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

sixth international primary design and technology conference

...10 Years On

sponsored by

department for education and skills
creating opportunity, releasing potential, achieving excellence

Sixth International Primary Design and Technology Conference –
10 Years On
29th June – 3rd July 2007, Birmingham, England

The conference is sponsored by

department for
education and skills
creating opportunity, releasing potential, achieving excellence

TTS

ISBN 978 1 901884 08 1

First published 2007

Published by
CRIPT at UCE Birmingham
Faculty of Education
Attwood Building
University of Central England Birmingham
Franchise Street
Perry Barr Birmingham
England B42 2SU

Design by
WOOD&WOOD Design
33 – 35 Cathedral Road
Cardiff CF11 9HB

Printed by
McLays Printing Solutions
Longwood Drive
Forest Farm
Cardiff CF14 7ZB

CRIPT
CENTRE FOR RESEARCH IN PRIMARY TECHNOLOGY

2187/06/2007. Design by WOOD&WOOD. 029 2039 9362. wood2.com

DEDICATION

This publication is dedicated to Mike Ive, OBE, who has continuously supported the development of primary design and technology since its introduction into the National Curriculum through his work as an HMI. His support of previous CRIPT conferences has been of great value.

Introduction

It is ten years since CRIPT was established and we held the first International Primary Design and Technology Conference in Birmingham. Since then, we have hosted the conferences biennially and we are delighted to be able to host this sixth conference June 29th – July 3rd 2007. Colleagues from every continent have joined in sharing their research and curriculum development work through the many and varied papers presented, and the Conference Proceedings have become a major source of information for those engaged in the development and implementation of the subject worldwide. CRIPT has always subscribed to the notion of the importance of the inter-relationship between theory and practice, and ensure that this is adhered to throughout the conference. We have continued to place papers into two sections – research and curriculum development, and as in 2005, there will be presentations by children involved in a design challenge, set by Sebastian Conran, and in work on Sustainability.

In the two intervening years since the last conference, it appears that the focus of work illustrated by the papers is now on review and consolidation of policy and practice rather than the introduction of the subject into new countries. The papers mainly reflect the work of individuals or small groups working on and researching particular aspects of implementation both in school and in Initial Teacher Education. Designing is certainly one theme that emerges both at this and previous conferences, and is an area that still needs to be explored in greater depth to ensure children are given appropriate opportunities to develop their critical and creative thinking skills.

Clare Benson / Suzanne Lawson / Julie Lunt / Wesley Till

June 2007

CONTENTS

Page N°.

Dedication and Introduction

Keynote

Research

Curriculum Development


Parsons Down
Junior School

The Importance of Design and Technology 1997 – 2007

Qualifications and Curriculum Authority (QCA), 83, Piccadilly, London W1J 8QA England
Ian Williams – E-mail williamsi@qca.org.uk

Ten years ago CRIPT was formed. Over that time Clare Benson and all those connected with or influenced by the Centre for Research in Primary Technology have celebrated what design and technology brings to all young people in our country. In this paper I have set out to reflect on how the National Curriculum Programme of Study and its related 'importance of design and technology' statement has developed over those years, influenced in no small way by Clare and her team at UCE.

Design and technology in the National Curriculum in the years leading up to 2000

In the year that CRIPT was formed (1997), the School Curriculum and Assessment Authority (SCAA) published *Expectations in Design and Technology,* an imaginatively illustrated (by previous SCAA standards) 24-page booklet in response to requests from schools for guidance on standards as they were expressed in the National Curriculum Attainment Targets. At this time primary schools in England and Wales were working to the Order *Design and Technology in the National Curriculum* published by the Department for Education and the Welsh Office in 1995. The 'Expectations' booklet was well received in schools because it provided vibrant illustrations of work teachers could recognise as pupils responded to designing and making opportunities. I would like to thank again the teachers and pupils at Alumwell Junior School, Walsall; Cheddar First School, Cheddar; Four Dwellings Infant School, West Birmingham; Kaye's First and Nursery School, Kirklees; Lindley Infant School, Huddersfield St Petroc's CE School, Bodmin; Shortlanesend Primary School, Truro; Staple Grove Primary School, Taunton and Torpoint Infant School, Torpoint for their help and those examples of children's work that they provided.

In those days designing was assessed separately from making. The booklet described expectations in 'designing' under the headings: generating ideas; applying knowledge and understanding; developing and communicating ideas; and then evaluating. In 'making' those expectations were grouped under: planning; applying knowledge and understanding; working with materials; evaluating. With hindsight I could suggest that, as a result of the popularity of this framework, it took a long time to move some teachers towards a more holistic view of designing and making as thinking moved forward. At the time that advice however, amply supported by colleagues from UCE, was just what the Primary Phase D&T community needed. Projects like 'Keeping Gordon dry' and 'On the move' did much to build up teacher confidence and live on in the memory of many of us.

Into the new century

The re-named Department for Education and Employment published the revised *National Curriculum for England* in November 1999 after a review of the curriculum carried out the Qualifications and Curriculum Authority (QCA – an amalgamation of SCAA and the National Council for Vocational Qualifications). One important change in the programme of study was to conflate and reduce 25 strands outlining what pupils should be taught to 18 at Key Stage 1 and from 31 to 20 at Key Stage 2. The learning and teaching processes were now more helpfully laid out under more flexible headings: developing, planning and communicating ideas; working with tools, equipment, materials and components to make quality products; evaluating processes and products; and knowledge and understanding of materials and components.

A more integrated approach to designing and making was envisaged backed up by the new single attainment target that set out the knowledge, skills and understanding that pupils of different abilities and maturities are expected to have by the end of each key stage. The most important change for me, however, was the inclusion of the 'Importance of design and technology' statement at the head of the programme of study. The seven sentences in that statement were compiled by a group of highly regarded members of the D&T community to celebrate what is at the heart of the educational experience for all children. A further refined version of that statement appears later in this paper. In it we can see where key elements of the original have been carried forward to point up how D&T provides young people with exciting opportunities to 'intervene creatively to improve quality of life…become creative problem solvers as individuals and members of a team…respond to needs, wants and opportunities…combine practical skills with an understanding of aesthetics, social and environmental issues, function and industrial practices…become innovators' (DfEE 1999).

Two important publications followed the release of the new Programme of Study. Firstly, *The National Curriculum in Action* (ncaction.org.uk) QCA website was launched in 2002 and set out to support teacher's judgement of pupil performance against the Attainment Target Level Descriptions. Secondly, the booklet *Creativity: find it, promote it* released in 2003 aimed to support creative processes. Teachers from across the country willingly gave up time and shared materials to help illustrate both of these publications but it is the 'creativity' booklet that gave them the chance to show off how they promoted opportunities to 'think and intervene creatively to improve quality of life…and become innovators', words at the heart of the 'importance' statement. That booklet illustrated how teachers can spot creativity through the way pupils: question and challenge; make connections and see relationships; envisage what might be; explore ideas keeping options open; and reflect critically on ideas, actions and outcomes. It suggested how teachers can promote creativity by: setting clear purpose for pupil's work; being clear about freedoms and constraints; firing imagination through other learning experiences; giving pupils opportunities to work together; establishing criteria for success; and capitalising on unexpected learning opportunities.

The foundations for learning captured in the 'importance' statement were also in the authors thinking when they developed the Teacher assessment activities in design and technology for QCA in 2006. Professor Clare Benson, Professor Richard Kimbell and Jenny Bain from Goldsmiths College together with Sandie Kendall worked on materials that illustrated a range of approaches to assessment in the classroom. These suggested ways that learners can receive feedback on their work and the progress they are making. The material was published in booklets that clearly illustrate how much learning, teaching and approaches to assessment for progression have moved forward from 1997 and the Expectations in design and technology publication. I am extremely grateful to the time and materials provided by Stowheath Infants School, Wolverhampton; Montgomery Primary School, Birmingham; Bearwood Primary School, Sandwell; Whitehouse Common Primary School, Birmingham; St Nicholas RC Primary School, Birmingham; Ilderton Primary School, London; Fairchilds Primary School, Croydon; Applegarth Junior School, Croydon and St Matthew's CoE Primary School, Telford.

Ongoing review of the curriculum

In February 2007 QCA launched the consultation process on its review of the Key Stage 3 curriculum. The text above relates to design and technology in the primary phase but I feel that it is appropriate to examine these KS3 proposals in detail here so that we can share views on progression issues. It was felt that the 'importance' statement required only minor change. It is proposed that it should read:

> *'In design and technology pupils combine practical and technological skills with creative thinking to design and make products and systems to meet human needs. In design and technology pupils learn to use today's technologies and participate in developing tomorrow's. They learn to think creatively and intervene to improve quality of life, solving problems as individuals and members of a team. Working in stimulating contexts that provide a spectrum of opportunities and draw on the local ethos, community and wider world, pupils identify needs and opportunities. They respond with ideas, products and systems, challenging expectations where appropriate. They combine practical and intellectual skills with an understanding of aesthetic, technical, cultural, health, social, emotional, economic, industrial and environmental issues. As they do so, they evaluate present and past design and technology, and its uses and effects. Through design and technology pupils become confident practically and develop as discriminating users of products. They apply their creative thinking and learn to innovate, developing their self-esteem.'*

I believe that the 'knowledge, skills and understanding' and 'breadth of study' strands presented currently in the Key Stage 1 and 2 programmes of study will provide the foundation for new 'key concepts' that underpin the study of the subject and 'key processes' that pupils will undertake in the revised Key Stage 3 programme of study. The text that will appear under these headings is still undergoing revision as this paper is published but the draft is shown below.

Key concepts

There are a number of key concepts that underpin the study of design and technology. Pupils need to understand these concepts in order to deepen and broaden their knowledge, skills and understanding.

Designing and making

- Understanding that designing and making has aesthetic, technical, economic, environmental, ethical and social dimensions.
- Producing practical solutions that are relevant and connected to life in response to needs, wants and opportunities.
- Understanding that products and systems have an impact on quality of life.

Cultural understanding

- Understanding that designing and making reflects and influences culture and society.
- Investigating factors that have led to approaches to design and design decisions in different societies.
- Understanding how products contribute to lifestyle and choices.

Creativity

- Making links between principles of good design, existing solutions and technological knowledge.
- Recognising the significance of knowledge and previous experience, searching for trends and patterns in existing solutions, reinterpreting and applying learning in new design contexts and communicating ideas in new or unexpected ways.

Critical evaluation

Analysing products and solutions to devise solutions to practical problems.

Key processes

These are the essential skills and processes in design and technology that pupils need to learn to make progress.

Pupils should be able to:

- Generate, develop, communicate and model ideas in a range of ways, using appropriate strategies.

- Respond creatively to briefs, developing their own proposals and producing specifications for products and associated services.
- Apply their knowledge and understanding of a range of materials, ingredients and technologies to design and make their products.
- Use their understanding of others' designing to inform their own.
- Plan and organise activities and then shape, form, mix, assemble and finish materials, components or ingredients, choosing which hand and machine tools, equipment and computer-aided design/manufacture (CAD/CAM) facilities to use.
- Solve technical problems.
- Reflect critically when evaluating and modifying their ideas and proposals to improve the product throughout its inception and manufacture.

Reference is made to use of resistant materials, food, textiles and systems and control experiences that will build on those enjoyed at Key Stages 1 and 2 as pupils enjoy the Curriculum opportunities that are set out below.

During the key stage pupils should be offered the following opportunities that are integral to their learning and enhance their engagement with the concepts, processes and content of the subject.

In ways appropriate to the product area, the curriculum should provide opportunities for pupils to:

- Analyse products.
- Undertake focused tasks that develop skills, knowledge and understanding in relation to design and make assignments.
- Engage in design and make assignments in different and progressively more complex contexts.
- Work individually and in teams taking on different roles and responsibilities.
- Work with designers and makers where possible to develop an understanding of the product design process.
- Use ICT as appropriate for image capture and generation, data acquisition, capture and handling, controlling and product realisation.
- Make links between design and technology and other subjects and areas of the curriculum.

QCA is very grateful for the advice offered during the development of this draft programme of study by the two primary phase specialists on our advisory group. Clare Benson represented CRIPT and the Design and Technology Association, and Gareth Pimley represented the National Association of Advisers and Inspectors of Design and Technology. I would appreciate comments from delegates at this conference on progression issues relating to the draft above. Please send responses to the email address at the head of this paper.

Where we are in 2007

I sincerely hope that colleagues can see how the heart of design and technology as portrayed in the Importance of design and technology statement has developed over the past ten years and how CRIPT has been at the centre of these developments. Above all, more and more pupils are being given the opportunity to 'learn to think creatively and intervene to improve quality of life'. D&T makes a difference.

References

- DfE (1995)
  Design and Technology in the National Curriculum (1995)
  DfE
- SCAA (1997)
  Expectations in Design and Technology (1997)
  SCAA
- DfEE (1999) Design and Technology,
  The National Curriculum for England (1999)
  DfEE
- www.ncaction.org.uk QCA website (from 2002 onwards)
- Creativity: find it, promote it
  www.qca.org.uk website (from 2003 onwards)
- QCA (2006)
  Teacher Assessment Activities, Design and Technology – Foundation Stage and Key Stage 1,QCA (2006)
  QCA
- QCA (2006)
  Teacher Assessment Activities, Design and Technology – Key Stage 2, QCA (2006)
  QCA
- www.qca.org.uk/secondarycurriculumreview
  QCA website (from Feb to April 2007)


JACM7

One Teacher's Sociocultural Constructivist Response to the Introduction of a Curriculum Unit

School of Education, Brunel University, Uxbridge, Middlesex, UB8 3PH
David Barlex – E-mail dbarlex@nuffieldfoundation.org
Faculty of Education, Queen's University, Kingston, Ontario, Canada
Malcolm Welch / Erin O'Donnell – E-mail malcolm.welch@queensu.ca

Abstract

A sociocultural constructivist approach to learning is based on the concept that human activities take place in a cultural context and are mediated by language and social interaction. Recent research has shown that designing within the design & technology classroom is enhanced when taught as a social activity that utilises pupil-to-pupil and pupil-to-teacher interactions.

In the study reported here, the researchers conducted an in-depth investigation of one teacher's attempts to stimulate 'designerly thinking' in an elementary classroom. The teacher enabled the co-construction of knowledge by a) encouraging interaction, b) using questions and visual stimulus materials, and c) using questions to consolidate learning and demonstrate its utility.

Data were collected using audio and video recordings of the teacher while in conversation with the class. Audio recordings were transcribed verbatim. Analysis involved the identification of substantive open coding categories. This analysis revealed that the teacher's creative use of exemplars as stimulus material, use of open-ended higher-order questions, and ability to allow for free-flowing class discussions resulted in a 'safe' classroom environment in which pupils took creative risks, not only with their responses to questions but also later in response to a design brief.

Introduction

The purpose of this paper is to report some results from a study that is investigating how pupils learn to design. The paper is in four parts. First, it will briefly review the literature on a) a sociocultural constructivist approach to learning, and b) using questioning to support pupils' learning. Second, the paper will describe a case study of a single class of Grade 6 pupils and their teacher in a Canadian elementary school encountering design & technology for the first time in their schooling. The following research questions drove this study: a) To what extent will a teacher new to design & technology use a sociocultural constructivist approach to learning? b) In what ways will the teacher use exemplar stimulus materials to initiate designerly thinking? and c) To what extent will the teacher be able to demonstrate the utility of learning? The third section of the paper will report the results of an analysis of data. Finally, the paper will illustrate how a well-resourced teacher adopting a sociocultural constructivist approach to teaching and learning can initiate designerly thinking in an elementary classroom.

Review of Literature

The sociocultural constructivist theory of learning

Constructivism is a theory about knowledge and learning: it describes both what "knowing" is and how one "comes to know" (Fosnot, 1996). Learning from this perspective is viewed as a self-regulatory process in which constructing new models of reality are seen as a human meaning-making venture using culturally developed tools and negotiating through cooperative social activity (Piaget, 1950; Vygotsky, 1986/1934). Recent research has shown that learning to design within the design & technology classroom is enhanced when treated as a social activity that utilises pupil-to-pupil and pupil-to-teacher interactions (Hamilton, 2003, 2004; Hennessy & Murphy, 1999). This sociocultural constructivist approach derives from a view of learning that places language and interaction at the heart of the process. But Vygotsky (1978) suggested that since human activities take place in cultural contexts, it is the interdependence of social and individual processes, in addition to language and interaction, which is essential for learning and development (John-Steiner & Mahn, 1996).

Using questioning strategies to support pupils' learning

A teacher's use of questions has been shown to be important in supporting pupils' learning. Banks (2002) describes the use of open and closed questions in design & technology and the cognitive level required of pupils to answer them. Atkinson and Black (in press) have described questions with different cognitive demands and suggested that, "questions [can] be designed that allow for factual responses, for imaginative and speculative ones and for developing pupils' competence in asking meaningful questions themselves" (in press). Black, Harrison, Lee, Marshall, & Wiliam, (2003) noted that higher-order questions require time for the learner to generate an answer. Hence the teacher ought to 'wait' for some time before expecting a response. Following Rowe (1974), Black et al. reported that teachers could, with practice, increase their wait time to around 3-5 seconds and that doing so has a dramatic effect on not only the involvement of pupils in classroom discussion but also on the richness of their responses.

In this paper we report on how a teacher used a sociocultural constructivist approach to learning to initiate designerly thinking a) by encouraging pupil-to-pupil and pupil-to-teacher interactions, b) through the use of questions in conjunction with visual stimulus materials, and c) through the use of questions to consolidate learning and indicate its utility (Ainley, Pratt, & Hansen, 2006).

Method

A case study method was adopted for this study since the researchers were interested in a detailed study of a single event over time (McMillan & Schumacher, 2006). The participants were one class of Grade 6 pupils (16 girls and 10 boys), aged 10 – 11 years, attending a small Catholic elementary school located in a city in Eastern Ontario. The school had a total pupil population of 297 drawn from the immediate suburban surroundings. Pupils in this study were encountering design & technology education for the first time. The Grade 6 teacher, Geoff (a pseudonym), holds a PhD in language and literacy, but had no formal teacher education, or experience in teaching, design & technology education prior to the beginning of the study.

