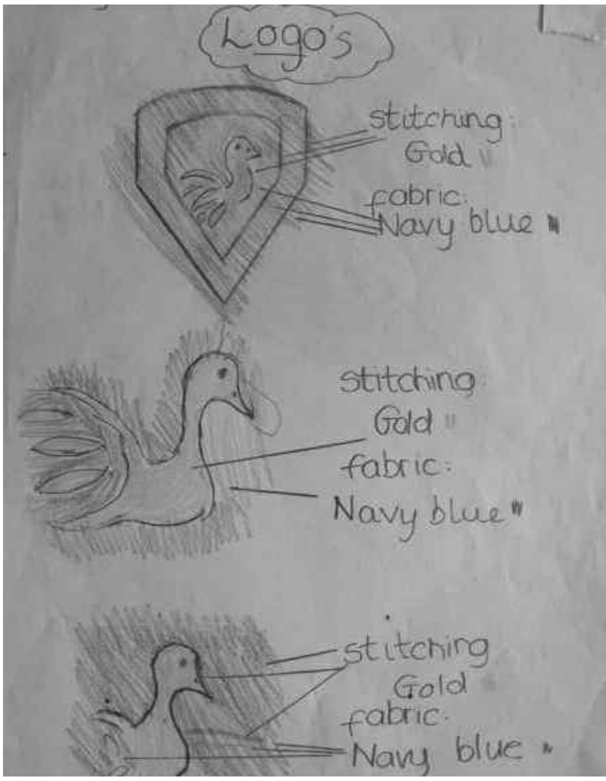


Mood Board 1

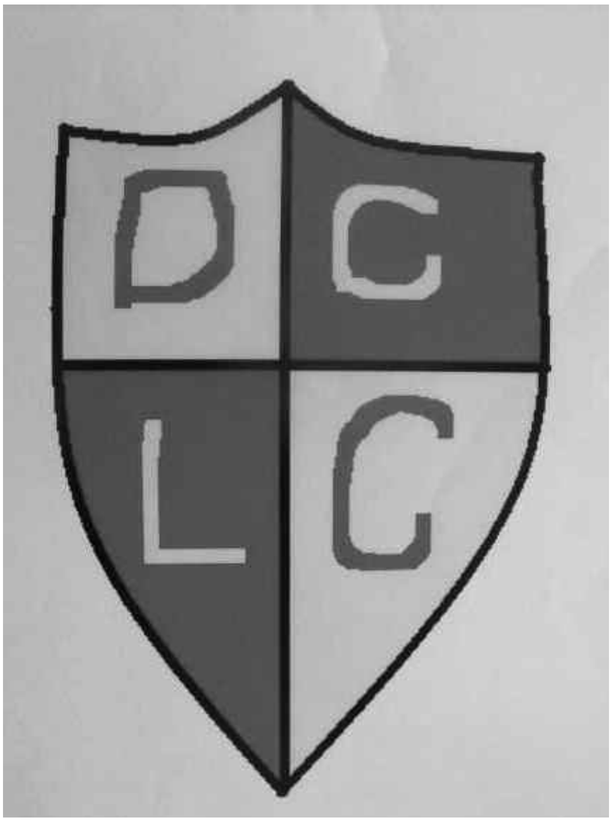
Mood Board 2



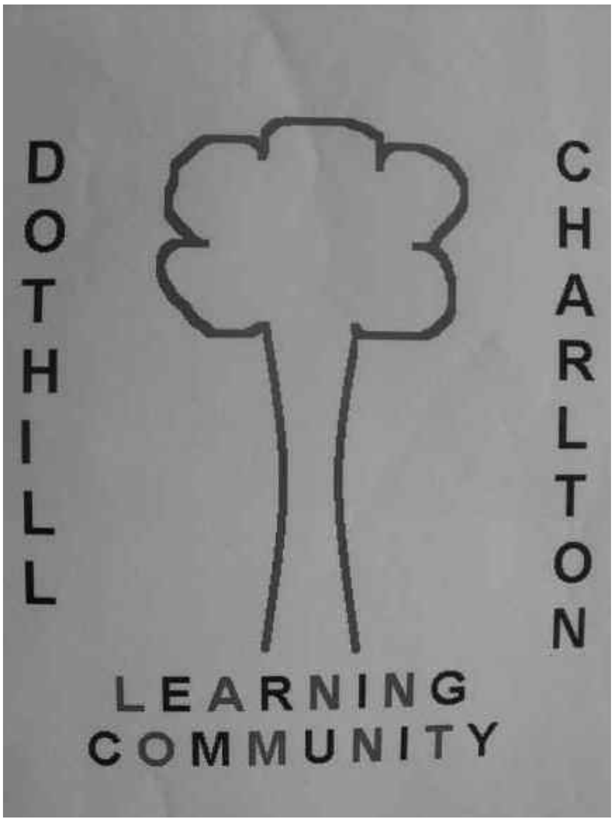
Roughs / Thumbnails 1



Roughs / Thumbnails 2

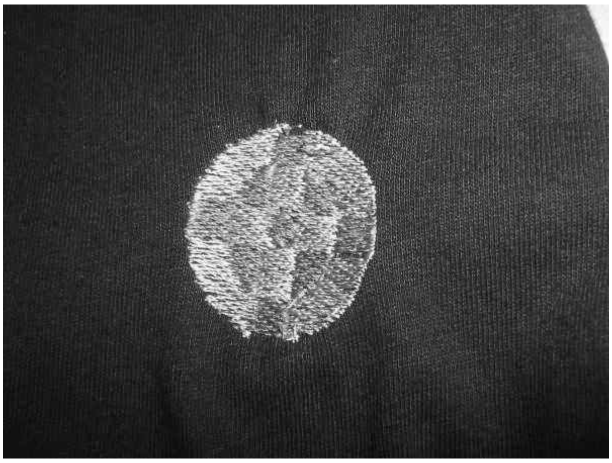


Logo design 1



Logo design 2

Final design choices



Chosen Identity

University extended course 'Primary Design and Technology' at M level funded through the Teacher Development Agency (TDA). Although the course was aimed at primary schools, secondary schools were being invited to attend in order to help with delivering work similar to my earlier project. I eagerly accepted the offer for professional development in this area as I had found the link work with Dothill very enjoyable, stimulating and informative. I have given feedback from the course to the Primary D&T coordinator which has been warmly received. We have forged a close professional relationship and look forward to working together again in the near future.

The course has been of great benefit to me not only in developing my knowledge and awareness of the primary curriculum content, and the practical and time constraints with which my colleagues have to work, but it has made me re-evaluate my own working practices. I have learnt the value of simple yet effective resources, which can be used not only for early key stages but as a revision tool for General Certificate of Secondary Education (GCSE). It has stimulated different ideas and approaches to design activities, focussed practical tasks and projects which I will adapt and use with older students. Throughout the course I was able to reflect on what is good Design and Technology and review my department's practices to ensure our schemes of work are relevant and how they can be improved. As a result, my colleagues and I are currently engaged in a debate over how much time should be spent learning practical skills and how much should be spent on design and creativity.

Future Work

Working cross-phase at Charlton School has already proved successful, with regular visits being made to primary schools by secondary staff in various subject areas, notably Science, Maths and Physical Education. It is hoped that in the future more work will be done in Design and Technology, timetable permitting. Currently the majority of cross-phase work has been restricted to the summer term when Year 11s leave for exam study. Further work is planned this summer for a cross-curricular project with Science, designing and making kites and investigating the forces acting on them.

Conclusion

Overall, during the past year I have found my joint working with other schools and teachers to be valuable not only in the positive outcomes achieved but in my own professional development. Attending the extended 'M' level course has helped consolidate this and working with the team and other participants at the University has been an exciting and motivational experience which I hope to build on in the coming years.

Design and Technology at University of South Australia, Mawson Lakes Campus for Pre-Service Students Studying in the Undergraduate Course

The Bachelor of Education (Primary and Middle) LBPM Programme, Division/Portfolio: Division of Education, Arts and Social Sciences, School/Unit: School of Education, Campus: Mawson Lakes Campus
Larry Spry – E-mail Larry.Spry@unisa.edu.au Telephone +61 8 830 25457 Facsimile +61 8 830 26778

Abstract

Technology involves the creation of products, processes and systems to solve perceived problems or meet perceived needs ... and that … Design is integral to the creation of new technologies and involves changing one set of circumstances into another.

The course introduces the pre service student to design and technology as a learning area and to the four clear and interconnected phases of technology, the intentions at its conception, its design, manufacture and its consequences. The programme utilises classroom focused activities that reflect the breadth and depth of the learning area