The teacher taught a curriculum unit written by the researchers in which pupils were required to design and make a mobile. The unit was divided into two parts. The first consisted of a series of Support Tasks through which pupils acquired knowledge, skill and understanding likely to be useful in designing and making the mobile; exploring hanging and pedestal mobiles, exploring natural and geometric shapes, investigating symmetrical and asymmetrical balance, and exploring appropriate materials. The second part of the unit required pupils to respond to the following design brief: *Design and make a mobile for a person and a place of your choice. The design of the mobile should reflect an interest of the user and take into account the location where it will be used.*

Prior to teaching the unit, Geoff was provided with two days of professional development, led by the researchers, during which he completed all components of the unit. This experience provided him with the opportunity to: a) discuss pedagogical and logistical issues likely to arise in his classroom; b) explore tools and materials; c) engage with, for the first time in a classroom setting, designerly thinking; and d) explore and develop his own creativity. Feedback from Geoff as the professional development proceeded was subsequently used to modify sections of the curriculum unit prior to use with pupils. In addition to the professional development, Geoff was provided with four exemplar mobiles and a PowerPoint presentation showing a wide range of mobiles.

Data were collected using audio and video recordings of the teacher while talking to the class and to individual pupils. Audio recordings were transcribed verbatim. Analysis involved reading the transcripts and the identification of substantive open coding categories (Maxwell, 2005; Strauss, & Corbin, 1990).

Results and discussion

Using the four exemplars and the PowerPoint presentation, Geoff led and sustained a lively discussion through which pupils began to appreciate the nature of mobiles. Geoff used pupils' responses to introduce and revisit a wide range of important ideas concerning the nature of mobiles. These included naming of parts, types of mobile, balance, user appeal, visual elements, choosing a theme, and the importance of location of use.

Analysis of the data revealed how Geoff generated an understanding of the nature of the product to be designed (mobiles) through the use of open-ended questions related to the stimulus materials. He also consolidated this learning at the end of the lesson and helped pupils relate it to the Big Task.

Understanding the nature of mobiles

- Naming of parts

  Geoff asked questions to establish the specialist vocabulary used in naming the parts of a mobile. He carefully reiterated the pupils' answers in most cases (B7 = boy participant number 7; G4 = girl participant number 4).

T What do you think that's called?
B7 The string?
T What do you think it is [called]?
B3 It's maybe called the support.
T What's it doing?
B5 It stabilizes it.
T [Names B3]
B3 A hold.
T A hold? Why do you say hold?
B3 Because it holds the two bottom ones.
G4 Like something to do with balance.
T What's the rope doing?
G8 It's holding up the panda.
T But that's not far off. It's called a hanger. Right? Does it make sense now?
Chorus Yes.
T Something is hanging from it.

Note how Geoff established the correct technical vocabulary by first eliciting similar vocabulary from the pupils and then relating this to the terms he wanted the class to use.

- Balance

  Geoff asked questions in order to establish in pupils' minds that balance may be a function of symmetry or equal mass/distance relationships on either side of a centre line. Note how the teacher allows a considerable amount of unrestrained pupil-to-pupil and pupil-to-teacher interactions in this episode:

T Why do the ships balance on this mobile? Why do the bits on that mobile balance, on that one, on this one, and this one, why do they balance, or what causes them to balance?
G3 Because the other one balances it.
B3 Weight, … maybe because it has to have a line of symmetry to balance the weight, no, no, that one doesn't. Does it?
T [B3]'s saying it has to have a line of symmetry to balance.
G7 No it doesn't.
B10 Yes… it does.
G4 Yes it does.
T Like that [names B3]?

B3	Yeah kind of.
T	And does it?
B3	Ah, no it doesn't.
G4	Not quite, because.
G6	Well, it's on the angle though.
T	I disagree, I think it does.
G6	Yeah.
T	How about this one? See look here. Does it have a line of symmetry?
B3	Yeah.
G4	Yes.
T	How about this one?
G4	Yes.
?	Yes.
T	How about this one?
G4	No.
B10	No.
B3	No.
T	Does it have to have a line of symmetry? Okay so Girl 4 is raising the question that they don't have to balance.
B3	No they don't.
T	But I want to balance mine.
G4	What if you don't?
T	Ah, she's got it!

Note how Geoff developed the key concept of balance by engaging the class with an idea suggested by a pupil. The exchange shows that he took notice of the pupils' comments, using them to structure the class discussion so that the pupils can work together to co-construct an understanding of balance with regard to mobiles.

- **User appeal**

  Pointing to an image in the PowerPoint presentation, Geoff asked the class why certain mobiles appeal to babies.

B9	They make noise.
B3	They're colourful.
T	I want you to look at this bumblebee one too, okay. Look at the bumblebees. What do you notice about the bumblebees?
G4	That they're all facing down, including the flower.
T	They're facing down. Why is that important as opposed to … imagine this is the underside of the bees as opposed to this or this or this, why is that important?
B3	Oh I know.
T	[Names G6]
G6	Because the baby will be lying down.
T	Yeah, how's the person using this mobile, what position are they going to be in? Right, that's right for a baby and they're looking at this bumble and this funny thing's looking down at them, and that's far more appealing to a baby to be able to look up and see the face of the critter rather than its butt.
T	Or…if you…just imagine this is a bee right now, everybody look at my ruler, see how much you can see. [Holds ruler with edge facing class]
B3	Yeah.
B10	Yeah.
T	Now if I turn it now how much do you see? [Turns ruler face down]
B3	Nothing.
T	You see very little, so if they had taken those bumblebees and done this, right, the baby's going to be looking at the stand.

Geoff used the example of a bumblebee mobile to explore the importance of seeing the mobiles from the user's (in this case a baby's) point of view, demonstrating the importance of face-on versus edge-on views. Note the way he used his ruler as a visual aid, developing a spontaneous demonstration, instructing the class to look at his ruler and to comment on what they could see.

- **Choosing a theme**

  Geoff asked the class to provide examples of themes for mobiles. They responded enthusiastically, and in most cases he reiterated the response before taking an answer from another pupil.

G3	Halloween
B10	Black cats.
B2	Easter.
G8	Bunnies.
G2	Thanksgiving.
B10	Summer.
G12	St. Patrick's Day.
B5	Father's Day and Mother's Day.
Who?	Canada Day.
T	So again, depending on for whom you're making it or for what occasion you're making it for, you need to think about …

He has taken the idea of designing for user appeal further by developing the pupils' understanding of themes for mobiles. He elicited several possible themes from the class, including Halloween, Easter, Thanksgiving, St. Patrick's Day, Father's Day, Mother's Day, and Canada Day. This is important, as it enabled the pupils to engage with the cultural dimension of the unit. The school is Roman Catholic; hence Easter Day, Mother's Day and Father's Day will be celebrated. Thanksgiving Day and Canada Day have national significance. Halloween, although a secular and highly commercialised event, is given a high profile on local and national television.

- Importance of location of use

Geoff initiated a lengthy discussion of how location of use is an important design decision with the following example:

T The Big Task is for pupils to design and make a mobile.… So if you want your dad to use the mobile in the garage, maybe he's a worker and he has a shop out in his garage, that will effect the design of your mobile, as opposed to if your dad has that shop in his garage but is also a lawyer in an office… Would the same mobile that you would design for dad in the garage be appropriate for the mobile that you might design for dad's office as a lawyer?
G4 Yes and no.
T Okay why?
B10 No.
G4 Because it depends… because obviously the office has to be more formal and that matters more because of there's other people around. If you can incorporate something from the wood shop into the [lawyer's office] then maybe you could.

In exploring the importance of the location of use, Geoff used a very demanding question that enabled some members of the class to explore the potential conflict between a user's interests and where the mobile might be displayed. Importantly Geoff allows some short answers, giving pupils the thinking time to develop a longer, fuller answer that deals with the complexities of the issue raised. This is an unusual way of increasing "wait time" (Rowe, 1974). As Alexander (2006) has explained, "children, we now know, need to talk, and to experience a rich diet of spoken language in order to think and learn" (p.9):

- End of lesson review

First, Geoff asked the pupils what they had learned about mobiles. They responded in detail:

B3 Different types of mobiles, the hanging mobile and the pedestal mobile.
G10 The different parts of a mobile.
G10 A beam.
G10 Decorative elements
B1 Um how they balance.
G6 Um which ones appeal more to babies than to children.
B3 Yeah the different ones that appeal to everyone.
G4 That there are tons of different mobiles.
B9 Place.
G1 Most of the mobiles here are symmetrical.
T Whoa you learned a lot!

Second, Geoff asked the class "How will what you learned today about mobiles help you in your Big Task?" Again they were able to respond in detail:

G4 All the different parts of a mobile.
B5 All the different types so we know … different parts
G4 Maybe like say the balance too, we learned how to balance things out.
G4 Well because if you have three really heavy things and maybe one light thing on one side it's either going to collapse or tip or not work.
B3 We saw … how all these mobiles look like so we could use … like we can take examples and things like that.
T Exactly … examples for you to build upon.
B9 Themes.
G4 The place.
T The place, the place that it's going. So all of those characteristics, those things, are important factors in how and what you design and make.

Research by one of the authors (Lee & Welch, 2005) has shown that the way the teacher conducts the end of lesson review is critical to the success of a curriculum unit that uses pupils' learning from a sequence of Support Tasks to empower them to successfully tackle a Big Task. Geoff conducted a very thorough lesson review. He elicited a wide range of appropriate responses to the question *"What have we learned today about mobiles?"* More importantly, he then asked *"Okay how will what you learned today about mobiles help you in your Big Task?"* And the pupils were able to indicate the utility of their learning (Ainley, Pratt & Hansen, 2006).

Conclusion

Although this paper uses data from a single lesson, it illustrates how a teacher who approaches learning from a sociocultural constructivist perspective and uses thoroughly prepared stimulus materials in conjunction with high-order questions can initiate designerly thinking.

Geoff, the teacher participating in this study, is experienced, enthusiastic, and has a deep understanding of, and expertise in, a sociocultural constructivist approach to teaching and learning. Murphy (2003) has reported that, for those teachers who do not share this perspective, the teaching of designing is particularly challenging.

Using questioning as a strategy, Geoff originated, sustained and scaffolded dialogue that encouraged designerly thinking within a community of pupils. Geoff showed that he understood how pupils could co-construct their knowledge and understanding through pupil-to-pupil and pupil-to-teacher interactions. He viewed the classroom as a community of discourse engaged in activity, reflection and conversation. The learners, rather than the teacher, were responsible for communicating their ideas to the classroom community. Geoff provided pupils with opportunities to co-construct knowledge of various aspects of mobiles and the sorts of design decisions they would later be required to make. Through his use of questioning Geoff encouraged pupils to think and to explore that thinking. Geoff was able to demonstrate the utility of learning by relating new learning to the Big Task that pupils would complete. As a result, pupils were later able to produce a wide range of mobiles, each for a particular user to be displayed in a particular place. Space considerations in this paper require that the other lessons and the mobiles resulting from them be described in a future paper.

References

- Ainley J, Pratt D & Hansen A (2006)
  Connecting engagement and focus in pedagogic task design
  British Educational Research Journal, 32(1) 23-38
- Alexander R J (2006)
  Towards dialogic teaching:
  Rethinking classroom talk (3rd ed.)
  Cambridge, UK: Dialogos
- Atkinson S & Black P (in press)
  Useful assessment for design & technology
  In D. Barlex (Ed.), Design & technology: The next generation.
  Wellesbourne, UK
  Design & Technology Association
- Banks F (2002)
  Teaching strategies for design and technology
  In G Owen-Jackson (Ed.), Aspects of teaching secondary design and technology: Perspectives on practice (pp.75-89)
  London: Routledge/Falmer
- Black P, Harrison C, Lee C, Marshall B & Dylan W (2003)
  Assessment for learning: Putting it into practice
  London: Open University Press
- Fosnot C T (Ed.). (1996)
  Constructivism: Theory, perspectives, and practice
  New York: Teachers College
- Hamilton J W (2003, July)
  Interaction, dialogue and a creative spirit of enquiry
  In E W L Norman & D Spendlove (Eds.)
  DATA International Research Conference 2003 (pp.35-44)
  Warwickshire, UK: University of Warwick
- Hamilton J W (2004, July)
  Enhancing learning through dialogue and reasoning within collaborative problem solving.
  In E W L Norman, D Spendlove, P Grover & A Mitchell (Eds.)
  DATA International Research Conference 2004 (pp.89-101)
  Sheffield, UK: Sheffield Hallam University
- Hennessy S & Murphy P (1999)
  The potential for collaborative problem solving in design and technology. The International Journal of Technology and Design Education, 9, 1-36
- John-Steiner V & Mahn H (1996)
  Sociocultural approaches to learning and development:
  A Vygotskian framework. Educational Psychologist 31(3&4), 191-206
- Lee M & Welch M (2005)
  The elementary science and technology project:
  An evaluation of its impact on teachers' pedagogic and subject knowledge. Unpublished manuscript, Faculty of Education, Queen's University
- Maxwell J A (2005)
  Qualitative research design:
  An interactive approach (2nd ed.)
  Thousand Oaks, CA: Sage
- McMillan J H & Schumacher S (2006)
  Research in education: Evidence-based inquiry (6th ed.)
  Boston: Pearson
- Murphy P (2003)
  The place of pedagogy
  In D Barlex (Ed.), Creativity in Crisis? Design & Technology in KS3 and KS4 (pp.14-17)
  London: Nuffield Foundation
- Piaget J (1950)
  The psychology of intelligence
  London: Routledge & Kegan Paul
- Rowe M B (1974)
  Wait time and rewards as instructional variables, their influence on language, logic and fate control. Journal of Research in Science Teaching, 11, 81-94
- Strauss A L & Corbin J (1990)
  Basics of qualitative research:
  Grounded theory procedures and techniques
  Newbury Park, CA: Sage
- Vygotsky L S (1978)
  Mind in society:
  The development of higher psychological processes
  Cambridge, MA: Harvard University
- Vygotsky L (1986/1934)
  Thought and Language (A Kozulin, Trans)
  Cambridge, MA: Massachusetts Institute of Technology

10 Years On: Critical Reflections and Future Aspirations

CRIPT, Faculty of Education, University of Central England Birmingham, Perry Barr, B42 2SU
Clare Benson – E-mail clare.benson@uce.ac.uk

Introduction

In 1997, the Centre for Research and curriculum development In Primary Technology (CRIPT) was established, based at the University of Central England Birmingham. The word 'technology' was chosen to reflect the worldwide use of the word to describe the curriculum area that is design and technology in England. Ten years on, this conference allows us the opportunity to reflect on developments and changes that have taken place in design and technology education, not only in England, but worldwide, and to look to the future. Whilst the Proceedings from all six conferences provide a snapshot of specific activity in different countries, of course this may not reflect national trends as there are always time, economic and political constraints on participation. The evidence for this paper has been gathered from policy documents, educational research, OfSTED reports and from a survey carried out with teachers, nationwide who are participants in an MA Ed extended design and technology course, validated by UCE Birmingham.

Context

When the National Curriculum (DES 1989) was introduced in 1990 into the English primary curriculum, it contained one 'new' subject. Whilst aspects of design and technology had been part of the work of primary schools for a number of years, it was the first time that the subject had been named and content outlined. From the outset, there were many aspects of the curriculum that confused teachers, but there was much that teachers felt was valuable for children to experience. Between 1990 and 1995, the continuing development of design and technology was very varied throughout England. Teachers had little if any continuing professional development (CPD); very few had the confidence to deliver an appropriate experience (OFSTED, 1992, 1993, 1994, 1995); and there were very few resources available to help teachers understand the nature of the subject and how it could be delivered. Examples of excellent practice could be found, but these were not the norm (OFSTED 1992, 1993, 1994, 1995). In 1995, the revised curriculum (DFE 1995) was more focused and contained guidance about the types of the activities that children should undertake (Investigate, Disassemble, Evaluate Activities, Focused Practical Tasks and Design and Make Assignments). This coupled with more appropriate CPD and resources led to a rise in standards in the delivery of design and technology (OFSTED 1996). This was reflected in national inspection reports and the increase in publications and disseminations of quality case studies in the Design and Technology Association (DATA) publications and at conferences.

Until this time there was almost no research relating to primary design and technology; obviously until there was practice in schools, there was little to research. The IDATER (www.lboro.ac.uk) conference proceedings from 1990 – 1995 show in some way the beginnings of research into primary design and technology. Few clear themes emerged; rather there were disparate areas covered, relating to the personal interests of individual contributors. However, design was a theme that was being explored and this has continued, not only in this country but overseas.

Whilst there were opportunities to present and disseminate findings, both from research in this country and overseas, it was felt by a number of primary colleagues that primary matters often were overlooked by those from other areas of design and technology. It was also apparent that during the 1990s the growth of primary design and technology or technology education was gathering momentum across the world. France, Australia, New Zealand, USA and South Africa were all including it in their curricula. Interest was shown elsewhere including the Netherlands Sweden, Poland, Canada, Botswana, and Taiwan. More recently countries including Bahrain, Chile and Singapore have included it in their national curricula and countries such as Brazil, El Salvador and Peru and are investigating the value of the subject.

Ten years on

During the period 1997 – 2007, there were a number of key initiatives introduced into primary education in England that have affected the development of the subject. The emphasis on numeracy and literacy was the first such factor and the introduction of the Numeracy and Literacy strategies (1998 a and b) meant that schools focused much time and resources on CPD to allow for its introduction. Initially time for Foundation subjects (art, design and technology, geography, history, music, physical education) was cut and this was mirrored later in countries such as South Africa and Australia. However, the publication of the Qualification and Curriculum Authority (QCA) scheme of work in 1998 went some way to restore the balance in the curriculum, and schools used this to help plan a balanced and progressive scheme in their schools. QCA in internal reviews identified that it was the subject scheme that most schools used. It can certainly be argued that the scheme, if used without thought and adaptation, is limiting; if it is used as it was intended – as a guide – then it is a valuable tool in supporting the delivery of quality design and technology in the primary school. As schools became more confident with the delivery of the new Strategies, there was a move by some schools (Davis 1999, QCA report 2002/3) to look for the links between English and mathematics and other subjects, including design and technology to help children put their learning in relevant and appropriate contexts.