The course also introduces to the pre service students to the South Australian Curriculum Standards and Accountability (SACSA) Framework – the mandated curriculum framework for all South Australian schools:

- ***What is the LBPM programme?***
- ***Why is design and technology in LBPM course?***
- ***What does the design and technology programme include?***

The Case Study – What is the LBPM programme?

In the LBPM course, graduates gain recognised professional qualifications as an educator in primary and middle education. The Bachelor of Education (Primary and Middle) prepares graduates to teach children in the primary and middle years of schooling, from year three to ten.

There is a need for teachers to be skilled in appropriate methodology related to middle years schooling. This degree addresses teaching pre-adolescent and adolescent students and allows students to specialise in particular learning areas. Graduates are qualified to teach in both primary and middle school educational settings and will have completed studies in education, the curriculum, and teaching and learning.

The programme includes studies in core education courses, professional experience, curriculum courses, and two areas of specialisation, selected from a range of areas.

Students are also required to study at least one course in indigenous studies and one course in educating students with special needs. Professional experiences are field-based placements that allow students to combine theory with practice. These experiences are scheduled in each year of the programme in a range of school settings from year three to ten, providing students with the opportunity to apply the principles that they learn throughout the Bachelor of Education (Primary and Middle).

A variety of school sites are utilised for professional experience placements that include all education sectors across metropolitan and rural South Australia. Students specialise by completing courses in two of the following learning areas: social and cultural studies; language and literature; mathematical and natural sciences and the environment; health, human growth and movement, the arts, and design and technology. Courses may include studies in drama, multimedia, the environment, health and physical education, Australian studies, design and technology and many others. These courses allow students to specialise in specific teaching and learning subjects. Students have the chance to complete a professional experience placement teaching their specific learning area in their fourth placement. Students will work within a variety of educational settings as part of their professional experience placements, allowing them to gain experience in the workplace and develop their understanding of theoretical concepts.

Why is Design and Technology in LBPM course?

The SACSA framework and Design and Technology Education Design and technology is one of the eight mandated learning areas that are taught in primary, middle and senior schools in South Australia schools using the South Australian Curriculum Standards and Accountability (SACSA) Framework.

All learners in South Australia can expect their education to be based upon the South Australian Curriculum Standards and Accountability (SACSA) Framework which clearly articulates the 8 mandatory areas of learning of the curriculum:

- The Arts
- Design & Technology
- Health & Physical Education
- Languages Other than English (LOTE)
- English
- Mathematics
- Science
- Studies of Society and Environment (SOSE)

All areas have clearly identified key ideas and outcomes for all learners. All learning contained within the SACSA framework is based upon the constructivist theories of learning. This ensues that all learners take an active role in their learning as they take on information and build knowledge, skills and understanding while engaging in productive learning activities.

> *'The Framework's key ideas and outcomes provide the basis for constructivist approaches to teaching and learning which build on learners' prior knowledge and experience and engage them in purposeful, contextualised, challenging and inherently interesting learning activities.'* SACSA; Overview; p.2

Design and technology education in SACSA seeks to provide an appropriate style of learning needed to engage in a rapidly changing, knowledge economy. We face new and diverse lifestyles, environmental and economic challenges and opportunities. With this comes an increasing demand to commit to an education that fosters new knowledge, capabilities and dispositions. Thinking in new ways challenge traditional boundaries such as culture or subject discipline, developing critical awareness, embracing technological understanding and imaging many futures. Design and technology provides an education for an increasingly global and culturally diverse community where ideas, innovation and enterprise are central to the design and development of sustainable, socially responsible, preferred futures

Design and technology education in SACSA not only supports this notion "of improving pathways for all young South Australians to engage in further education, training and /or employment" (Design and Technology Teachers Association of South Australia (DATTA SA) introduction), but it is the vehicle that links this ideal with school, business and enterprise Vocational Educational Training (VET), Training and Further Education (TAFE) and Universities.

> *…policy is more than simply the policy text; it involves processes prior to the articulation of the text and the processes which continue after the text has been produced, both in modifications to it as a statement of values and desired action, and in actual practice*
> Taylor, Riizvi, Lingard, Henry (2006)

Design and technology as a learning area was given recognition, status and was seen as a separate area of learning. Therefore the role of design and technology education in South Australian schools is vital and an essential learning area. Design and technology in SACSA is centred on developing individuals and groups that are able to plan, design and critique intentions of products and processes that they make or use. It satisfies a need to make something, to do something better or to solve a problem. Design and technology promotes critical thinking skills that aid the development of creative thinkers and skilled decision makers that aim to promote enterprising operators.

Design and technology creates exciting learning; it encourages communication of ideas and intentions. Design and technology integrates skills, experience, resources and creativity. It is an active, thought provoking learning area. It provides a vehicle for innovative ideas to turn into reality in order to meet human needs. It encourages the use of rich tasks of research, innovative and extensive rich design projects.

The SACSA framework in design and technology has as its core, the notion that *'design and technology is human innovation in action'* and it is built around the philosophy that *'design and technology education involves the creation of products, processes and systems to solve perceived problems or meet perceived needs'* SACSA, D&T; Introduction

The design and technology learning area is split into 3 interconnected strands of:

- Critiquing
- Designing
- Making

The strands are all verbs and involve an action taking place, each implying that there is a combination of critical thinking, creativity and active involvement. The strand of CRITIQUING is centred on the critical analysis of design: – the purpose, intention, manufacture and the impact of technologies. The DESIGNING strand has two distinct aspects of communicating of design and ideas and the skill of designing. The MAKING strand which is the major focus of design and technology education has three distinct aspects: – skill and techniques of making; characteristics of materials, tools and equipment; duty of care, time management and sustainability issues.

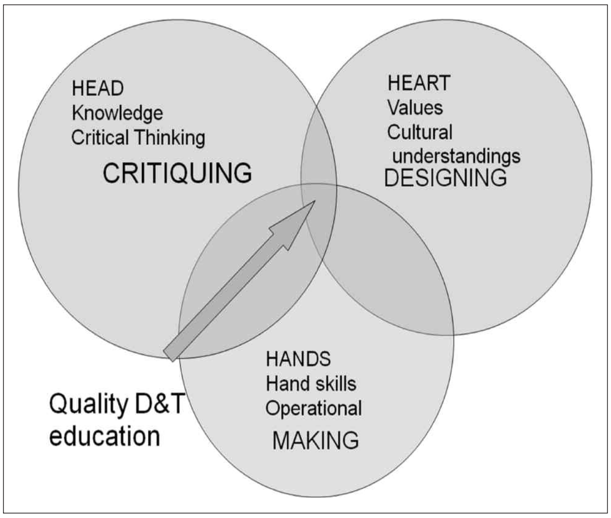


Figure 1. Adapted and developed by, Stephen Keirl, Denise Macgregor and Larry Spry, University of South Australia 2008

These three strands are interdependent and none of them is predominant. They do not constitute a sequential process but interrelate to support deeper understanding. A quality design and technology education weaves the three into a dynamic and holistic learning experience for all students.

The structure of SACSA framework (see over) in design and technology and in fact all learning areas allows for learning to translate from one band of schooling to another, each building on from the previous stage. A huge focus is placed upon the development of technological literacy which is seen as a crucial learning process within design and technology.

	Early Years	Primary Years	Middle Years	Middle Years	Senior Years
S A C S A	R-2	3-4	5-6	7-8	9-10
	Standard 1	Standard 2	Standard 3	Standard 4	Standard 5
	3 Strands CDM	3 Strands CDM	3 Strands CDM	3 Strands CDM	3 Strands CDM
	Key Idea	Key Idea	Key Idea	Key Idea	Key Idea
	6Learning Outcomes	6Learning Outcomes	6Learning Outcomes	6Learning Outcomes	6Learning Outcomes

Figure 2. Larry Spry University of South Australia 2009

What does the design and technology programme include?