The next two major initiatives to affect primary design and technology came in 2000. Another revision of the National Curriculum (DfEE 1999) took place. Schools had argued that the curriculum was 'too full' and a slimmer version was produced that focused on fewer key learning objectives. For primary design and technology, this brought little change (the section on structures was removed, but included within materials) and schools were able to continue to build on the schemes and practice that were emerging. More importantly, for the first time, in 2000, an Early Years Curriculum was created (DfEE 2000). It was divided into six areas of experience, and the focus for design and technology came within Knowledge and understanding of the world. However, if the six areas are examined, it is clear that design and technological activity is to be found in all areas. As with the introduction of the National Curriculum, there was little support material, apart from English and mathematics, made available to Early Years teachers. Indeed on reviewing past publications, such as Desirable Outcomes (1996) it was apparent that little had been included in publications that were available. A small scale research project undertaken for QCA by Benson (QCA 2001/2) indicated that Early Years teachers were unclear as to the nature of design and technology, nor how to plan and implement it within the Early Years curriculum. The Designerly thinking project, funded by the DfES, supported these findings and there is still need for more development in the Early Years. Unless young children have a good foundation in learning, it is difficult to build and develop this as they move into Key Stage 1 (5 – 7 years) and ultimately as they move through the primary and into the secondary phases.

The most recent initiative was introduced by the DfES in 2003 through the publication Excellence and enjoyment. It was felt that after several years of focusing on Language and mathematics (DfES 2003) it was timely for schools now to plan a more creative curriculum, integrating areas of learning. This was followed up by the publication of the Primary Strategy (DfES 2005) and offering CPD for senior managers. There have been many misconceptions as to the nature and purpose of this Strategy; it offered suggestions for the development of generic areas such as questioning and thinking skills, but still much of the emphasis was directed to the development of language and mathematics. However many primary schools are moving towards a thematic approach again. Best practice offers children experiences that allow them to develop their creative and critical thinking skills through relevant and exciting activities that link learning; at worst the integrity of subjects including design and technology is under threat. Through the data collected from teachers throughout England on the Extended design and technology course it is clear that there are many schools who are reverting to craft rather than design and technology; purpose, user and the development of design and practical skills are getting lost as children are being asked to make, for example, a Tudor house, a Greek temple, with no thought given to design.

Support for schools is needed quickly to provide subject leaders with exemplar materials to help them plan meaningful activities that reflect the nature of design and technology.

The future

There are already a number of known initiatives that will affect the future of primary design and technology. At the present time QCA (2007) is undertaking a review of Key Stage 3 (11 – 14 years). Whilst it was announced that there are no plans to review Key Stages 1 and 2 (5 – 11 years), the Key Stage 3 review will almost certainly impact on primary practice. At the present time, suggestions for change include the review of the importance statement that is included in the National Curriculum (DfES 2000); a change to attainment levels; and the introduction of a choice of key areas that are studied. Obviously the impact of the review on primary practice cannot be determined yet, but for example, if there is a choice of material areas that can be studied, it may be that this is also changed at primary level.

The recently published Assessment at Key Stage 1 and 2 (QCA 2006) together with the ncaction website (www.ncaction.org.uk) provide schools with tools against which they can moderate their own work to determine standards, linked to the attainment levels of the National Curriculum. Assessment has been identified as an area for development by OfSTED (1995, 1996, 1997, 1998, 2000, 2001, 2002, 2003) for a number of years, and now schools have national exemplification materials to support their discussions relating to standards and target setting, it is hoped that assessment for learning in design and technology will be implemented in many more schools.

The Primary Strategy will continue to play a part as more schools will be taking on board the idea of a 'creative curriculum'. It is crucial that support materials are produced that schools can draw on to help them keep the integrity of the subject whilst integrating it into a thematic approach. The Moving Forward publication (D&T Association 2006) offers schools a range of alternative contexts to use but this is just a start. Many schools base their theme work around history (data from teacher survey); there is a need for materials that support teachers who choose to place design and technology at the heart of their theme.

Sustainability is an issue that is being pushed to the forefront by DfES (www.teachernet.gov.uk/sustainableschools) for consideration by schools. They are being encouraged to think about Curriculum, Campus and Community. With the publication of a new resource pack Developing Sustainability through Primary Design and Technology (CRIPT 2007) schools now have some practical support to help with their curriculum planning to ensure that the issue of sustainability is embedded in their teaching and learning. From an initial survey, it was very apparent that the ideas that teachers had relating to sustainability were varied and often not very well developed. Very few had considered how, or what, to incorporate into their planning, and it is the intention that the pack will provide teachers of children 3 – 11 years with some realistic ideas and much needed background knowledge and understanding to support their teaching.

Design and technology offers so many, varied opportunities for young people to take risks, to ask questions, to develop their thinking skills, to work together and independently, and to use ICT in an appropriate way-as a tool for learning. Certainly it is my hope that design and technology moves to centre stage over the next ten years in the primary curriculum to allow young people to experience an exciting and relevant curriculum for the 21st century.

Developments worldwide 1997 – 2007

A review of the CRIPT conference proceedings (1997, 1999, 2001, 2003, 2005, 2007) has given some clues as to the development of the subject, as the number of countries contributing has increased. In addition, themes have emerged that can be followed through. Countries including Australia, Brazil, Canada, England, France, Japan, New Zealand, Scotland, South Africa, and Taiwan are represented in most Proceedings. Readers can follow through the development of, and changes to, the nature of the subject, its policy and implementation. More recently, participants from Cyprus, Chile, Zimbabwe and Bahrain have contributed as design and technology/technology education has been investigated and implemented in these countries. It is interesting to identify the way in which the nature of the subject has been developed. For example in England, the subject has been defined through the designing and making of a quality product that has a clearly defined user and purpose. Designing is considered crucial to the production of the final product and evaluation important in identifying possible modifications and further developments. In other countries, or states in other countries, technology is linked more closely to science and the outcomes based around 'the appliance of science' where user and purpose play little part.

Common themes

Looking back at previous work relating to the identification of useful research themes Anning (1993) and Johnsey and Baynes (1997) they identified six main agendas between them. Both previous works identified the need to define the nature of the subject and how it was taught. This was at a time when the subject was in its infancy, and there were on going curriculum revisions. Whilst reflection and evaluation are always important, it could be argued that now there are more pressing areas for research in countries where the subject is established in the curriculum. The second agenda item focused on investigating students' competence in, and attitudes to, design and technology. Whilst there has been much research of Pupils' Attitudes Towards Technology (PATT, 1990 – 2006), there has been little that focuses on primary attitudes. The recent paper by Benson and Lunt (2007) focuses on this area and there is a need for a larger study to support/contradict their findings. The third agenda item was that relating to ITE and the need for research into the training process, to inform policy and practice. The fourth item links with the research opportunities that CRIPT has since afforded. A study of international, national and local Government policy and its effects in the classroom was recommended. Johnsey and Baynes (1997) from their survey identified a further two agenda items-again developed more recently through CRIPT papers-designing skills and cross curricular links.

Some of these agenda items can be found in the CRIPT papers since 1997. The most common themes that occur relate to designing, issues with regard to Initial Teacher Education (ITE), Early Years, ICT, and cross curricular links or linked learning. More recently there have been contributions that relate to the implementation of the subject by individuals through case studies that focus on a very specific issue.

Issues relating to ITE have been highlighted in papers from Australia, England, New Zealand and Zimbabwe. The Early Years focus has been mainly through the dissemination of some aspects of the Designerly thinking in the Foundation Stage project (Benson 2003, 2005 Treleven 2007) and its impact on practice. The use of ICT within design and technology has been discussed through papers from England, Australia and France, for example, on the use of lap tops linked to teaching and learning, and the use of ICT within designing and control technology.

Having built up a community of researchers in primary design and technology education, what future developments might be possible? From an analysis of the papers, it is apparent that most researchers are using situations and experiences from their everyday work from which to develop their current research. There are few examples of large scale, well funded research projects-most are built around small case studies. Reasons for this are varied; most delegates are based in Education Faculties, which in this country and overseas do not usually have research as a high priority; some delegates are based in countries where research in such areas is relatively new and does not yet attract funding; whilst others come from countries where there is little funding available for educational research in any field. Hopefully, with the growth of the subject, and the development of an understanding of its value for primary children, it will become easier to attract larger scale funding. However there are strategies that the community can adopt and build on to strengthen and widen research that require less funding. Links between researchers in different communities can support studies; for example, studies by Barlex and Welch (2007) in England and Canada have been developed through joint funding; an Alfa project between Europe and South America (Chatoney, Benson, Elton 2006) helped the understanding and development of technology education; joint funding between Nuffield Foundation and a Local Educational Authority (Barlex and Balchin 2005) supported work in school; and research between ITE establishments (Davies, Fasciato, Howe and Rogers 2005) supported work relating to students' understanding of teaching for creativity. Groups can get together to provide mutual support, such as those initiated by the Nuffield Foundation in England. Teachers as researchers are a growing number in many countries and these can be offered support by researchers in Higher Education. In England, funding is available for teachers to take part in extended courses at post graduate level and at present over one hundred and fifty primary teachers are undertaking small scale action research in their schools as part of such courses in design and technology. Perry and Butterfield both reported on their work at the 2005 CRIPT conference, and Coles, Doorbar, Khangura, Morris and Treleven (2007) have written up their action research. It seems likely that the trend to link research to small scale case studies related to daily work will continue in the near future but identifying important areas for future development is also necessary so that the agenda is there when funds are forthcoming.

From a review of the research that has already been undertaken, and those areas identified through the Primary Interest Group 2006 Design and Technology Association National Conference, Telford, England, priorities that have been identified include:

- The appropriateness of the use of ICT in the implementation of design and technology
  The growth in the use of ICT worldwide is rapid. Used as a tool, it can offer support in many ways that other tools cannot. However, what are the areas of support that are most appropriate? What uses are less successful? How is control technology best introduced? Should CAD/CAM have a place in the primary curriculum?
- Designing
  How do children design? Is this different at different stages of development? What strategies are useful?
- Early years
  Is designerly and technological activity included in the curriculum in reality? What is its value to young children? How can designerly thinking be developed?
- Assessment
  How can we assess design and technology? What is the value of assessing the subject? Should we assess differently at different stages of development?
- Appropriate learning and teaching strategies
  Are they different in design and technology? What methods work well for different aspects of the subject?
- Sustainability
  What is primary teachers' understanding of sustainability? How is sustainability planned for? How could it be included in the design and technology curriculum? What are the most relevant teaching and learning activities that will support the development of knowledge and understanding relating to sustainability?

These are key areas that would be useful to study, particularly if we want to ensure the continuing rise in uptake and achievement in the subject, and perhaps most importantly the provision of an exciting, relevant and appropriate curriculum for all primary children in the future.

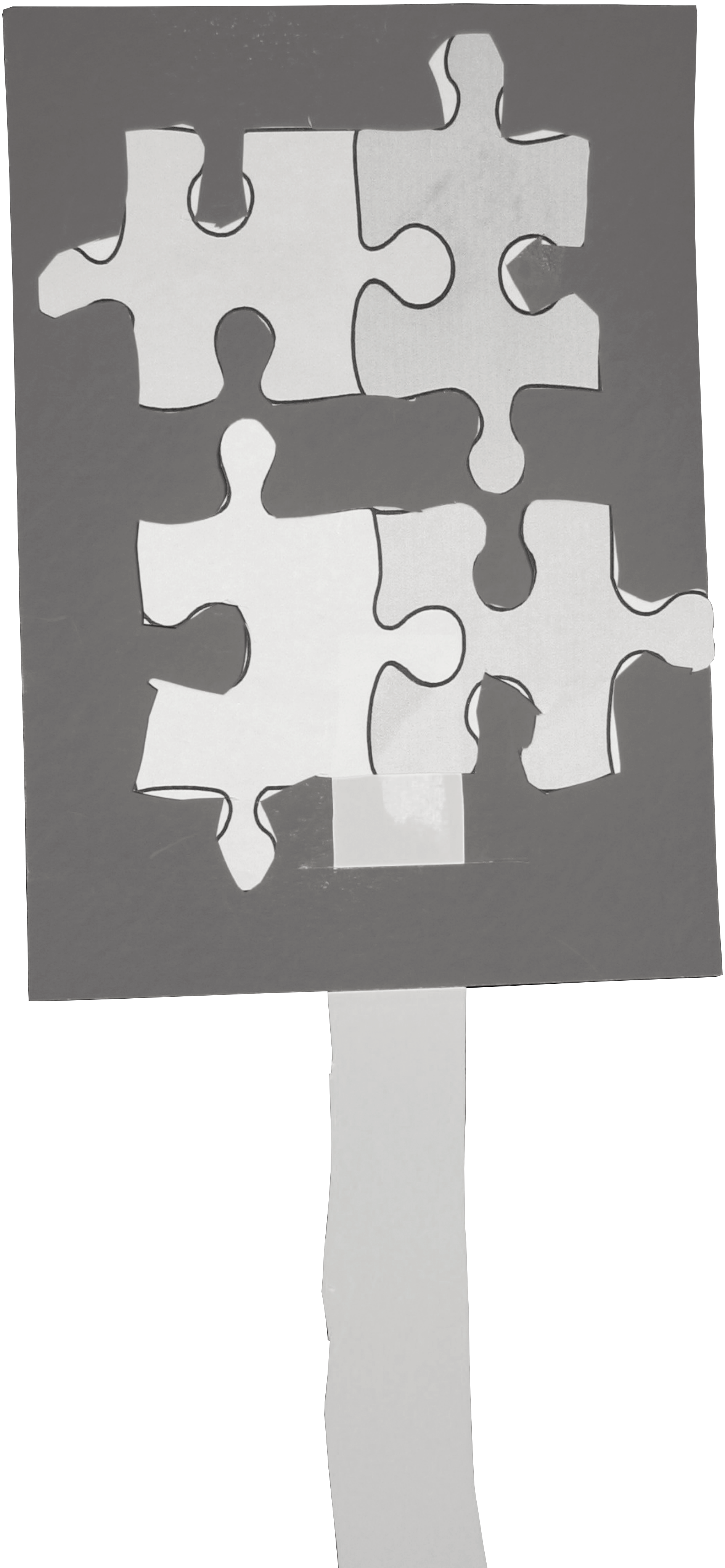
References

- Anning A (1993)
  Technological capability in primary classrooms
  in Smith ed IDATER 93
  Loughborough University
- Barlex D & Balchin T (2005)
  What does an enrichment programme reveal about the nature of gifted and talented behaviour in primary school d&t, in Benson C et al ed.
  Fifth International Primary Design and Technology Conference Proceedings, CRIPT
- Barlex D, Welch M & O'Donnell E (2007)
  One teacher's sociocultural constructivist response to the introduction of a curriculum unit in Benson C et al ed.
  Sixth International Primary Design and Technology Conference Proceedings, CRIPT
- Benson C (2003)
  Developing designerly thinking in the Foundation stage
  in Benson C et al ed.
  Fourth International Primary Design and Technology Conference Proceedings, CRIPT
- Benson C (2005)
  Developing designerly thinking in the Foundation stage-perceived impact and teachers' practice and children's learning
  in Benson C et al ed.
  Fifth International Primary Design and Technology Conference Proceedings, CRIPT
- Benson C & Lunt J (2007)
  It puts a smile on your face!
  What do children actually think of design and technology? Investigating the attitudes and perceptions of children aged 9 – 11, in Dakers J ed.
  PATT 2007, Glasgow
- Butterfield B (2005)
  A consideration of a Triad of Impairments for Pupils with Autism in Benson et al ed.
  Fifth International Primary Design and Technology Conference Proceedings, CRIPT

- Cole S (2007)
  Think your design and technology teaching:
  Linking sustainability with d&t, in Benson C et al ed.
  Sixth International Primary Design and Technology Conference Proceedings, CRIPT
- CRIPT (2007)
  Developing sustainability through primary design and technology ed. Benson C & Lunt J CRIPT
- Davies D et al (2005)
  Supporting trainee primary teachers' understanding of teaching for creativity, in Benson C et al ed.
  Fifth International Primary Design and Technology Conference Proceedings, CRIPT
- Davis (1999)
  From Unsatisfactory to Excellence, in Benson et al ed.
  Third International Primary Design and Technology Conference Proceedings, CRIPT
- DES (1989)
  National Curriculum for England and Wales, DES
- Design and technology Association (2006)
  Moving forward, D&T Association
- DFE (1995)
  Design and technology in the National Curriculum, DFE
- DFEE (1999)
  The National Curriculum, DfEE
- DFEE (2000)
  Early Learning Goals, DFEE
- DfES (1998a)
  The Numeracy Strategy, DfES
- DfES (1998b)
  The Literacy Strategy, DfES
- DfES (2003) Excellence and enjoyment, DfES
- Doorbar A (2007)
  A reflection on practice, in Benson C et al ed.
  Sixth International Primary Design and Technology Conference Proceedings, CRIPT
- Johnsey R & Baynes K (1997)
  Research priorities and primary design and technology in Smith ed. IDATER 1997, Loughborough
- Morris I (2007)
  The potential conflict within d&t: creativity versus practical skills acquisition in Benson C et al ed.
  Sixth International Primary Design and Technology Conference Proceedings, CRIPT
- OFSTED (1992-2003)
  Inspection reports, OfSTED
- PATT (1990-2006)
  Conference Proceedings, PATT
- Perry C (2005)
  The impact of home languages on the teaching of d&t in Benson, C et al ed.
  Fifth International Primary Design and Technology Conference Proceedings, CRIPT
- QCA (1997)
  Design and technology:
  A scheme of work for Key Stages 1 and 2
  DfES/QCA
- QCA (2001/2; 2002/3)
  Monitoring the National curriculum for design and technology an annual report, QCA
- QCA (2005)
  The Primary Strategy, QCA
- QCA (2006)
  Teacher assessment activities design and technology Key Stage 1, QCA
- QCA (2006)
  Teacher assessment activities design and technology Key Stage 2, QCA
- SCAA (1996)
  Desirable outcomes for children's learning on entering compulsory education, SCAA
- Treleven (2007)
  Developing designerly thinking in the Foundation Stage:
  A case study,in Benson, C et al ed.
  Sixth International Primary Design and Technology Conference Proceedings, CRIPT

Websites

- IDATER papers www.lboro.ac.uk
- www.qca.org.uk/KS 3 review
- www.ncaction.org.uk
- www.teachernet.gov.uk/sustainableschools



EFL Online Learning Course: A Case Study at Univille On-line Learning Course: A Case Study at Univille

University of the Region of Joinville (Univille), Joinville, São Bento do Sul, São Francisco do Sul, Santa Catarina, Brazil
Cristala Athanázio Buschle – E-mail cristala@univille.br Telephone 55 47 3461 9051

Abstract

Computer-mediated-communication (CMC) is gaining more attention in the English as a foreign language (EFL) field. Based on Collaborative Learning, it is claimed that CMC promotes learner and learning empowerment. The present project was an extension program, which used technology as a support, and had a twofold aim: a) to explore how a virtual community facilitates foreign language learning and b) to create opportunities for a faster development of the reading and writing strategies through relevant texts. Students were asked to weekly participate weekly through asynchronous and synchronous activities.

Introduction

The field of Applied Linguistics supports the idea that teachers have to offer learning materials, which should be motivating and relevant for students to get involved with the tasks and consequently obtain better results in their learning process.

It has been at least three decades since technology has entered and became part of our lives. We can find a variety of conceptions about it, from the evaluation of mankind to the importance of understanding its implications. Whatever concept chosen, applying it to the pedagogical act might be more complex than it seems at first glance. Concerning this issue, this research project aims to explore how EFL learning activities mediated by computer, may form a virtual community through which learners can develop their linguistic competence regarding reading and writing skills.

Literature review

Significance of Technology in Education

According to Schlaffke (1997), general education should be seen as a foundation, which "is ready to support a complex building of education – with an increasing number of stories and corridors". General education should provide global knowledge, and the ability to think along structural, procedural, or systematic lines, but also standards of value, which are all combined to form one complete concept (Schlaffke, 1997).

Education is more than knowledge, which, on the face of it, can be utilized as a key of the job market and a means of social balance. Education has to prepare for a "life in freedom and self-determination" (Herzog, 1997 anpud Graube and Theuerkauf, 2005, p.129). It must not remain limited to imparting knowledge and functional abilities. On the other hand, school education must not remain separate from the realities of life. School education should enable individuals to cope in a highly complex world and understand the significance of technology for the reality of life of individuals as well as its significance.

Education comprises three basic components. These are the process of imparting knowledge as an informational component, the process of learning to learn as a didactical component, and the process of arousing interest as a motivational component. Today education is, therefore, above all the ability of learning how to learn. It is not the product, object, or formula-based learning which gives access to understanding, but the process and phenomena related learning, and translating it to other fields (Pfenning, 2002). The intention of technology is to develop a competence, a disposition of the individual to successfully solve problems in a given situation.

Reflecting upon this, Michael Long (1983) proposes the interaction hypothesis to which acquisition derives from the negotiation of meaning in authentic exchanges. It's when through discourse participants negotiate meaning to make input comprehensible that learning takes place. Hatch (1978) states that acquisition of a foreign language is the result of learning how to hold conversations. Ellis (1995) discusses the idea of internal and external processes, which should be in a continuum reflecting the way language is used. That is to say, language learning is not an isolated skill but a process of socialization.

In recent years, discussion has paid more attention to EFL – English as a Foreign Language learning process. It is argued that reading and writing activities facilitate collaborative learning. Reading and Writing are regarded as not only an individual task but also a process of socialization. EFL learners are expected to become competent readers and writers, when they get to know how to read and to write via discussion. With the rise of computer networks some researchers have applied synchronous on-line discussion to facilitate the processes of reading and writing in a foreign language. Computer-mediated-communicating seems to be beneficial to collaborative EFL Learning, in the sense that through computer networks all participants are linked and form members of a discourse community. This "sense of community", may have a good influence since learners may empower their autonomy, equality, and learning skills.

Networks are supposed to have potential merit in providing English learners with a suitable virtual environmental for discussion and also serves as a good aid effect on their learning. Due to the lack of systematic and empirical studies about using computer network for EFL learning at UNIVILLE – University of Joinville Region, this present project was conducted to explore how e-learning can benefit learners in their process of acquiring/learning a foreign language.

Methods

Participants

The number of participants involved in this project was twenty-five university students who were at pre-intermediate level of EFL. This means that most of them, before starting the project, could read text of some complex syntactic structures and that they had some practice of writing. The class used to meet once a week as an extension program of the university. Participants were allowed to read or send messages at any time they liked, although, there was a deadline for each task.

The Learning Medium and Instruments

The idea was to create a group on the Internet. To get access to this group, students had to fulfill an application form and send a message saying that they want to participate in this project. After that they received a message saying that they were accepted in the group.

This project counted with one instructional designer and a pedagogic writer, both of them are undergraduate students who have their major in Computer Science and in EFL Language Learning respectively. The instructor designer had the role of putting all of the content in an electronic platform. The pedagogic writer, with the researcher, selected and wrote all the content of the course.

Two questionnaires were designed to survey students' background and their attitudes toward their participation in this project.

Instructional Design and Research Procedures

This project lasted one semester – 16 weeks, from August to December 2006. During that semester, some activities were designed to encourage students to take advantage of the computer-mediated communication. This study consisted of three stages: the first week of the class, students had orientation, activities, a background questionnaire was delivered to them and an opening request of an individual account at Univille computer administer was done; they wrote a self-introduction in English and sent it to the group. All the first stage activities functioned as a warm-up for this project. The second stage, focused on reading and writing activities, which were designed to encourage students to use and participate in discussions forums and chats. At this stage they were assigned to read articles out of class and answer some in reading comprehension questions. There was a plan for the students to watch sitcoms, movies, to answer some specific questions, and to write a short summary and send to the instructors.

After analyzing the texts, the good ideas were delivered to the group for them to revise some of their work and to share the good ideas with the others. At the third stage, in the last week of classes, an Evaluation Questionnaire was applied to assess students' impressions and attitudes toward their EFL learning, and their participation in the project itself.

Table of the Stages

First Stage	Second Stage	Third Stage
Orientation	Reading and writing activities	Evaluation questionnaire
Background and questionnaire	Participation in Forums and Chats	Impressions & Attitudes
Activities	Sitcoms and movies	MSN; SKYPE
Portfolio	Portfolio	Processfolio

Sample of some activities

First Stage
Background Questionnaire
Let's talk about ourselves
1. People generally think I
2. My parents
3. When I was young
4. I am very afraid of
5. The first thing I do when I wake up is
6. I hate
7. I love
8. I wish I knew
9. In twenty years
10. The best thing about me is
11. I never
12. If I could live somewhere else
13. A good student is someone who
14. A good teacher is the one
15. The worst thing about me is
16. I hope this course will be

First Stage (continued)

Reading Comprehension

Read the text and answer the question

The Museum of Technology is a “hands-on” museum, designed for people to experience science at work. Visitors are encouraged to use, test, and handle the objects on display. Special demonstrations are scheduled for the first and second Wednesdays of each month at 13:30. Open Tuesday–Friday 12:00–16:30, Saturday 10:00–17:30, and Sunday 11:00–16:30.

When during the month can visitors see special demonstrations?

a) Every weekend.

b) The first two Wednesdays.

c) One afternoon a week.

d) Every other Wednesday.

Read the following card and answer the questions:

1. When did the guest receive this card?

a) When making a room reservation

b) When checking into the hotel

c) When ordering a meal at a restaurant

d) When paying the bill

2. Who issued this card to the guest?

a) P. Angelo

b) Ms. Martelli

c) The hotel manager

d) The restaurant cashier


Welcome, Ms. Martelli,
to the Star Plaza Hotel. We hope you have a pleasant stay. Please present this card when enjoying our restaurant, coffee shop, and sporting facilities and when signing charges to your room account.

Check Out Date: 10th December

Room No. 635 P. Angelo
Desk Clerk

Second Stage

Writing Activity – Describe Yourself

Dear student,

As our first writing activity, I would like you to describe yourself.

Here follows some suggestions that may work as a guideline: Please read the e-mail attached and write a similar e-mail about you.

You can write paragraphs like this:

1) name, nationality, age, family, work / study
2) physical appearance
3) personality
4) hobbies and interests

Hope you enjoy it! You have until Monday, 28/08 to send this activity to projonline@univille.net

Attached file – Sample e-mail

From: Alessandra [alessandra@andes.com.ar]

To: Daniel [dani2199@yahoo.com]

Subject: Hi from Argentina

Hi Daniel,

My name’s Alessandra. It’s an Italian name, because my grandmother was from Italy, but I’m Argentinian and I live in Mendoza, a big city in the west of the country. I live with my parents and my two brothers. I am 19 years old, and I’m at university. I’m studying computer science. I’m in my first year and I really like it. I’m going to tell you about myself. As you can see from the photo, I have long hair – it’s quite fair- and green eyes. I wear glasses, but I want to get contact lenses soon. I think I’m a positive person. I’m quite extrovert and friendly. My mother says I’m very talkative – I think she means that I talk too much! In my free time I love reading and going to the cinema. But I don’t have much free time because I have classes every day, and a lot of work to do even at weekends. I also go to English classes on Friday afternoon. Please write soon and tell me about you and your life.

Best wishes,

Alessandra

Second Stage (continued)

Student's answer

HI,

My name is Cátia. My full name is Cátia Rejane de Carvalho Seabra. I am from Rio de Janeiro but I live in Joinville for four years, since I was married. All my family live at Rio de Janeiro, I miss them. But now I can't and I don't want come back from Rio de Janeiro, because I love Joinville, this city is more than calm but is wonderful like Rio de Janeiro.Now I am studying at Univille in 4° year, in the next year I will graduate! I want to be a good teacher, because at Rio de Janeiro I did "Magistério" and I gave private class, but after I started to work as administration auxiliary at hospital, and after two years I left this job for come from Joinville, so I started to work in this area, first I worked at "Clínica Odontológica" at Univille for two years how trainer, and after that I started at "Hemosc" how trainer about five months and after I started to work at "Centro Médico Diagnóstico por imagem" how employee, I was typist of result doctor, but only one year, because this place closed for "SUS" and half employees were axed. Now I am how housework and student at Univille and at CNA where I am doing English's course.

About my physical appearance, I am fairly short, slim, 27 years old; I have a long, straight and blond hair and brown eyes. My quality is pleasant, lovely …, and my defect is, Oh my God! I am very selfish and jealous! This is terrible feeling!

I love listening music kind rock but love metal, and I love kind of movies love story, comedy and drama.

I don't have children yet! But I have a cute cat, my puppet called Augostinho! He is so handsome and lovely!

So I hope that I describe about myself!

Best wishes,

Cátia

Third Stage

Participation in Virtual Shops

Let's go shopping! Go to www.gap.com;

- Visit the site gap: gap men, gap women, gapkids, babygap, gapmaternity, gapbody;
- Choose 4 items you want to buy and fill in the table below:

Item	Section	Regular price	Sale price	Sizes	Color
1)					
2)					
3)					
4)					

- Visit the departments if this online store and answer the question;
- What are the 4 things you need or would like to buy?

Item	Department	Product description	Quantity	Price
1)				
2)				
3)				
4)				
Total: US$				

- Read the text and fill in the blanks with the words and expressions in the box below.

"Servicemerchandise.com is an online store. In this homepage, there are different online _________ such as: Electronics, ___________, Home Accents, Kitchen and Dining, and _____________. In the Electronics departament, for example, you can find: _______________, _______________, and _______________. And in the Jewelry departament, there are many sophisticated gift options, including: _____________, ______________, ____________ and _______________. Servicemerchandise.com sometimes offers good products for a reduced price. For example, the _______________ of the men's Seiko Perpetual Calendar Watch is $219,90 but the ____________ is $185,00. That's a good buy!"

diamond bracelets   Dolby digital receivers   Travel and Adventure   pearl necklaces   regular price   store departments
gold earrings   Health and Exercise   CD players   VCRs   silver rings   sale price

Third Stage (continued)
Evaluation Questionnaire
What are the advantages to a student to learn by e-learning?
After taking part in our "Projeto Inglês On Line", what are the good points? And what could be better?

Data Analysis

In order to evaluate how on-line tasks may aid students in their learning, this research was conducted both quantitatively and qualitatively. The idea was to first investigate how a virtual community facilitates foreign language learning from the perspectives of the instructors, the researcher, and the students. The participants completed an Evaluation Questionnaire at the end of the semester. The instructors were interviewed by the researcher in order to acquire the instructors' feedback toward students' attitudes during "in-class" activities. Secondly, some of the students' reading and writing were scored in terms of: general and specific comprehension, organization of ideas, vocabulary and language use.

For each part of the assessment, detailed criteria were provided in order to check if the opportunities created contributed to the development of the reading and writing strategies.

Discussion

Virtual English Learning Community

The idea was to check students' interaction during the project, and whether this interaction was facilitated through the virtual community, verify the way learners see their learning experiences, and how they develop autonomy. In order to do that, attention was paid during students' individual tasks and/or when they had to discuss with the others before responding them. Also special attention was taken to observe how students answered the questions raised by their peers, instructors, and researcher. Through this observation it was possible to analyze how students behave in a virtual learning community as well as the effect of synchronous and asynchronous activities in EFL learning process.

References

- Bielacsyc K & Collins A
  Learning Communities in Classrooms: a Reconceptualization on Educational Practice. In: Reigeluth, C M (Ed)
  Instructional Design Theories and Models: A New Paradigm of Instructional Theory
  Volume II, Lawrence Erlbaum Associates, Inc.
  1999, p.269-292.
- Boeckner K & Brown P C
  Oxford English for Computing. Oxford University Press: 1993.
- Brown R E
  The Process of Community-Building in Distance Learning Classes. Journal of Asynchronous Learning Networks (JALN), vol 5, issue 2, September, 2001 (cited 10 Oct 2001)
  Available from World Wide Web:
  www.aln.org/alnweb/journal/Vol5_issue2/Brown/Brown.htm
- Buschle C A
  A Teacher's Beliefs about Teaching EFL in Brazil:
  A Critical Discourse Analysis Case Study
  Florianópolis: UFSC, 200
- Cheng Y, Liou H
  Using electronic Bulletin Board as a
  Virtual Community to Aid College English Learning
  In: ICCE/ICCAI 200 (International Conference on Computers in Education/International Conference on Computer-Assisted Instruction) Proceedings (cited 10 Oct 2001)
  Available from World Wide Web: http://icce2000.nthu.edu.tw
- Dias R
  Reading Critically in English: Inglês Instrumental
  Belo Horizonte: Editora UFMG, 1996
- Ellis R
  The Study of Second Language Acquisition
  New York: Oxford University Press, 1995
- Graibe G & Theuerkauf W
  Technological Development and
  Development of Technology Education
  In: Fifth International Primary Design and Technology Conference. p.129-132
  CRIPT, England, 2005
- Hatch E
  Discourse Analysis and Second Language Acquisition
  In Hatch (ed.), Second Language Acquisition
  Rowley, Mass. Newburry House, 1978

- Herzog R
  Aufbruch in die Bildungspolitik Rede des Bundespräsideten am 5. November 1997, in Berlin
  In: Rutz M (Org): Aufbruch in die Bildungspolitik Roman Herzogs Rede und 25 Antworten Wilhelm Goldmann Verlag, München, 1997
- Long M
  Native Speaker/Non-speaker conversation
  and the negotiation of comprehensive input
  Applied Linguistics, 4 – 126-41, 1983
- Paiva V I M D (org)
  Interação e Aprendizagem em Ambiente Virtual
  BH: Faculdade de Letras, UFMG, 2001
- Pfenning U
  Quo Vadis Technicus
  Technik und Jugend – Vortrag Anlässlich der Fest-vranstaltung zum 10 jährigem Jubiläum des Landesverbandes Sächsischer Jugendbil-dungswerkr e.V.
  am May, 14th 2002, Dresden
- Tavaras K C A
  Comunidades de Aprendizagem On-Line e o Ensino de Línguas
  São Paulo: IFRJ/PUC-SP, 2001. Abralin
- Schlaffke W
  Beruffsausbildung – Qualifikatin für das näschste Jahrtausend –
  In: Rutz M (Org): Aufbruch in die Bildungspolitik Roman Herzogs Rede und 25 Antworten Wilhelm Goldmann Verlag, München, 1997
- Vygotsky L S
  a Formação Social da Mente. Trad.
  Grupo de Desenvolvimento de Ritmos Biológicos
  Departamento de Ciências Biomédicas – USP. 1ª ed
  São Paulo: Martins Fontes, 1984

The LMD and Teacher Training in the Field of Sciences and Technology in the Primary School

IUFM – Site UNIMECA, Technopôle de Château Gombert, 60, rue Joliot Curie, 13453, Marsaille Cedex 13
Marjolaine Chatoney – E-mail m.chatoney@iufm.aix-mrs.fr

Abstract

With the protocol of Bologna, the French university, as well as the European universities, reorganizes the university courses from the point of view of a harmonization at the European level and by extension at the international level. The system Licence, Master, Doctorate (LMD) in three cycles is adopted. Each diploma corresponds actually to the same duration of study, i.e. three years for the licence, five years for the master and eight years for the doctorate. The stake is major for Europe, the university and the students. Europe aims at freedom of movement of the people in European space. The universities aim at the development of their policies of formation and research in European space. The students wish the recognition of their qualifications and their university level at the European level.