Design and technology is an essential part of the school curriculum, and is one of the key learning areas identified in the SACSA framework. This curriculum core course aims to provide support for students planning to become "general practitioner' teachers in primary and middle schools and to understand the role of design and technology within the three to nine curriculum and be able to plan appropriate learning experiences (see Image 2, right).

Image 1

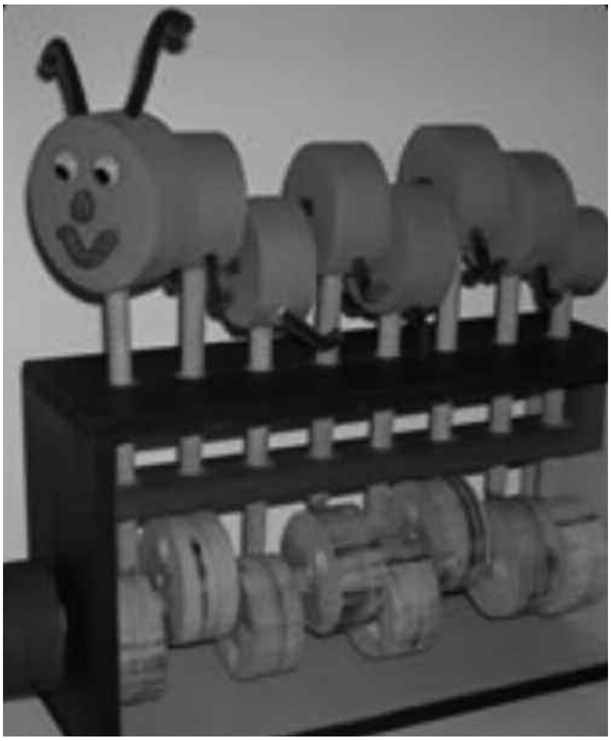
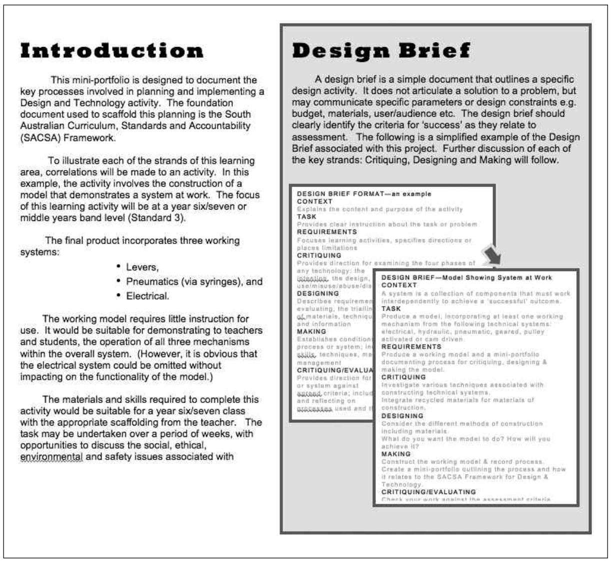


Image 2

In this course, design and technology will be taught as a separate subject, and with links to other learning areas. Students will be able to focus upon methodology and theories particular to design and technology. Links to teaching experiences and practicums will be explicit.



Introduction

This mini-portfolio is designed to document the key processes involved in planning and implementing a Design and Technology activity. The foundation document used to scaffold this planning is the South Australian Curriculum, Standards and Accountability (SACSA) Framework.

To illustrate each of the strands of this learning area, correlations will be made to an activity. In this example, the activity involves the construction of a model that demonstrates a system at work. The focus of this learning activity will be at a year six/seven or middle years band level (Standard 3).

The final product incorporates three working systems:

- Levers,
- Pneumatics (via syringes), and
- Electrical.

The working model requires little instruction for use. It would be suitable for demonstrating to teachers and students, the operation of all three mechanisms within the overall system. (However, it is obvious that the electrical system could be omitted without impacting on the functionality of the model.)

The materials and skills required to complete this activity would be suitable for a year six/seven class with the appropriate scaffolding from the teacher. The task may be undertaken over a period of weeks, with opportunities to discuss the social, ethical, environmental and safety issues associated with

Design Brief

A design brief is a simple document that outlines a specific design activity. It does not articulate a solution to a problem, but may communicate specific parameters or design constraints e.g. budget, materials, user/audience etc. The design brief should clearly identify the criteria for 'success' as they relate to assessment. The following is a simplified example of the Design Brief associated with this project. Further discussion of each of the key strands: Critiquing, Designing and Making will follow.

DESIGN BRIEF FORMAT—an example
CONTEXT
Explains the content and purpose of the activity
TASK
Provides clear instruction about the task or problem
REQUIREMENTS
Focuses learning activities, specifies directions or places limitations
CRITIQUING
Provides direction for examining the four phases of
DESIGNING
MAKING
CRITIQUING/EVALUA

DESIGN BRIEF—Model Showing System at Work
CONTEXT
A system is a collection of components that must work interdependently to achieve a 'successful' outcome.
TASK
Produce a model, incorporating at least one working mechanism from the following technical systems: electrical, hydraulic, pneumatic, geared, pulley activated or cam driven.
REQUIREMENTS
Produce a working model and a mini-portfolio documenting process for critiquing, designing & making the model.
CRITIQUING
Investigate various techniques associated with constructing technical systems.
Integrate recycled materials for materials of construction.
DESIGNING
Consider the different methods of construction including materials.
What do you want the model to do? How will you achieve it?
MAKING
Construct the working model & record process.
Create a mini-portfolio outlining the process and how it relates to the SACSA Framework for Design & Technology.
CRITIQUING/EVALUATING

Image 3

On completion of this course, students should possess an understanding of the curriculum document, the design and technology component of SACSA (Department of Education, Training and Employment DETE 2001) and be able to understand the role of design and technology within the primary and middle school curriculum and develop basic curriculum planning for years three and seven. A core element of the course is based around the development of a range of skills, knowledge and experiences to enable graduates to conduct elementary lessons in design and technology. A key by product of the course is that students develop a passion for design and technology as a meaningful and engaging curriculum.