The University Institute of Teacher Training, Institut Universitaire des Maîtres (IUFM) in French, hitherto independent of the university are like many of other Institutes and high French schools, gradually integrated into the university. (the IUFM of Aix Marseilles is the first to be integrated). Its integration is effective since January 2007). The training of the Masters such as its conceived in France lends rather badly to integration into LMD for several reasons: First, is that the future teachers are recruited starting from a licence by way of contest. The contest is difficult to obtain, the demand is keen and the high standard level institutional. The second reason comes from the difficulty of the perception of the nature of teaching socially. Some people think that the trade of teacher does not offer sufficient development of ideas, that it is insufficient to acquire some social competences and to provide a good base for disciplinary knowledge to be taught. This acceptance denied the professional competences. It is thought that they gain through innate activity or through testing ideas on the pupils. Others think that the socially acquired competences associated a good range of disciplinary knowledge are not sufficient criteria professionally. For them, knowledge to teach comes from specific professional knowledge. There are gestures, techniques, organizations, associated instruments has epistemologies, which have to be known. In this context, the process of inscription of the teacher training courses LMD supposes the passage of a design of a vocational training under the responsibility for the employer (the contest) to a university vocational training (competences). This new configuration imposes a new design for the formation of the new course.

In this paper, we will begin to present the idea of the LMD and the problems of opening teaching to the trades. Then we will present successively an LMD implementation in direction of sciences and technology education and the new design of the teacher training in the field of sciences and technology.

The idea of the LMD

System LMD is the fruit of this reflection launched, in 1998, by four Ministers for education (French, Italian, English and German) in the Sorbonne[1]. This declaration initiated the process of construction of current European space and led to a conference on the topic of the European harmonization of the university course[2] (MEN, 1998). One year after, the European Ministers for education in Bologna (Italy) outline the common broad outline of reference of the courses and the European diplomas and widened the process with the unit of the European countries (MEN, 1999). Since then, the idea of a European space of the higher education progresses and takes form. Work focuses on agreement of harmonization about a question of the quality of the formations, equivalences of diplomas and freedom of movement of the students in Europe. An arsenal of European programs, such as Socrates, Comenius, and Leonardo supported largely this last point. Work of harmonization continues today.

System LMD reinforce at the same time the legibility of the policies of formation and research of the universities while respecting diversity on offer. This process of harmonization is not therefore a process of standardization of the higher education; it must make it possible for the universities to propose their own programs and their diplomas as well as for all the large universities in the world. The LMD meets a double aim: First aim is to revalorize the national diplomas to give to the students the insurance of a qualification recognized in the whole of the European countries. Second aim is to build a European space that rests on mutual confidence between the various national systems that constitute Europe. Methods of evaluation of the quality of the formations and diplomas founded this confidence (MEN, 2002).

At the European level device LMD clarifies the organization of the formations to make them readable and comprehensible in European space:

- Course de-partition, to allow a better identity by the posting of the great fields of competences of the establishments.
- Course flexibility processes for a progressive orientation and the teaching treatment of the diversity of the public ones.
- Introduction of a modular organization of the lesson and adoption of a European system of appropriations (ECTS) for supports mobility between formation and occupation as well as mobility between the countries and the establishments.

At the level of the university and the student, diagram LMD connects the offer of formation and research. This introduced more competition inter-establishment. This led to the following reorganization:

- Installation of great training areas in relation to research.
- Installation of courses diversified to take into account diversity of the students and the development of the request for vocational training.
- Promotion of the teaching innovation and experimentation to leave the traditional distribution run, TD and TP.
- Support innovating steps of type "multi-field" making place for the general culture, the living languages, technology and the professional to leave the disciplinary whole.
- Scientific engagement of the teams of formation attested by productions of research to give coherence enters the scientific forces.
- Recognition that masters' professional type, meet economic, social, cultural and local needs.

The opening to the teaching trades in the LMD

Course LMD towards the masters and the doctorate does not pose real problems at the university in the traditional university courses. On the other hand, the installation of professional courses towards the trades of teaching is more problematic to conceive. The ministry for national education issues reserves on the capacities of the IUFM to be formed with the teaching trades since the training of the teachers will be integrated in masters: « *It is important... to indicate reserves in front of certain projects which envisage the creation of master" trades of teaching "... A partnership university-IUFM is likely to register the IUFM in a university step qualification, while at the same time its action must focus itself, on the vocational training of the prizes winner of the contests* " (MEN, 2002). To facilitate the integration of the IUFM, the university decided to contribute fully to the preparation of the future teachers by the licences which it delivers and by preparations with the contests and precise *"The integration of the IUFM will make it possible to better articulate these preparations with in particular the licences…". The question of a masters delivered for teaching, has one moment of their professional course will find new answers with the IUFM pedagogically integrated into the universities* "(MEN, 2002). In these remarks, the opening to the teaching trades is not limited to the two years of training to the IUFM. It introduced without waiting until the effective integration of the IUFM.

The Marseilles universities, like others, and before others, integrated the licence course of the modules open to the trades of teaching. How does the professional dimension concerning the teaching trades appear in the fields of technology at the University of Provence in the first LMD, set up in 2003?

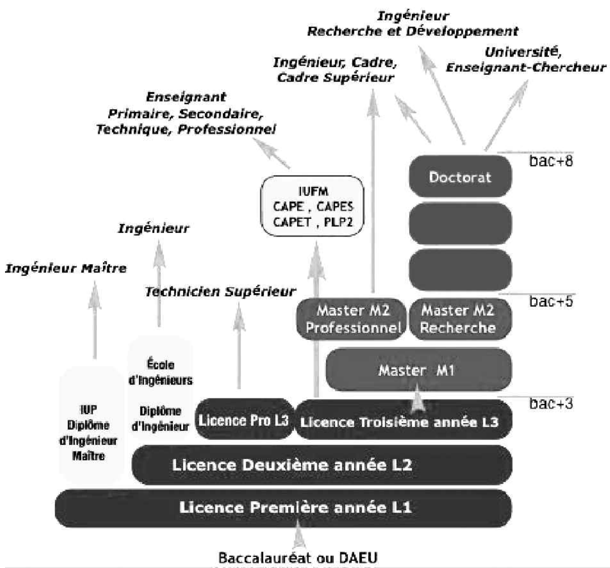
To look at the question we will present an LMD set up at the level of the scientific licences since 2003, leading to the teaching trades and addressing to students of "sciences of the life and the ground" and "physical chemistry".

The multi-field licence – teaching and scientific & technology literacy

The sector sciences of the university of Provence (Aix-Marseilles 1) proposes to the students new offers of formation in conformity with named diagram LMD "multi-field licence – Teaching and scientific & technology literacy. This licence leads to the trades of teaching, in particular with the professorship of the schools and the die technology of secondary education. Where and how this licence fits in course LMD?

The illustration below represents the possible courses offered to the students at the university of Provence sector sciences.

This illustration makes it possible to include/understand the structure of the unit and the general ecology of the system LMD which will make it possible for a student to organize his/her course throughout its studies. On entry into the licence, the students have several possibilities of choice. In the general course of "Licence", three choices are possible: *"Mathematics, Data processing and Physical sciences and Chemical" (MI-SPC), "Life sciences and Sciences of the Universe and Environment" (SV-SUE) and "Sciences for the Engineer – mechanical engineering electronic and automatism"* (SPI).



The scientific multi-field licence is in the 3rd year of licence. It leads (as indicates by two yellow arrows of the illustration) to the formations is exemplified with the IUFM and which prepare with the trades of teaching that is to say towards a master with a professional aim or of research. It is distinguished from the professional licences, which lead directly to the trades of technician. A small team of academic young people, who enjoy the installation of courses, coordinated this Multi-field Licence which answers the philosophy of the LMD. The objective is to give the students support to succeed with the contest of the professors of the schools and other contests of the public office by allowing the options that it proposes. It allows for the presentation at the contests of recruitment of teachers for primary schools or that of Advising Education of National Education. It is located before preparation at the contest, exempted in the IUFM, preparation accessible by a contest, which 90% to 95% of the students succeeded in this formation. By a judicious choice of options, it also makes it possible to reach the socio-educational contests of the public office of the level of the Licence.

To achieve its "multi-field and cultural" goal, this licence comprises an important scientific unit (physical and chemistry or biology and sciences of the ground) including a multi-field science report presented in talk, lesson of mathematics, of technology, TIC, a living language, an initiation with the methodology of the literary analysis and the writing of a tale. It comprises also an opening towards the epistemology of sciences and technology and the possibility of carrying out a training course or of acquiring concepts of constitutional law and sciences social and political.

Two modules (technology and organization of the training courses) are, explicitly, towards the trade of teachers for primary schools. These modules are a partnership with the IUFM of Aix-Marseilles. The Technology one focuses in on acquiring knowledge relating to the organizations of the production of technical objects and to the modes of existence of these objects. It also aims at controlling the bases of the various technological approaches (structural, functional, systemic, etc.) and the languages, which referred to it. It aims at the acquisition of minimal competences of step of technical project control in particular from a point of view of anticipation, planning and organization (systems of dependences, causal a chain, designs of interactions, analyzes value, etc). It is a disciplinary module. Knowledge that is introduced: the history of the inventions and the techniques, the study of the social organizations of production of objects, the steps of technical project and industrial design, interdependences between operation, functions, structures and forms of the objects and the technical systems, charts and languages, the relations man-object, machine man, man-tools.... In addition, the students receive an initiation with the software of modelling in 3D. These approaches regard technological initiation at primary school through video, documents produced in school, even produced by the pupils. Thus, the students must lead studies in applications determined by the level of comprehension of the pupils, the material conditions. For example the students carry out a file (technical project), apart from the lesson. Starting from this file, they carry out the technical object in TP. In this project, the technical object is realizable only with the tools and materials used at the primary school. This makes it possible for the students to become aware of the material constraints of the primary school and the importance of the preparation of this kind of activity. They learn the most from the possible techniques available in the school, the conditions of feasibility, a technical vocabulary... The technical dossier is constrained by a precise schedule of conditions. The drafting of the file is representative of the common practices of reference in the teaching of technology, in France. The step is rigorous: investigation-research, functional approach, search and technical choices for solutions, technical drawings of the object, organization of its production, conformity. The file and the realization of the object are the subject of an evaluated talk. With regard to the lesson, the problems related to the graphic languages are illustrated with examples from the primary school (drawings, legend, encoding...). The systems of transformation and transmission of the movement are introduced by a TP of automatism adapted to the level of the primary school. The course of history of the inventions is the subject of a work of application adapted for some 10 years old pupils. Such a design of the technological formation exceeds obviously the disciplinary framework, which reserved to him.

The module makes it possible for the students to become aware about what is technology in general education, within such registered frameworks and discovers the conditions of feasibility of this teaching with young pupils. This approach is a complementary training given to the IUFM, which, for lack of time[3], cannot develop these various aspects and especially the contextualiser in the school practices. Spontaneously, the students tend to consider that technological initiation concerns manual education, whereas this teaching disappeared in the Eighties. This thorough teaching enables them to exceed the simple imagination and ideas of the institution in regards to technological education. It enables them to become aware of the relations with other disciplinary fields through technology discussion.

There is obviously an epistemological range in school terms of references and design on multidisciplinary and transversely approaches'. IUFM exploited all of that in its training just later.

The training courses in primary school include a preparation for the course and the course in primary school. A final assessment is concluded through a written report/ratio. The training course constitutes an approach to the primary school and trade of teacher through the observation of the activity of the Master in the school and the class. The objectives are to develop the capacities of analysis, the teacher activity and the different situations of learning. Courses about the missions of the school, the teacher, the education system, the programs, the situations of teaching-training, precede the training course. The organization "course-training, course, memory" prepares the students through observation gradually. It then makes it easier to include/understand the didactic choices of the teachers, to discover how the pupils react in situations. The observation of the work of the teacher relates to the preparatory work before going into the class (the teaching preparations, material anticipation, prevention of the risks and multidisciplinary...) and the evaluation of the choices that the teachers make (strategy, supports for activity, organization). Of course, in the training course, the students live the school with the daily newspaper. They also discover part of the work that is not discussed enough in detail for example: the team work, the relation with the parents, the monitoring of the course, the sick pupil, the school exit.... This option does not have professional aims. It is a discovery of the professional environment and work of the teachers in the broadest sense. The IUFM is in charge of professionally apprenticing, just recently.

Obviously, these two modules built in partnership between the university and the IUFM contribute to develop the knowledge of the students in the trade of teacher in the schools. It is in particular a question of stressing the importance of scientific and technological initiation in the primary school in order to ensure their teaching and in hope to bring more and more pupils and students in these areas. In addition, it is a question of developing the contribution of the scientific and technical culture in the process of general education of the pupils.

The introduction and positioning of the multi-field Licence in the LMD course produced many controversies between academics. Some think that the choice of orientation towards the trades of teaching makes this licence less mainstream. They believe that this course absorbs the weakest students who, obviously, do not have the means of making thorough scientific studies. In other words, the trade of teacher would not be at a very high university level. This idea supports the thesis that summons us all qualified to teach. Others think that the place granted to the general culture, with the orientation does not have a place in the science. These resistances are placed on an academic model of the scientific knowledge testify to divergent designs of the role of teacher, on what the exercise of his/her practice supposes and thus on which knowledge this practice is based. We are always in the debate, which poses that it would be enough to be qualified in the control of the knowledge of a discipline to be ready to teach it. Such a design denies the trade of teacher, in particular the control of the knowledge and competences necessary to teach disciplinary knowledge. It denies especially the knowledge and competences for a teacher ensures the missions of education within the framework of a school system registered in a socio-cultural environment, socio-professional and socio-economic. It is in the sense that we speak higher about time necessary to make lead the generalization of course of licence towards the trades of teaching.

Thus of the 2002/2003, modules devoted to the knowledge of the teaching and the trades of teaching are proposed to the students who would wish to make the choice of teaching later. The integration of the IUFM is in hand. The IUFM of Aix Marseilles is the first integrated. Its integration is effective since January 2007. In this intention and on teacher training point of view exclusively, the IUFM has: to specify the contents of the course, to give them a university level, to organize the formations in modules, to think the evaluations based on appropriation ECTS, to establish a bond with research, to propose new orientations... in accordance with the idea of the LMD.

The master of teacher training of the IUFM

The IUFM teacher training constituted in two years before the integration at the university is adapted in master. This adaptation was not easy, because of confusion between recruitment by way of concourse of civil servant persons of the state and the vocational training of the teachers. This contradiction takes all its direction, when it is known that the organization of the 1st year of training to the IUFM, which aims exclusively to the preparation of the concourse, tests, while falling under the prospect for a master 1. The success at the test cannot be a relevant means of evaluation for obtaining a master 1, because it depends on a ratio between the number of stations offered and numbers of candidates. The formation suggested with the IUFM reconciles master1 and success with the contest.

The first year of training made up of disciplinary subject, cultural subject and standard subject, “drive” towards the success. The disciplinary subject of schools is numerous because of the versatility of the schools teacher. They prepare the french tests, mathematics test, history geography test or sciences and technology test with the choice, but also test on language, sport, visual art and music. These entire subjects are preparing in training and in course. The course, help the students to build a speech on the professional environment. Speech required in the concourse tests.

The 2nd year of training falls under a more traditional diagram of vocational university training whose validation depends directly and exclusively on the institute of formation. This validation rests on a triptych, which articulates training courses of professional practice, modules of teaching and a professional report. The device fulfils the university requirement of delivery of ECTS and has that of the academic jury charged with pronouncing establishment in the public office.

The second year of training is organized in 3 components. A component is devoted to the teaching & professional lesson. It makes it possible to learn, connect theoretical practical and lightings, to analyze practices and to approach sets of themes shared by all the teachers. The second component relates to the courses in school. It is used for applying, trying out, observing, knowing the institutions, and of another education systems. The student undertakes a course in which they have the responsibility for class, a course of observation in an college, a course of practice accompanied by a teacher and a course in foreign school. The third component is devoted to the drafting of a professional report. It makes it possible to analyze, write, research about a question of teaching in relation to the contributions of research in education. Its aim is methodological.

Teacher training in sciences & technology for the primary school

The concourse of recruitment of the professors of schools (CRPE) defined the structure if the first year of the master. The students for this reason must choose between presenting the test of history and geography or that of sciences and technology. Nevertheless, all, some is the choice of the test, will have a question of knowledge in history, geography, sciences and technology. The other part of the test is devoted to sciences and technology or the history geography.

In fact, of the general-purpose nature of the test, the training in first year is organized in 2 components: a “major” component of 36h and a “minor” one of 28h. Aim at the control of the principal scientific and technological concepts and their articulations compared to live & alive, matter and manufactured objects.

The objective of the training is to widen knowledge and competences of the students to the entire disciplinary field taught at the primary school to make them success at the concourse test. With this intention, the formation made choice initiate them with the process of the transposition of scientific and technological concepts and give them the means of building a scientific and technological culture basic.

The contents taught are those on which the candidates will question in test. A program of the concourse tests specified these contents. Contents are organised in different fields as measurement, the matter, energy, electricity, living it, ground and astronomy. The students adapt the great disciplinary concepts via file. For the minor component, the files gather varied documents (descriptive experimental, drawings of objects, assembly diagrams, of synthesis, manufacturing ranges...) and used as support of study and analysis. For the major component, the students constitute files, which enable them to mobilize the concepts scientific and technological essential and to outline sequences of training privileging the step of investigation. Training offer also two entertainments that put student in situation of contest

In second year, the formation centred on teaching and professional dimension exclusively.

The students learn how design teaching devices starting from common documents for teachers, how doing an evaluation, how organizing the study, how manage the materials, design instruments of assistance to the transposition as for example of the posters, flow charts... the time affected at this training is 15h.

A collaborative platform ensures links between teachers and the students.

Conclusion

The training of the teachers in IUFM is defined today in four distinct stages, each with a different rationale. The first stage is that which precedes the entry into IUFM, stage of construction of the disciplinary knowledge and the first elements of a course towards the trades of the formation. The second stage corresponds to the preparation of the concourse test proof of the public office in M1 IUFM. The third stage is that of the vocational training in alternation that organizes lesson, practical periods in school establishment and a reflexion on the trade. It corresponds to the second year of IUFM. The fourth stage relates to the duration of the professional career of a teacher. These times sanctioned by diplomas, which are the licence and the master, even for some the doctorate.

The teacher training is not limited to the control of the knowledge of a discipline. Of course, this control is a condition necessary but it is not sufficient to train a professional able to transmit knowledge in various school organizations, with populations of very heterogeneous pupils. The formation also rests on the control of the teaching knowledge and education system knowledge. This knowledge must take direction in the professional gestures that the teacher do to exert his/her trade. The development of master training to teach is a search for balance between practice, lesson, time of the formation and components of the formation. These balances built in continuity on the two year, engaged student in direction of their professional identity. A long course stays building, in architecture LMD.

The teacher training in the field of the sciences and technology has to be conceived in perspective of an integrated discipline in which juxtaposition of sciences of life and ground, physics – chemistry and technology remain to be built around collaboration of certain points of view. The design of “integrated” teaching is not commonplace. It concerns the capacity of the teacher to adopt different considering field on the covered subject. It is in this direction that the training of sciences & technology as of the school-entry 2007 will made. This design of this training opens several questions: that of the topic and its multidisciplinary, but also that of the management from the points of view and the concepts built through these points of view, in other words that of knowledge and the epistemology has which it is appropriate to train the teachers.

References

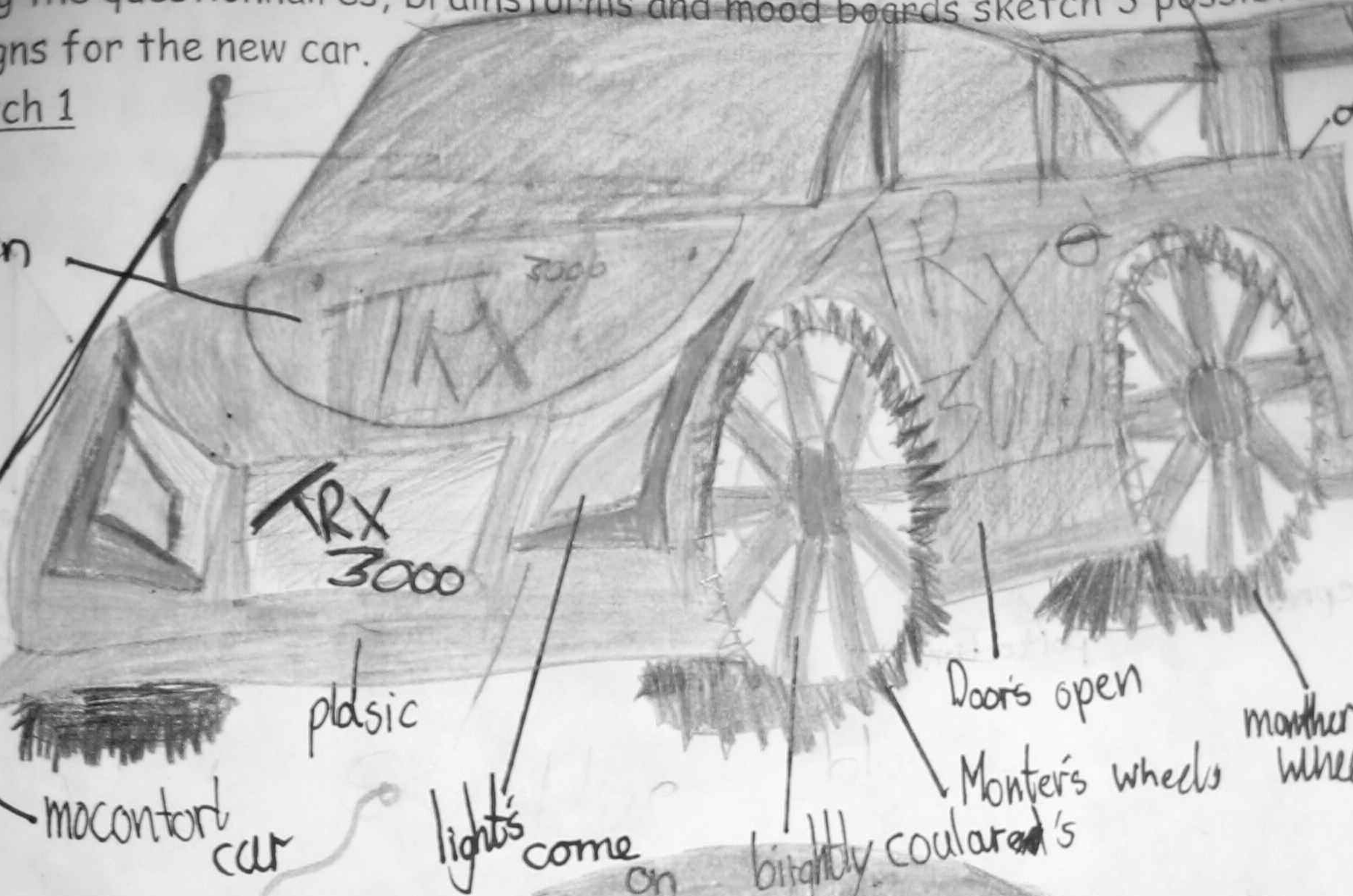
- Chatoney M, Ginestié J (2006)
  La formation universitaire et professionnelle
  des enseignants dans le LMD:
  Exemples d'intégration et de structuration des cycles
  universitaires dans les domaines scientifiques et technologiques
  Symposium international FORAPEVAL, novembre, Fez, Maroc
- MEN (2002)
  Circulaire de mise en œuvre du schéma Licence
  Master – Doctorat (LMD) du 14 novembre 2002
  http://www.amuefr/
- MEN (1999)
  Déclaration de Bologne des ministres Européens de l'éducation.
  http://www.amuefr/
- MEN (1998)
  Harmoniser l'architecture Européenne d'enseignement
  supérieur (Déclaration de la Sorbonne). http://www.amuefr/

Notes

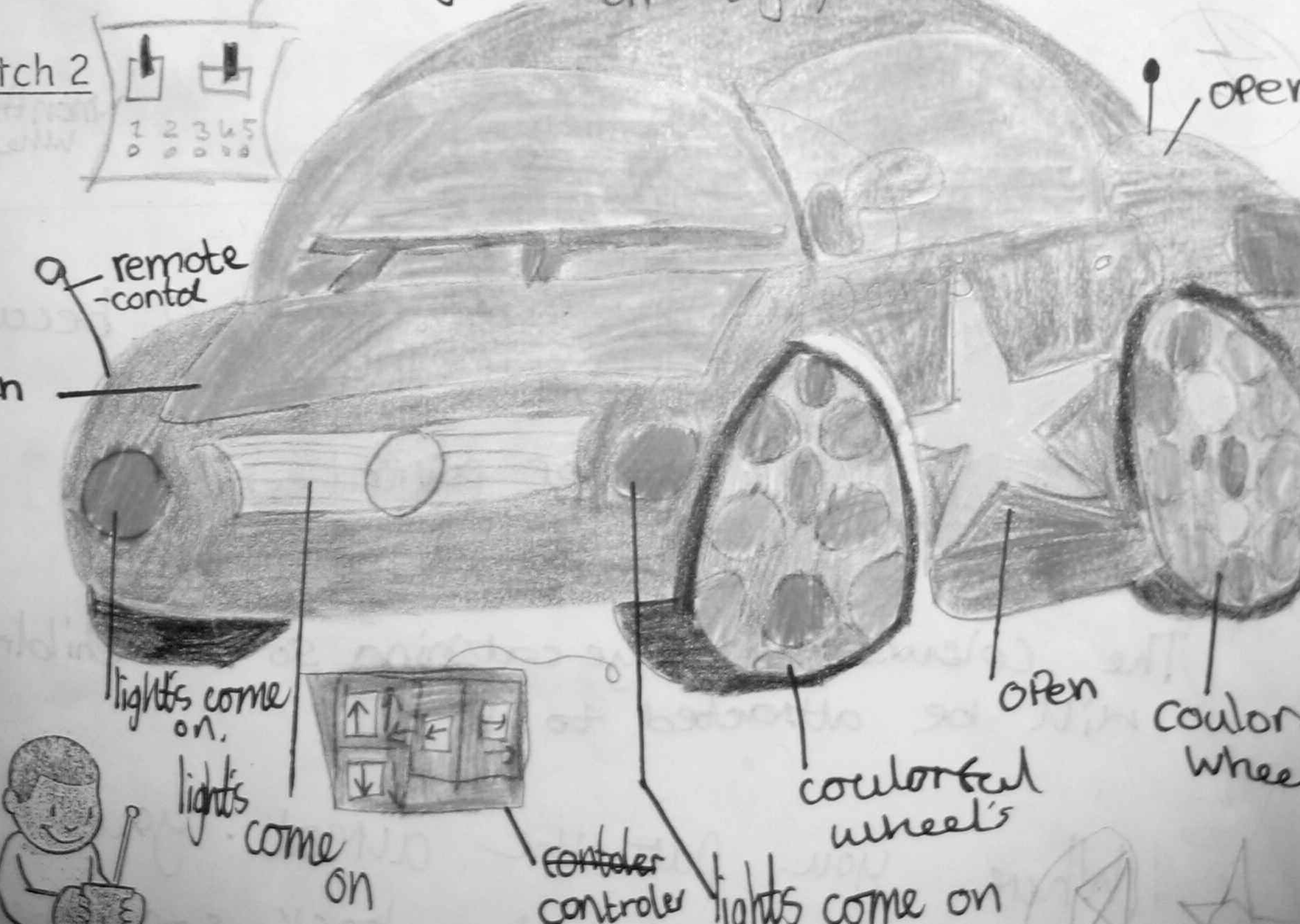
1) La Sorbonne est une grande université Parisienne
2) Colloque de la Sorbonne
   «vers l'harmonisation Européenne des cursus universitaire»
   Paris, 1999
3) La formation toutes sciences et technologie confondues est
   d'environ 30h a l'IUFM

g the questionnaires, brainstorms and mood boards sketch 3 possible
gns for the new car.

ch 1



tch 2



Exploring Issues Related to Gender in Primary Technology Education Introducing UPDATE: A European Union Funded Longitudinal Research Study

Centre for Research into Primary Technology, University of Glasgow, Faculty of Education, Department of Educational Studies, St Andrew's Building, 11 Eldon Street, Glasgow
Wendy Dow – E-mail wdow@educ.gla.ac.uk Telephone 0141 330 1915
John R Dakers – E-mail jdakers@educ.gla.ac.uk Telephone 0141 330 3064

Abstract

UPDATE stands for 'Understanding and Providing a Developmental Approach to Technology Education' and is a European Union funded project which started in January of this year and will complete in December 2009. The value of the contract is €922,300. The constitution of the project team is made up of a Europe wide consortium of sixteen institutions from eleven different countries. The University of Jyväskylä in Finland acts as the Coordinator of the project. (See appendix for a complete list of participating countries).

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 the attitudes are often formed. From this understanding, it is far too late to start to try raising the girls' interest at only at secondary or later stages. We are convinced that with new, improved technology education practices it is possible to make science and technology more attractive for young people, promote their interest, and encourage their critical and creative ways of thinking.

Several studies conducted by the European Union (e.g., Eurostat 2004, Implementation of 'education & training 2010' work programme) demonstrate that women and girls are continuously dramatically underrepresented in science and technological education, areas, and jobs. This is highlighted in the Joint Interim Report 'Education and Training 2010' by the European Commission under domain of Maths, Science and Technology (MST). The joint report points out the persistent shortage of women in scientific and technical fields and calls on Member States to encourage the development of a scientific and technical culture among its citizens. In particular, action was recommended in order to motivate young people, especially girls, to undertake scientific and technical studies and careers. Even in countries where gender imbalance is not a problem in the areas of mathematics and science, there is a marked imbalance when technology subjects are taken into account. Technology, is an area where the gender imbalance culminates, and therefore the focus of the UPDATE project.

The UPDATE project's aim is threefold: 1) to examine why girls drop out from technology education at different stages of their education, and 2) to create new ways and educational methods to make the image of technology and technological careers more attractive for both boys and girls, and 3) to promote, encourage and mobilise especially girls and young women for engineering and technology, both as a career, and as active users of modern technology.

Background

The Lisbon European Council in March 2000 set the objective for the European Union to become the world's most dynamic knowledge based economy. It acknowledged that:

> *"the European Union was confronted with a quantum shift resulting from globalisation and the knowledge-driven economy and agreed a strategic target for 2010: to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion." (Council of the European Union: 5828/02, 2002: 5).*

As part of this initiative, education systems throughout Europe were considered to be the main areas of development in this respect. In this respect they underlined …

> *"…the importance of increasing recruitment to scientific and technological disciplines, including a general renewal of pedagogy and closer links with industry throughout the whole educational and training system" (Council of the European Union: 5828/02, 2002: 21).*

Science and technology education, along with mathematics was consequently identified by the Education Council as one of three priority areas for consideration as highlighted in the conclusions of the Stockholm European Council. This was in recognition of the view that scientific and technological advancement is not only fundamental for the development of a competitive knowledge society, but that specialised knowledge in these areas is increasingly an essential feature of both professional and private life.

The authors of this paper were appointed to act as consultants for this project from 2002 to 2004. A number of issues relating to increasing recruitment to science and technology were studied over the two-year period. These involved, amongst other things, the study of a variety of pre-existing initiatives being undertaken in each country that had been designed to make the subject area more appealing, particularly to girls. These studies revealed, however, several generic areas of concern that were common to the delivery of technology education. Three areas in this respect stood out as needing special attention.

Primary teacher confidence

The importance of developing the interest of pupils in the area of technology from an early age was highlighted as an important issue, although this was clearly not reflected in the number of initiatives provided in this area. An important factor, which may at least partly account for the low number of initiatives at this stage, involves levels of teacher confidence.

Research carried out in England to determine the confidence levels of primary teachers in the delivery of science (Harlen, 1996, Stables, 1997) for example, demonstrated problems in this area by identifying a high number of primary teachers who had no background in science (65%). An investigation of confidence levels of both science and technology (Harlen and Holroyd, 1996) concluded, moreover that, in general, primary teachers had a low level of confidence in teaching these areas. Similar studies carried out in Scotland (Dakers, 2001; Dakers and Dow, 2004) indicated similar problems with teacher confidence relating specifically to the teaching of technology.

That this is a problem in many European countries is further evident from the initiatives relating specifically to teacher education courses, where a particular concern expressed was the need to increase confidence of teachers at all levels, but most particularly at the primary stages. New programmes for teachers, part time studies for existing teachers, support for teachers in the development of resources and methodologies through short courses or internet networks were some examples of attempts to tackle this particular issue in a number of countries.

Transition

The enthusiasm demonstrated by pupils in primary school for subjects like technology was found to be difficult to maintain after transition to the secondary sector. An important aspect of this are problems associated with the transition process itself.

Several factors affecting the success of transition from primary to secondary school in relation to curricular continuity have traditionally been identified. These include: the existence of effective liaison procedures; a knowledge and understanding on the part of both sectors about the respective courses taught, programmes of work and teaching methods adopted; a willingness on the part of secondary teachers to value the work done in primary schools and to trust the primary teachers' judgements in terms of assessment, along with a willingness to use the information to provide a starting point appropriate for each individual pupil (Nicholls and Gardner, 1999). Secondary teachers must also have commitment to a curriculum, which builds upon the knowledge, understanding and skills appropriate to their subject which pupils have already acquired.

Pedagogy

Other countries have attempted to address the problem of diminishing interest at the secondary stages by attempts to introduce changes in the methodologies employed. There is a growing recognition that in order to learn effectively, children must be actively involved in the learning process. Effective learning, moreover, is increasingly regarded as an essentially socially mediated process. Learning is fundamentally constituted through interactions and relationships in a given sociocultural system (Cole, 1996; Engestrom et al, 1999; Lave, 1993; Lemke, 1997; Matusov, 1998; Rogoff, 1990; Vygotsky, 1978; Walkerdine, 1997; Wenger, 1998). This system comprises, at the micro level, a variety of particular cultural identities situated in a particular environment, whether natural, social or artifactual, where a community of practice, and thus learning, is constituted and where "[p]ractice is not conceived of as independent of learning" (Barab & Duffy, 2000: 26).

There was a general consensus, therefore that both technology and science education, should be moving away from the transmission model and the acquisition of facts towards a system "more concerned with interpretation and understanding than in the achievement of factual knowledge or skilled performance" (Olsoen and Bruner, 1996:19). There was, in each of the positive initiatives, a particular emphasis on the type of pedagogy which will develop higher order thinking skills, such as problem solving, research skills and meta cognition as well as producing motivated and autonomous learners. In addition the importance of setting learning within authentic contexts, which are meaningful to pupils, was clearly recognised. There was further evidence revealed that both specific skills and generic skills are best acquired within authentic practice contexts. Relating technological concepts to the world and making connections between subjects and contemporary society helps to make the subject areas more accessible.

Gender

Permeating every initiative could be found the issue of gender imbalance. Most countries admitted to an imbalance in this respect. Females were not attracted to the subject domains of science and particularly to technology. It was with these issues in mind that the UPDATE project was formed.

UPDATE

One of UPDATE's intentions is in answering the question 'At which point of development do boy's' and girl's' interests in technology and thus, technology education, start to differ?' Assuming that their first engagements with technology are similar (e.g. at home, in the kindergarten), at what point do girls loose interest? The developmental approach offered by UPDATE hopes to seek find some answers to this question.

With this in mind, a fundamental aim of UPDATE is to have an impact on learners' views about themselves as users and developers of technology, especially girls. The project hopes to develop a more holistic approach to the learning and teaching of technology education by attempting to move away from the embedded 'skills acquisition' model that tends to prevail in the secondary sector. The consortium will act collaboratively to this end by combining the expertise of a network of complementary universities, research institutes, schools, and partners from relevant public and private organisations. Research suggests that, in general, girls are less inclined to be attracted to a technology education paradigm that is focussed upon fabrication and the development of procedural knowledge related to fabrication (see Murphy, 2006 for example). To this end, UPDATE will set out to encourage teachers and student teachers to view technology education conceptually as well as procedurally.