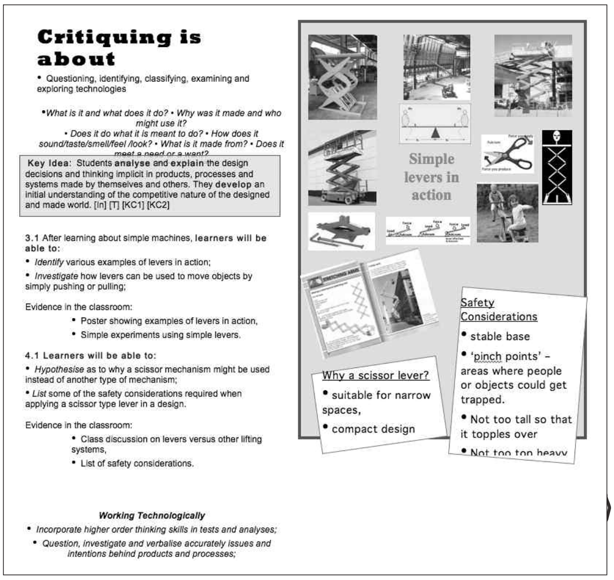


Image 4

Over the last 3 years an average of one hundred and eighty undergraduate students per year in the LBPM programme successfully completed the course work. Approximately thirty to forty students then take up the option to study design and technology in more depth, and graduate as specialist design and technology teachers in the primary setting.

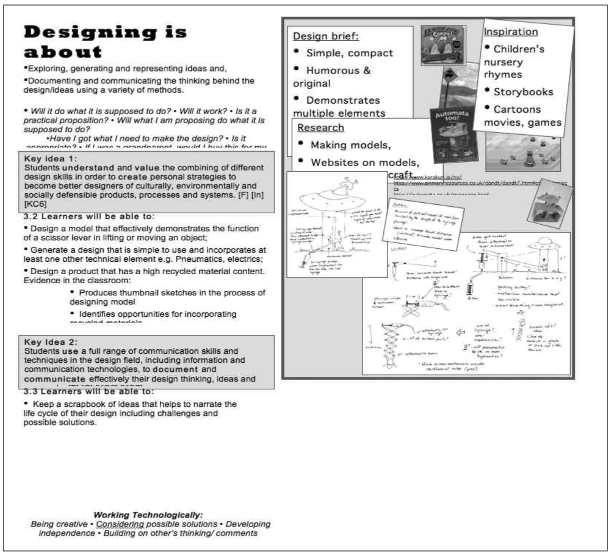


Image 5

This is proving to be a very popular option for the graduates as schools in South Australia are looking for 'new' teachers that focus on engagement and hands on activity based programmes for year 3 to year 7 in the primary school.

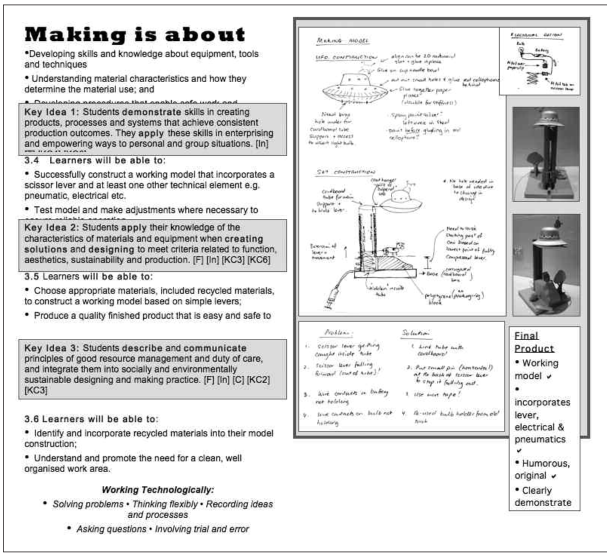


Image 6

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  Design and Technology Learning area introduction
  DETE (2001)
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  University of South Australia
  course booklet (2008)

Design and Technology Education in South Australia – The Framework, The University Course and My Classroom

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Abstract

This case study reflects on design and technology (D&T) as an influential & commanding learning area in the SACSA framework, primary schools, the D&T programme that is offered at Magill campus Uni SA in the Bachelor of Education (junior primary and primary) degree course and the realisation of what happens actually happens in a junior primary classroom at Edwardstown Primary School.

Case Study – The SACSA Framework

All learners in South Australia can expect their education to be based upon the South Australian Curriculum Standards and Accountability (SACSA) Framework which clearly articulates the 8 mandatory areas of learning of the curriculum:

- The Arts
- Design & Technology
- Health & PE
- Languages Other Than English-LOTE
- English
- Mathematics
- Science
- Studies of Society & Environment-SOSE

All areas have clearly identified Key Ideas and Outcomes for all learners.

All learning contained within the SACSA is based upon the constructivist theory of learning. This ensures that all learners take an active role in their learning as they take on information & build knowledge, skills, understanding & dispositions while engaging in productive learning activities that stimulate & engage learners.

> *'The Framework's Key Ideas and Outcomes provide the basis for constructivist approaches to teaching and learning which build on learners' prior knowledge and experience and engage them in purposeful, contextualised, challenging and inherently interesting learning activities.* South Australian Curriculum Standards and Accountability (SACSA) Framework, p.2

This places the learner at the centre of the learning process. As teachers we construct the curriculum using the experiences, expertise, interests and needs of the learners. This ensures the learning takes place in a relevant & meaningful environment that easily leads to success orientated outcomes.

When engaging in learning, a diverse variety of teaching & learning strategies are used to take into account the characteristics of learners, as well as the characteristics of groups of learners. The strategies and methods used support the ideal that learning is an on-going life long process of improving knowledge and skills that involves personal development and relationship building.

Teachers are the key to the quality of the learning and great teachers make great classrooms. The teacher is the facilitator of student learning. Pedagogies must be relevant, up-to-date and dynamic in order to support learning in the acquisition of this new knowledge, while at the same time managing it, understanding it and being ethical in the use of it. As society is rapidly changing, students need to develop and acquire, from various sources, knowledge skills and dispositions. This enables them to understand their world and take an active part in it as thoughtful, involved and responsible citizens.

Rather than using a segmented curriculum, the SACSA framework when implemented & accompanied by suitable teaching strategies, creates a cohesive curriculum framework which enables learners to develop values, skills, dispositions and understandings to:

- Respond to change and plan for the future
- Develop a positive sense of self and being part of a group
- Work cooperatively & successfully with others
- Be independent critical thinkers
- Communicate effectively

There are standards within the SACSA framework that provide common reference points for assessing and reporting learners' achievement at each band of learning.

The SACSA framework has been designed in 4 curriculum bands:

- Early Years Band (birth to Year 2)
- Primary Years Band (Years 3, 4 and 5)
- Middle Years Band (Years 6, 7, 8 and 9)
- Senior Years Band (Years 10, 11 and 12)

Each Band has an introduction which assists educators to consider a variety of learning & teaching aspects when considering curriculum planning.

> *'The Learning Areas change through the Early Years to capture the rapid growth and broadening horizons of young children. The Learning Areas for students from Reception to Year 12 are drawn from the* Adelaide Declaration on National Goals for Schooling in the Twenty-first Century (MCEETYA, 1999).'
> (SACSA Overview, p.3)

In the SACSA Framework, these Learning Areas are structured and organized through strands (year level).

Underpinning the SACSA framework are the Essential Learnings.

> *'They describe the values, dispositions, skills and understandings that are considered crucial in the education and development of all learners in our care. The development of these learnings is an ongoing,*

lifelong process and occurs in every context of a learner's life. All curriculum Learning Areas contribute to learners' development of the Essential Learnings.
SACSA, Overview, p.4

They are coded throughout the framework.

- Futures Learners develop the flexibility to respond to change, recognise connections with the past and conceive solutions for preferred futures.
- Identity Learners develop a positive sense of self and group, accept individual and groupers possibilities and respect individual and group differences.
- Interdependence Learners develop the ability to work in harmony with others and for common purposes, within and across cultures.
- Thinking Learners become independent and critical thinkers, with the ability to appraise information, make decisions, be innovative and devise creative solutions.
- Communication Learners develop their abilities to communicate powerfully using literacy, numeracy and information and communication technologies.
  SACSA,Overview, p.5

The SACSA framework develops and incorporates the areas of communication, literacy & numeracy and information & communication technologies and, explicitly refers to where, how & why they should be included & used throughout all the learning areas.

The Primary Years

The Primary Years Band of the SACSA Framework describes the curriculum Scope & Standards for learning in Years 3 to 5.

Students approach learning having accumulated an immense diversity of knowledge, skills & experience. They come from a wide variety of different cultural & social backgrounds. To address the different needs of learners, the learning process needs to be dynamic, interactive and current so as to relate their learning to the world around them & the communities in which they live.

In the Primary Years learners are characterised as:

- Having high levels of energy and enjoy physical activity resulting in natural movement and noise in both class and play spaces
- Experiencing different kinds of friendships and exploring power dynamics
- Exploring the similarities and differences between being male and female
- Experimenting with identity and referencing themselves against peers
- Keen to extend their capabilities and self-expression
- Able to engage enthusiastically and expand their thinking in ways that are reflective and spontaneous.' SACSA, Design and Technology Introduction, p.1

When facilitating learning, teachers appreciate that students are active learners who learn at different rates, in different ways and need diverse and multiple challenges to support and encourage their learning. They need opportunities to acquire thinking skills that they can use to critically evaluate, challenge ideas and solve problems. As student learning grows the students need to develop, & be supported in, assuming responsibility for their own learning.

Design& Technology

'Technology involves the creation of products, processes and systems to solve perceived problems or meet perceived needs. Design is integral to the creation of new technologies and involves changing one set of circumstances into another. Designing can be complex, drawing on established and new values, skills, techniques, knowledge and thinking to achieve particular goals. SACSA D&T Introduction, p.1

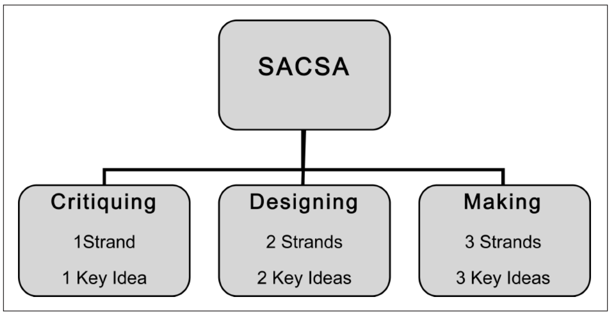


Figure 1

The Design and Technology Learning Area is articulated through three strands. Figure 1 These reflect the processes of thinking and doing that constitute a quality education common to any technology (eg agriculture, architecture, information technology and communication technology, electronics, engineering, food, genetics, media, robotics, textiles, viticulture).