Previous research has indicated that technology lessons across the developed world and in the upper school sector, have tended to orientate around the concept of craft skill development relating more to the perceived needs of industry (see for example Dakers, 2006; Dow 2006). These skills, such as those related to woodwork, metalwork, working in plastics or technical drawing skills, whether by hand or using computer aided design or computer aided manufacture, tend to emphasise the development of procedural knowledge over the development of conceptual knowledge. Even where more complex technological areas such as electronics, pneumatics, structures or computer control are studied, they tend to err towards the development of procedural knowledge. Procedural knowledge development in technology education is more concerned with teaching young people to become proficient users of technology in the form of using tools, machines, CAD packages etc., rather than becoming proficient in understanding the underlying conceptual issues resulting from technology use. In simplistic terms, the development of technological knowledge is more related to how to use technologies to achieve some required end, such as the development of a new technological innovation, fabricating a cloth pencil case or developing a nuclear bomb for example. The development of knowledge about technology, on the other hand, might considers the ethics of whether the development of cloning sheep might lead to human cloning or whether the skills acquired in the fabrication of a simple mechanism are internalised and so transferable (One author has argued elsewhere that they cannot. See Dakers, 2005).

Where design is incorporated into technology education we can begin to see opportunities for concept development, however, where this is taught as a "process," that is as a set of developmental procedures such as: 1) Define the problem; 2) Compose the design brief; 3) Undertake an investigation; 4) Develop alternative solutions…, we can see it being pulled back towards the development of procedural knowledge, or put another way, follow this set of procedures and a design solution will follow. Design is not simply a linear process that is stage dependent, each successive part relying upon the one before. Evidence suggests that it is a more complex process (see for example Barlex, 2004; and many others.)

Conceptual knowledge about technology requires a more developed understanding of issues relating to technology and its impact upon societies: it is more concerned about knowing that technology will do something and will, as a result, have consequences for human beings. The technology of electricity produced by nuclear power for example, has consequences. Unlike procedural knowledge which is rule driven, algorithmic and procedure driven, conceptual knowledge is about being able to understanding the relationships between the various different components, including human beings, that collectively form a system. Thus, learning about the various extant procedures involved in the generation of electricity using the technology of nuclear power, offers a somewhat contained and limited type of technological knowledge. By incorporating the development of an understanding of the various relationships between the nuclear power station, the costs of decommission, the consequences of poor maintenance, (think Chernobyl for example), the consequences for human beings that will serve to enrich and widen the learner's knowledge about that particular technological system, including the implications for humans. It is as a result of the syntheses of procedural and conceptual knowledge development that technological literacy can be developed.

The four UPDATE objectives

As has been seen then, four objectives arise out of the story thus far. Update proposes as a first objective to examine why girls drop out from technology education at different stages of their education. The reasons why few women choose technological fields for their further careers carriers and jobs, we argue, are rooted in their early years, and continuing continue through all stages of education. Therefore the problem has to be addressed already at the beginning phases of education. In concert with this, UPDATE proposes to examine how we might create new pedagogical frameworks that will go some way in making the image of technology education more attractive for both boys and girls. It will do this by embedding more concept development into the curriculum, at all stages of school technology education. As part of this, technology education and career pathways will be promoted in a girl friendly way by encouraging young women to take a more active interest in engineering and technology. New learning environments for technology education will be a necessary requirement in achieving this. Finally, this collaboration is aimed at building a European network for continuous Technology Education enhancement, supplemented with national networks. The network members will continue collaboration, collecting both research knowledge and best practices for creating models for innovative technology enhanced learning environments for boy's' and girl's' technology education. The main focus of the network lays on continuous improvement and change of technology teaching practices.

The research methodology for the primary sector

Analyses of the various technology curricula will aim to single out how technology education is carried out in different technology subject areas taught in elementary school. This will reveal whether a gender imbalance already exists at this age, and how this varies in different countries. Semi- structured interviews will be undertaken in order to establish the views of teachers and children about their attitudes toward technology, and the sources of these attitudes (home, media, kindergarten, toys, friends etc.) The objective is to analyse self image differences in boys and girls and to link them with the image of technology. Particular attention will be given to the views expressed by girls.

The best practices and ideas found in the technology content analysis, interviews, and the pilot case studies will be used to develop joint European ideas for an enhanced elementary school technology education curriculum, taking into consideration the developmental approach and gender-specific challenges.

Teacher training will be synergically involved in the project in all phases. This way the results obtained will be readily to hand and disseminated. Based upon the results of the previous research, the project partners will structure a new way of teaching and a new way of involving girls to be interested in technology. At this step it will be very important to work with student teachers to develop new pedagogical frameworks which will deliberately set out to encourage girls to study technology education.

During the project, new technology education ideas, based on the information change between the partners, as well as on the results of curriculum content analysis and interviews, will be tested in practicse. These experiments or case studies will be carried out as part of the teacher education programmes in the participating countries. The pilot case studies include evaluation of impact on attitudes towards technology, and results will be reported and shared with other partners.

Conclusions

Weber and Custer (2005), to whom we will give the last word, carried out a study recently in the United States on issues related to gender in technology education. Their findings resonate strongly with the issues raised by the European Union. Environmental and social issues relating to technology were found to be more appealing to girls than was the study of industrial technologies. Significantly, however, they found that:

> *"Pedagogical considerations are also critical to sound gender-balanced curriculum design. Research has found that there are instructional methods, learning styles, and interests that can be characterized as distinctively female. [ ] Females' preference for designing learning experiences and males' preference for utilizing learning experiences was consistent with gender stereotype research. Research indicates that females are more interested in design-oriented activities. This is particularly true when the design activities include a focus on problem solving or socially relevant issues" (67).*

References

- Barab S A & Duffy T M (2000)
  From Practice Fields to Communities of Practice
  In: David H Jonassen & Susan M Land. (Eds.)
  Theoretical Foundations of Learning Environments
  Lawrence Erlbaum Associates. New Jersey
- Barlex D (2004)
  Creativity in School Technology Education: A chorus of voices.
  In (Eds.) Howard Middleton, Margarita Pavlova and Dick Roebuck
  Learning for Innovation in Technology Education
  Griffith University. Brisbane
- Cole M (1996)
  Cultural Psychology: A Once and Future Discipline
  Cambridge, MA: The Bellknap Press of Harvard University Press
- Council of the European Union Council (2002)
  Detailed work programme on the follow-up of the objectives of Education and training systems in Europe
  In: Official Journal of the European Communities
  (2002/C 142/01).
- Dakers J (2001)
  Primary Teachers Confidence in Delivering Technology Education. In: (Eds) Benson C, Martin M, Till W
  Third International Primary Design and Technology Conference Proceedings. Birmingham. CRIPT. 50-54
- Dakers J & Dow W (2004)
  The problem with Transition in Technology Education: A Scottish Perspective.
  The Journal of Design and Technology Education. 9:2 116-124
- Dakers J (2005)
  Technology Education as Solo Activity or Socially Constructed Learning. International Journal of Technology and Design Education. V15. N1. pp.73-89
- Dakers J (2006)
  Towards a Philosophy for Technology Education
  In: Dakers J (Ed). (2006) Defining Technological Literacy: Towards an Epistemological Framework
  Palgrave MacMillan. New York. (pp.145-158)
- Dow J (2006)
  Implicit Theories: Their impact on Technology Education
  In: Dakers J (Ed). (2006). Defining Technological Literacy: Towards an Epistemological Framework
  Palgrave MacMillan. New York. (pp.239-250)
- Engeström Y, Miettinen R and Punamäki R (1999)
  Perspectives on activity theory
  New York/Cambridge: Cambridge University Press

- Eurostat:
  Götzfried, August (2004). Women, science and technology: Measuring recent progress towards gender equality
  In: Statistics in focus. Science and Technology
  Theme 9, 6/2004. Eurostat
  http://europa.eu.int/comm/research/science-society/women/wssi/pdf/stat-focus_en.pdf
- European Commission (2003)
  Implementation of "Education & Training 2010"
  Work Programme. Working Group D
  "Increasing Participation in Math, Sciences and Technology"
  Progress Report
- Harlen W (1996)
  Primary Teachers' Understanding in Science and its impact in the classroom.
  Paper presented at the British Educational Research Association's Annual Conference
  Lancaster, September 1996
  Scottish Council for Research into Education
- Harlen W & Holroyd C (1996)
  Primary Teachers' Understanding of Concepts in Science and Technology
  Interchange No. 34. Research and Intelligence Unit
- Lave J (1993)
  Situated Learning in Communities of Practice
  In: L B Resnick J
- M Levine & Teasley S D (Eds.)
  Perspectives on socially shared cognition
  American Psychological Association
  Washington. 17-36
- Lemke J (1997)
  Cognition, Context and Learning
  A social semiotic perspective
  In: Krishner D & Whitson J A (Eds.) Situated cognition, social, semiotic, and psychological perspectives
  Lawrence Erlbaum Associates. New Jersey. 37-56
- Matusov E (1998)
  When solo activity is not privileged:
  participation and internalisation models of development
  Human Development. Karger. 41: 326-349
- Murphy P (2006)
  Gender and Technology: Gender mediation in school knowledge construction
  In: Dakers J (Ed). (2006). Defining Technological Literacy: Towards an Epistemological Framework
  Palgrave MacMillan. New York. (pp.219-237)
- Nicholls G & Gardner J (1999)
  Pupils in Transition. Routlege. London
- Olson D R & Bruner J S (1996)
  Folk Psychology and Folk Pedagogy
  In Olson D R & Torrance N (Ed)
  The Handbook of Education and Human Development
  Blackwell, USA and UK
- Rogoff B (1990)
  Apprenticeships in Learning:
  Cognitive Development in Social Context
  Oxford University Press. New York.
- Stables K (1997)
  Critical Issues to consider when Introducing Technology Education into the Curriculum of Young Learners
  Journal of Technology Education. 8,2
- Vygotsky L S (1978)
  Mind in Society
  The Development of Higher Psychological Processes
  Harvard University Press. Massachusetts
- Walkerdine V (1997)
  Redefining the subject in situated cognition theory
  In: D Krishner & J A Whitson (Eds.) Situated cognition, social, semiotic, and psychological perspectives
  Lawrence Erlbaum Associates. New Jersey. 57-70
- Weber K & Custer R (2005)
  Gender-based Preferences toward Technology Education Content, Activities, and Instructional Methods
  Journal of Technology Education Vol. 16 No. 2 pp 55-71
- Wenger E (1998)
  Communities of Practice: Learning Meaning and Identity
  Cabridge University Press. Cambridge

Appendix

Partners of the project:

- University of Jyväskylä, Finland (Coordinator of the project)
- University of Glasgow, United Kingdom
- Teacher Training University Institute of Aix-Marseille, France
- "Alexandru Ioan Cuza" University of Iasi, Romania
- Ovidius University Constanta, Romania
- University of Tallinn, Estonia
- Dortmund University of Applied Science, Ada-Lovelace-Mentoring-Association, Germany
- University of Koblenz, Ada-Lovelace-Project, Germany
- Competence Center Technology, Diversity and Equal Chances, Germany
- Catalan Foundation for Research and Innovation, Spain
- Institute of Philosophy of the Slovak Academy of Sciences, Slovakia
- State College of Education in Vienna, Austria
- Regional Institute for Educational Research Marche, Italy
- Aristotle University, Dept. of Mechanical Engineering, Greece
- Central University of Complutense de Madrid, Spain
- IDEC S.A, Greece

A Reflection on Practice: Evaluating a Design and Technology Project

Anna Doorbar – E-mail adoorbar@sgfl.org.uk

Abstract

Before coordinators can support others in a school, they must be aware of the nature of the subject, and be able to reflect critically on their own practice. It is this reflection that will enable them to better support colleagues in their schools, to raise teaching and learning standards, and perhaps, most importantly, to offer opportunities for greater enjoyment for both teachers and children during design and technology sessions.

This is a summary of a piece of research that was carried out as an assignment for an MA course.

School Context

School A is a Church of England Primary School located in a deprived area within a city. It is 1.5 form entry, including a 35 place nursery. Design & technology (d&t) within the school has a very low profile and is in desperate need of attention as pointed out by the last OFSTED report:

> *"The weakness in the development of pupils' skills also explains why standards are unsatisfactory at the end of Year 6 in design and technology"*
> http://www.ofsted.gov.uk/reports/ Accessed January 2007

> *"Subject leadership and management are unsatisfactory. The coordinator ensures that resources are available but has done little to raise standards and deal with the issues raised in the last inspection. The weakness in design has not been recognised and a review of the curriculum, in the light of revised national requirements in 2000, has yet to be completed."*
> http://www.ofsted.gov.uk/reports/ Accessed January 2007

I joined the school as a newly qualified teacher, and became coordinator of d&t after a year. Subsequently I was given the opportunity to develop my own knowledge and understanding through attendance at an extended d&t course. After attending this d&t course, I decided to review and evaluate my own practice before supporting others in order to make a difference to the school. The unit that I decided to look at was unit 5a – Musical instruments. The children had covered a topic on sound (unit 5f) in science during the previous term as recommended by the QCA and had gained knowledge about producing and altering sounds through music lessons. This information will be used along with the research undertaken to critically look at the unit of work covered by the children in order to improve the teaching of design and technology in School A.

Data collection

Data for this research have been collected in a number of ways in order to be able to cross reference evidence: these include photos of the finished items, work completed by the children including an evaluation of their instrument, comments made by fellow teachers and thoughts and feelings of myself as the teacher completing the unit of work. Throughout this discussion, all names of children, schools and adults have been altered to ensure anonymity.

Other data was collected from children's diaries which they filled in during each lesson. I used their final evaluation for this research as I asked the children to reflect back over the whole project and to use notes made during each lesson to help. These diaries proved very useful. Hopkins (1993) points out that they are often different to the notes the teacher made on the same unit of work. This happened in this case. There are many other reasons why children's diaries can be extremely useful; however as Hopkins (1993) states in order to gain honest answers, rather than answers the children think you (teacher) want to hear, they have to have confidence in you and know that what ever they write will not come back on them.

Photographs were also used for this research to show and record the objects that the children made. Photographs are useful as they enable you to come back after the event and reflect upon this. Obviously photographs are only useful for those involved and those who are aware of the context in which they were taken as supported by Hopkins (1993).

Overview of the unit of work

I used the QCA unit of work as a basis for my plan, which was to be covered over 6 weeks. I decided to use each lesson to complete a sheet, all of which could be collated together to form a booklet.

I ensured that the programme had the 3 main sections, outlined in the National Curriculum; investigative, disassembly and evaluative activities (IDEA's), focused practical tasks (FPT) and design and make assignments (DMA).

IDEA's

For the IDEA's section the children investigated various instruments from our music trolley.

FPT

For the FPT section, the children looked at different ways of making sound; they looked at different materials that could be used as a skin over a container to tap; and they thought about other ways in which sounds could be made, and how we could reproduce these using materials around us.

DMA

For the DMA section, the children were asked to think carefully about what they had looked at and to decide on an instrument they would like to make. They were asked to go away and draw this instrument, thinking about what materials they wanted to use, how it would be put together and in what order they would need to assemble their instrument. They were asked to write out a set of instructions that they could come back to each week so that they could make their instrument successfully, and told that as part of the instruction they would need an "equipment" list. They then made their instruments.

Once their instrument had been made, they were given a list of questions to think about and answer about the instrument They also took a photograph with the instrument to go with into their evaluation.

Critical evaluation

The end product of this project was, in my view, disappointing in many ways. The products were finished poorly and lacked the quality I would have expected for children of that age. The following section will look at what helped the children in their learning but what did not work so well, offering a possible explanation as to why the outcome was not what I expected.

The QCA (1997) state that when the instruments are completed they could be used by the children to perform a piece of music. When initially planned, the aim was for the children to use their instrument to perform a musical composition but the project was done at a time when there was much pressure for assessments to be completed. But it was this lack of purpose, for making the instruments that led to the instruments being of a lower standard than I would have expected.

> *"A number of teachers described the increased motivation they had noticed as a result of their children knowing they were about to design and make a useful product." p.30 J Eggleston T&L D&T*

The fact that the children did not feel that there was a reason to make the instrument other than the fact that I had asked them meant that they would probably feel less motivated about producing it. Ritchie (1995, page 47) states that not only do the projects need to be relevant but they also need to be within a context that the children feel comfortable and enthused to complete the project:

> *"It is the context which often provided the motivation for successful work"*

This can be easily be achieved by using the world in which we live in for our context. Ritchie (1995) states that the creative teacher can easily exploit children's lives both in and out of school to find a meaningful starting point. Cross (1998) discusses the importance of making the task meaningful, stating that a child needs to understand the context or the situation of any D&T project which is why it is important that this context is familiar and meaningful to them. So if this project had been made more meaningful and purposeful for the children, I am certain they would have produced good quality, well thought-out instruments.

The plan for this project was to split it into 3 main sections; IDEA's, FPT, and DMA, to help both the teacher and the children. Benson (2000) suggests that these sections aid planning and help the teacher understand the process of designing teaching activities. Benson (2000) also stated that OFSTED (1997) supported this view of using these sections as they have a positive effect on the way that D&T is taught. From my view as a teacher, these 3 sections are extremely helpful, as they break it down into smaller chunks making it more accessible for both myself as a teacher, who has to teach it, and for the children, who will be making the item.

However, using these three sections means that each one is a separate process. Johnsey (2000) argues that it is not natural for children to design and then evaluate their object; these two processes often work alongside together throughout the project, but yet by using these sections, we are ultimately asking the children to do something that does nor occur "naturally" but we still expect them to produce an object which is of a high standard.

The children's evaluations show that all of the children changed some part of their instrument during the making process that was not there in the initial design, which supports Johnsey (2000) view.

Johnsey (2000) does discuss the good practice of allowing the children to handle and play with the materials needed in order to fully understand their properties and characteristics, so that when they design their object they can make informed choices about what to use.