The three strands are:

- Critiquing
  – the critical analysis of design – the purpose , intention, the manufacture and the impact of technologies
- Designing
  – the communicating of design and ideas
  – skill of designing
- Making
  – skill and techniques of making
  – characteristics of materials, tools and equipment
  – duty of care, time management and sustainability

These three strands are interdependent and none of them is predominant. Read alongside each other, they do not constitute a sequential process. They interrelate to support rich understandings. A quality design and technology education weaves the three into a dynamic and holistic learning experience for all students.

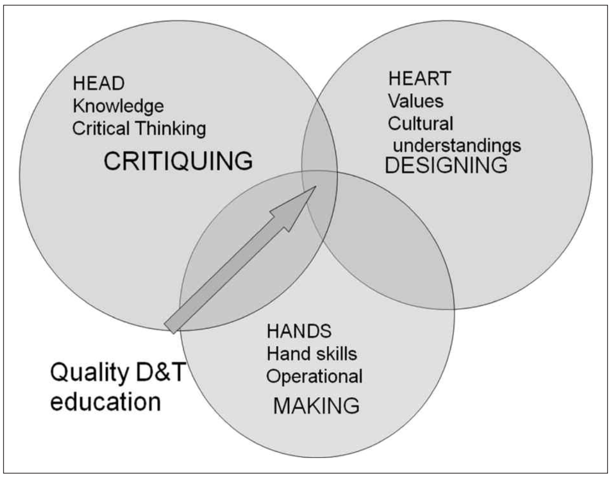


Figure 2

The strand names are all verbs, in other words doing words. All of the strands involve around an ACTION taking place, each implying that there is a combination of critical thinking, creativity and active involvement.

The University Programme

> *Design and Technology is an essential part of curriculum in schools, and is one of the key learning areas identified in the South Australian Curriculum, Standards and Accountability Framework* (SACSA) (DECS 2001)

This curriculum course aims to provide support for students planning to become 'general practitioner' teachers in the Early and Primary years of schooling, to understand the role of Design and Technology within the R-7 curriculum and be able to plan appropriate learning experiences.

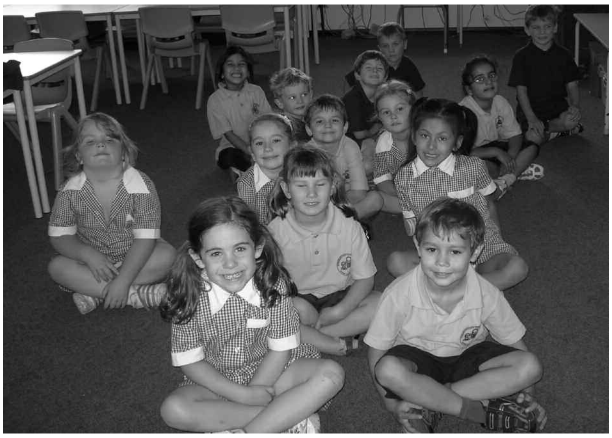
The core focus of the course in Design and Technology is built around the strong belief that D&T empowers and inspires learners to recognise and create opportunities for innovation in diverse and rapidly-changing settings. Fostering creativity and the power of ideas through the development of design skills, and the development skills in communicating these solutions, is also a critical focus. Enhancing practical knowledge and capabilities through relevant 'hands on' activities adds to the depth of the programme. Learning how to critique past, present and emerging technologies and developing the ability to apply new, different and appropriate technologies and mental tools enhances the capabilities of the students to engage in the teaching of D&T. Throughout the course and embedded in all activities are the values to promote the notions of environmental and social sustainability.

On completion of this course, the pre-service teachers will have developed a broad understanding of the Design and Technology Curriculum. They will have developed the skills to enable them to prepare open – ended design briefs for the R-7 students to allow them to become effective problem solvers. The pre-service teachers will gain an understanding of the significance of a Design and Technology educator's role in preparing students for an active and critical role in an increasingly technological society.

Gaining and possessing an understanding of the curriculum document the Design and Technology SACSA framework is crucial to the success of the programme. In the programme, the critical focus is on developing in all pre-service teachers, a range of skills, knowledge and experiences to enable them to conduct elementary lessons in Design and Technology, including thematic approaches and to be an advocate for the Learning area.

The Classroom

I believe that students learn best when they are in a secure environment, where the students are aware of what is expected of them, where learning is structured and well-planned with clear outcomes and where people in the room interact in a considerate and cooperative manner.



Designers of the future

The students need to be actively involved in their learning and develop concepts at their own rate. I believe that students need to learn how to learn and that I am here to assist them in achieving this skill.

I believe in collaborative learning where people share ideas, support each other and show consideration and recognition of other people's talents.

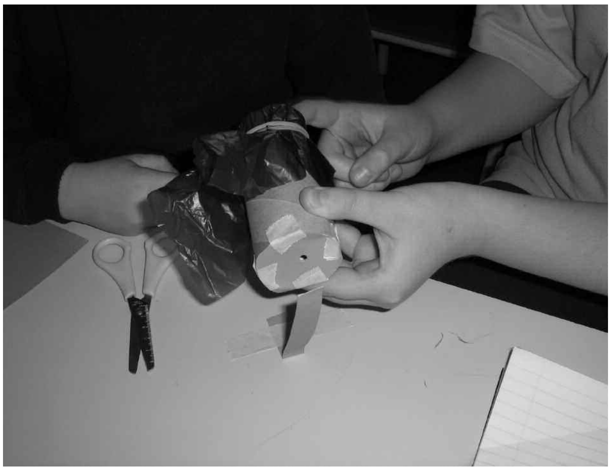
The learning activities in D&T which are provided in my classroom support my philosophy of how students learn. The D&T learning activities need to be structured in such a way that all students are able to attempt the work and achieve their own level of success. Sometimes grouping of students may occur (e.g. ability, interest, gender, friendship etc) so those students may achieve their full potential.

Figure 3: Bachelor of Junior Primary Education – D&T Programme

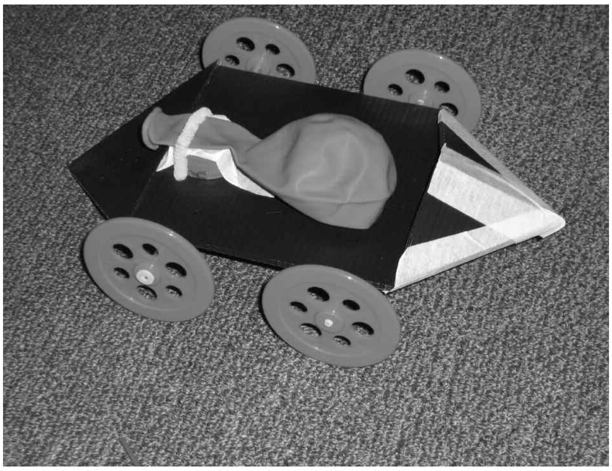
Week	Workshop	Lecture
1	What is Design and Technology? Picture Quiz	Lecture 1 Course outline; Attendance; Assignments; Workshops and Resource collection Design and Technology Education – What does it mean? Philosophy Why teach design and Technology?
2	Joining Techniques Land yachts Hinges- Tools; Materials; Safety aspects; No glue technology; Straws and Structures; Energy sources	Lecture 2 Design and Technology as a Curriculum area-SACSA; C.D.M. What do they mean?
3	Joining Techniques Land yachts	Lecture 3 Programming with Design and Technology-integrationapproach • Design a Brief • Lesson plans • Assessment techniques and issues
4	Deconstruction as a means of critiquing Dismantling products and the use of thinking skills, graphic organisers and design skills	Lecture 4 Design – designing, creativity and innovation. The "Big picture" –
5	Construction techniques House Designs Planning, designing and making simple cardboard houses.	Lecture 5 Design and Technology Resources and OHSW issues in the classroom
6	Systems Approach Electrical circuits Understanding, designing and making simple circuits through simple "question and answer" boards	Lecture 6 ICT as a tool in Design and Technology
7	Combining House Designs and Systems – Electrical circuits- using the houses designed and constructed and knowledge of circuits	Lecture 7 Design and Technology and Thinking skills –
8	Systems Approach Pneumatics and Hydraulics-balloon power Making simple machines that move or perform a function	Lecture 8 Developing 'Advocacy 'for Design and Technology – typing it all together
9	Fabrics technology Stitching and fabrics	
10	Fabrics technology Stitching and fabrics	
11	Working with wood Introduction of wood into the primary classroom – making a simple animal with moving parts	
12	Working with wood Continued	
13	2020 project – A futures perspective	

Learning in D&T occurs in different ways, and at different rates, so the critiquing, designing & making activities need to cater for many differing styles and abilities. Students are given many opportunities to express their ideas and thoughts as much as possible & communicate them to others.

Regular monitoring of the student's academic progress and social skills throughout the year is communicated through peer assessment and teacher contribution, both oral & written. Learning outcomes are reported to parents several times a year through formal written reports & informal 3-way interviews which involve parents, teachers & the student.



Working together



Balloon Power

Sun hats for our hot dry days in summer

Positive encouragement is important in supporting student learning & reinforcing concepts. However, it is important for the students to come to school happy and develop a positive self-concept through their learning. Each student needs to be prepared to work diligently and to attempt to honestly evaluate their own efforts in their learning.

Using the D&T curriculum & planned learning activities, all these aspects can be combined to create a vibrant, creative, dynamic, safe & secure learning environment that has students enthusiastic to participate in their own learning journeys.

Ships Ahoe!

References

- South Australian Curriculum Standards and Accountability Framework An Overview; DETE (2001)
- South Australian Curriculum Standards and Accountability Framework Design and Technology Learning Area Introduction; DETE (20011)
- Design and Technology Education Course MBED University of South Australia course booklet (2009)

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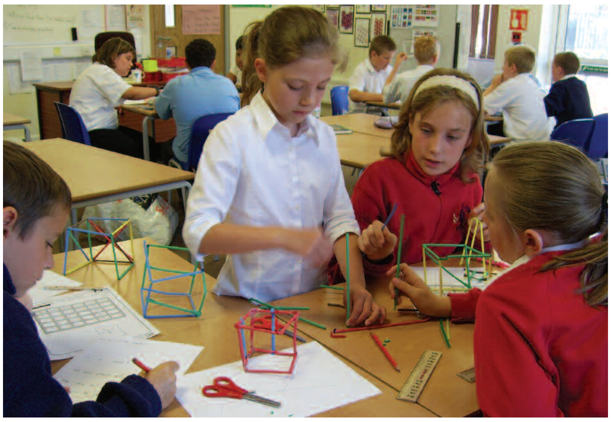

Further Information

Any further information relating to this conference, or courses, research opportunities and In-service work provided by CRIPT can be obtained from:

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