This is surely what FPTs are all about. In this case the children handled and played with different materials to understand the different sounds they made, so that when they came to design their instrument they could use the right material to produce the sound they wanted. This is also highlighted in OFSTED's subject report 1999 – 2000, where under recommendations for 'improving the teaching of designing' it states

> *"In schools where the teaching of designing is successful, teachers:*

- *undertake systematic teaching of practical skills through clear instruction and demonstration, so that pupils know what is possible" http://www.ofsted.gov.uk/portal/site/Internet/menuitem.eace3f09a603f6d9c3172a8a08c08a0c/?vgnextoid=3938cc0eaaf3c010VgnVCM2000003607640aRCRD&vgnextchannel=ba60905884e3c010VgnVCM1000003507640aRCRD. Accessed January 2007*

As with any subject the quality of the end product is ultimately down to the teachers' subject knowledge: the better the knowledge and understanding the easier it is for the teacher to remove any misconceptions and teach new skills needed. I suppose part of this knowledge is to "predict the unpredictable". Shield (2000, page 58) states

> *"To be successful the teachers needed to be able to overcome the difficulty of preparing for the unpredictable. The solution to this problem appeared to be achieved through a confidence in their technical understanding and at the same time an ability to anticipate the problems the students were likely to meet"*

As the teacher, teaching this unit of work, I felt that I did have a fairly good technical understanding. However these proved incorrect, as when the children were struggling with why the sounds were not as they wanted, I struggled in helping them to solve these problems. So although Shield (2000) says that you can overcome this through anticipating problems, this is easier said than done.

It is not only the teachers' knowledge of the 'technical understanding', but also the best way in which to use the materials they have. Although the children had a free range over what materials they used, I did try to guide them towards what would be the easiest for them to use through the FPT's. Cross (1998) states that understanding materials is important in primary school D&T. This lack of understanding of how to use the materials needed, was reinforced in OFSTED's subject report 1999 – 2000, where they stated that most tasks used paper and card.

> *"The majority of designing and making tasks have required pupils only to use paper, card or wood; little work with food or textiles takes place" http://www.ofsted.gov.uk/portal/site/Internet/menuitem.eace3f09a603f6d9c3172a8a08c08a0c/?vgnextoid=3938cc0eaaf3c010VgnVCM2000003607640aRCRD&vgnextchannel=ba60905884e3c010VgnVCM1000003507640aRCRD. Accessed January 2007*

The report does make recommendations for 'improving the teaching of designing' and they point out that a major reason for the weakness we see in d&t is lack of teachers' knowledge and that they have few opportunities to improve these. This reinforces the point made that it is not only teachers' technical knowledge but their knowledge of the resources that need to be improved through staff development.

One of the main reasons that this project was chosen to be completed at this time was due to the knowledge gained in other curriculum areas that would be useful when designing their instrument. Johnsey (2000, p.24) states that

> *"design and technology is unique in that it is often dependant on using the knowledge and understanding learnt in other curriculum subjects. It is a subject in which pupils 'draw together and apply knowledge and understanding for other curriculum areas when forming practical solutions' (QCA/DfEE, 1999)"*

However as a part of his research he looked at how well children transfer this knowledge, and his findings were interesting. He concluded that children are not able to transfer this knowledge from one subject as easily as we often think. The child associates the knowledge solely within the curriculum area it is taught. This then makes teaching d&t very difficult, as mentioned earlier, because d&t relies on the transfer of the knowledge.

Ritchie (1995, p.60) also acknowledges that although there is a link between science and technology, not all work is related to it, but it can be if it is thought through appropriately:

> *"Despite the differences, design and Technology and Science can appropriately be taught in an integrated way in the primary sector".*

With the pressure teachers have to 'produce' results, it is no surprise that the importance of some curriculum areas, D&T, being one of them, is lower than that of Literacy, Numeracy, Science, ICT and currently PE. Benson (2000) agrees with this view as she acknowledges that d&t is not high on the government's agenda to improve. The responsibility lies with the person delivering the unit, to show the importance it has to them in order for the children to recognise its importance and worth.

Many teachers see d&t as a difficult subject if they do not have the knowledge, but as a subject it can provide extra opportunities for children to practice key skills such as working together, listening to others, and problem solving (Benson, 2000). Due to the nature of d&t, children often need to work in groups, which will involve listening to others' ideas and coming to a compromise, which are valuable life skills.

There is currently a high profile on problem solving and the application of knowledge to different contexts. D&t provides many opportunities for this. Essentially, d&t is real life problem solving. DATA in their leaflet "Why D&T?" state

> *"The subject calls for pupils to become autonomous and creative problem solvers, as individuals and members of teams, who must look for needs, wants and opportunities and respond to them by developing a range of ideas and making products and systems."*
> *http://web.data.org.uk/data/publications/index.php#why. Accessed January 2007*

This problem solving enables the children to prepare themselves for our ever changing world. Indeed, the inventor of the Dyson vacuum cleaner, James Dyson, has stated that D&T teaching in school is vital for our country's future (DATA).

Many of the children lacked the basic skills such as cutting, drawing accurate lines to follow and finishing techniques, which are stated in the QCA(1997) scheme of work (unit 5a) should be part of the children prior learning in previous years.

It was obvious from this that the children had little experience of these skills. This, I feel, is due to a lack of teacher knowledge mentioned in the school context, where many teachers felt they did not have the necessary skills to teach the children and in some cases, had never taught the subject at all. Johnsey (2000) believes that children should have a 'toolbox', in which they can dip into in order to complete the task more competently.

This toolbox involves not only skills in making but also in the design process. In this case, many of the children did not have this 'toolbox' in order to complete the task to a satisfactory level, but it is a factor to consider for the future, perhaps to produce a list of what a good 'toolbox' includes, so that it is a reference point for teachers.

Conclusion

From reviewing the work undertaken, views from staff, pupils and myself along with research from educators in this field show that this unit of work had both positive and negative aspects.

I think the major negative aspect that has been highlighted is that there was no purpose or meaning to the project. It had not been put into a context that was relevant or familiar to the children. This then disadvantaged the children before they had even started and will be a major factor that will be considered in the future.

The children's lack of experience of d&t and its context was neither their fault nor the teacher's fault: rather, it was a school issue. Although when planning this unit of work, this was a factor that I should have considered, in order to try to arrange for the children to get some of the experiences they needed in order to complete this unit of work.

I, like most teachers, am responsible for omitting or 'forgetting' to do certain aspects of the unit in order for the children to have more practical sessions making their object. This is obviously wrong and has a negative effect on the finished product, which in this case happened. I believed that I did have sufficient knowledge of both the technical understanding and the materials to complete this unit, but I was mistaken. This taught me a valuable lesson, and it is a mistake I will endeavour not to repeat in the future.

I did think that the planning was completed to a good standard and covered the 3 main sections that have been proven to work and are recommended by OFSTED. On reflection, it did help me to understand the process a lot better and made it easier for me to see where I wanted the children to go.

Although my view of the topic was not completely positive, the evaluations show that the children did enjoy making their instruments and that they were pleased with their end product and that they did produce a sound.

Implications for the future

Reviewing this unit of work has made me realise how much I need to improve my own practice in order to improve the d&t within the school and as a co-ordinator there are some issues that I need to address.

It is important that all units of work in d&t in the future will have a purpose and this will in turn make it meaningful for both the teacher and the children, which will increase the motivation and enthusiasm.

D&T provides for a great number of opportunities to link knowledge and understanding from a range of different subject areas – an issue that I (as a coordinator) will ensure is highlighted within the school.

I need to support teachers to raise their confidence and knowledge in d&t.

Once the teachers are more confident, I will need to review more carefully how resources are used. This research has proved extremely useful, as it has highlighted many aspects that I need to concentrate on, one being that my own practice has to change in order for me to support others and that every task needs to be set within a meaningful context for the children.

What do Mental Models Have to Offer the Primary Design and Technology Teacher?

James Cook University, Queensland, Australia
Christine Edwards-Leis – E-mail c.edwards_leis@bigpond.com

Abstract

The longitudinal project, Mental Models and Robotics, investigates twenty-five, eleven year old students and their teacher in a socio-economically diverse Australian urban primary school. It aims to establish how the identification of participants' mental models can assist in the authentic assessment of learning through a richer understanding of the cognitive development taking place in a technology-based learning experience. This paper discusses the mental models that students bring to a learning experience. It shows how addressing specific mental models through learning experiences in Design and Technology can provide students with the opportunity to develop functional mental models that will enable them to problem-solve independently. The implication for teachers in Design and Technology classrooms is that having clearer understandings of students' mental models enables appropriate intervention at the appropriate times so that students can become not only independent problem solvers but also better designers and makers.

Imagining robots

You are ten years old and your teacher has asked you to brainstorm 'robots'. If, like me, you have grown up in the sixties you might have written words and drawn pictures that described your robot as a levitating contraption that gave warnings of 'exterminate' in a metallic voice such as the *Daleks* who were the nemesis of *Dr Who*. If you had grown up in the seventies, your robot may have had golden anthropomorphic features and the ability to conduct intelligent conversation such as C3PO in Star Wars. A nineties child might have given their robot the added sophistication of synthetic skin and the ability to redesign itself at will such as the robotic creations in *Terminator.* These examples of media representations from different technological ages are part of our interactions with our environment that enable us to generate ideas and concepts. Exposure to a variety of stimuli and experiences help shape our view of the world and how we interact with and within it. They help us to create our mental models.

Defining mental models

Mental model theory was first used in cognitive research when Craik (1943) proposed them as an explanation for human thought processes. His research claimed that users of a system have a mental model of that system; a dynamic, individual representation of the reality of the system. His early work was taken up by others including Johnson-Laird (1983) who used mental model theory as an approach in research into text comprehension and reasoning. Johnson-Laird and others (Gentner 1998; Barker, van Schaik, & Hudson, 1998; Carroll & Olson, 1988) confirmed that mental models exist in order to understand real-world phenomena.

Our interactions with the world and motivational urges to engage are personal and idiosyncratic and so are the mental models we create (Greca & Moreira, 2000). Pitts (1994) defines them as 'cognitive constructions that are a network or web of related understandings' (p.23). They are cognitive representations and are created to reflect structures and concepts in our environment, the tasks and interactions we undertake, the problems we solve (Halford, 1993) and even abstractions such as truth and justice (Newton, 1996). They also contain reflections of problems, events, and stories that are imaginary (Byrne, 1992). Our mental models of robots from the sixties were certainly fiction-driven, but the increasing development of robotic technology in medicine, armaments, and scientific exploration has made these out-of-this-world scenarios more realistic for children growing up in today's world.

We are motivated by different needs and desires and the mental models that we create, while functional for us, may be unworkable for another. Regardless of this individualisation, one of the roles of mental models is their power to inform learners of the variety of sensible actions that are possible during any interaction (Bibby, 1992). While learners are interacting with any phenomenon, they are constantly running various mental models (Johnson-Laird, Oakhill, & Bull, 1986; Norman; 1983; Payne, 1991) which facilitate the investigation of alternatives in problem-solving (Carley & Palmquist, 1992; Renk, Branch & Chang, 1994).

The effectiveness of a mental model through the subsequent reflection of how a goal is met or a problem solved is associated with a learner's meta-ability (Anderson, Howe & Tolmie, 1996; Haycock & Fowler, 1996; Johnson-Laird et al., 1986) and their capacity to utilise short-term or working memory effectively (Anderson et al., 1996; Johnson-Laird et al., 1986; Newton, 1996). While mental models are stored in long-term memory (Gentner & Stevens, 1983), they are created and manipulated in working memory (Henderson & Tallman, 2006). The ability to access enough working memory to run the retrieved mental models is important for making inferences and relating propositions in problem-solving situations. Johnson-Laird et al. (1986) found that young children often experienced limitations in retrieving the necessary long-term memories, where mental models are stored, to relate to a domain. Therefore, mental model creation and manipulation may be limited if the relevant long-term or working-memory is not accessed effectively. Once retrieved, however, mental models help diminish working memory load because of their transferability from one situation to another (Halford, 1993).

To create a working definition of mental models would include the premise that they enable us to 'understand the world by constructing working models of it in our minds' (Henderson & Tallman, 2006, p.22). Barker, van Schaik, Hudson, and Meng Tan (1997) go so far as to suggest that mental models are important as they form the basis of all behaviour. Mental models work as memory retention and meaning-making devices that enable individuals to interact cognitively and physically with information, concepts, and relationships within a domain.

Returning to robots

Mental models have multiple functions that enable multiple environments and problems to be explored. While they are sometimes incomplete or inaccurate, (Johnson-Laird, 1983; Halford, 1993) they continue to aid our investigations or alternatives in problem-solving situations (Carley & Palmquist, 1992; Renk et al., 1994). Their individuality arises from their reflection of our personal interactions with the environment, a situation, a task, procedure, concept or phenomenon (Halford, 1993) such as robots. Before their first exposure to the robotics program, the twenty-five students in the study were asked to describe a robot. Many included multiple descriptions. Their responses are categorised in Figure 1 below.

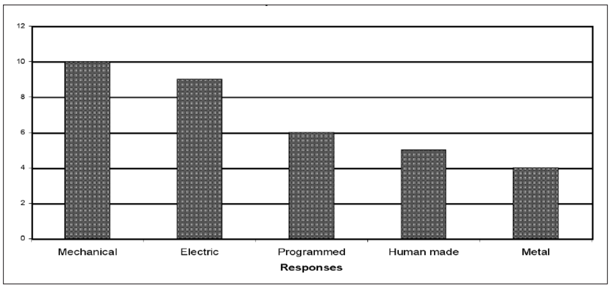


Figure 1. Descriptions of robots

Communication function of mental models

The students were 'exteriorising' (Barker et al., 1998) or externalising their mental models through their journals where they described their concept of a robot. The predominant responses, as shown in Figure 1, illustrate the students' mental models of robots were predominantly focussed on the mechanical and electrical aspects of the construction. The act of communicating one's mental model allows individual cognitive structures to be known to others and involves some externalisation either through discussion, writing, or drawing figures or concept maps (Williamson, 1999). While the students did not refer specifically to any media representation of a robot in their journal entry, their responses show that their mental models are based on previous experiences and exposure to robotic concepts.

Henderson and Tallman (2006) believe that the efficiency of teaching and learning may fail if the participants' (teachers and students) mental models are not ascertained. They propose brain-storming as a method of externalising the students' content knowledge as well as the relationships they have constructed linking various mental models in respect to a domain. Halford (1993) supports this belief and urges the examination of what students understand in any given domain, how they store and utilize that understanding and what we may be asking them to do with those mental models in proposed learning experiences. Mental models are the tools that enable this to happen.

Prior to their engagement with the robotics equipment, the students were asked to describe what robots do. Their multiple responses are shown in Figure 2.

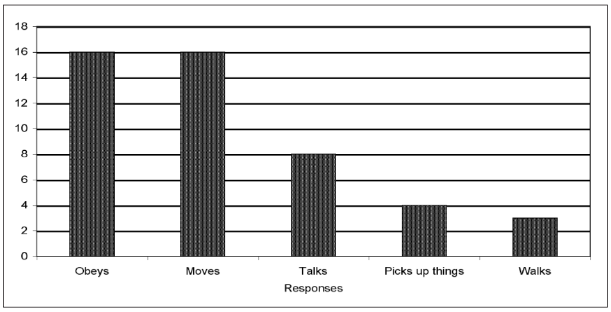


Figure 2. What robots do.

The responses illustrated the students' mental models of robots as 'helpers' or 'servants' that followed instructions (obeys) and completed tasks. While one student stated that a robot was 'a metal moving replica of a human', most of the students' mental models of a robot's function centred on the 'task completion' aspect of behaviour. Most of the tasks that students saw robots doing were household chores that they found onerous or time-consuming themselves. Their mental models were as yet unsophisticated enough to include industrial robotic functions. Their descriptions of robots and their uses externalised some of the mental models about robotics that the students were bringing to the experience. These particular mental models also had implications for how a robot would be built and programmed and particularly how information would be communicated to them.

Explanatory function of mental models

Mental models also have an explanatory function as they enable our cognitive and physical interactions with domains (Henderson & Tallman, 2006). They are the tools we use to understand and make choices in dealing with problems (Henderson & Tallman, 2006). When a learner is faced with a problem that must be solved, they retrieve the mental models that will enable them to understand the alternatives available to solve the problem and to validate the solution (Johnson-Laird, 1983). Mental models are both processes and products (Henderson & Tallman, 2006) because they enable a learner to both understand a situation and to take action in response to the demands of the task.

Prior to their engagement with the robotics equipment, the students (n=25) were asked to describe how we communicate with robots. While most of the students were certain that robots did not have human brains, some were uncertain of how instructions were given and received for task performance. The data revealed the following categories of responses as shown in Figure 3.

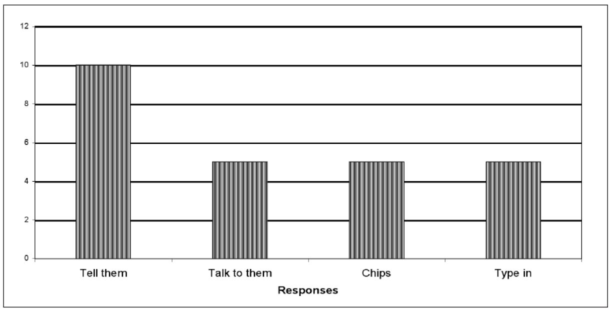


Figure 3. How we communicate with robots (A)

The students' mental models of communicating with robots included the concepts of providing instructions in one form or another in order to 'put it in their heads'. Very few students had a mental model of communicating with robots that matched the conceptual model of programming through infra-red (IR) technology, with responses ranging from using 'sign language' to using the 'right software on the computer'. The diversity of responses illustrated the students' novice explanatory mental models of robotics. This indicated to the teacher involved in the study that she would need to conduct a series of lessons that addressed these ineffectual mental models prior to any student engagement with the equipment. Stripling's (1995) research with library teachers and their programs, discussed how 'real learning' occurs when the mental models held by learners are 'restructured to include new ideas in a meaningful context' (p.165). She proposed that real learning can only happen if 'a learner is confronted with a contradiction, a new idea that cannot be incorporated into an old model' (p.166). In this case, the teacher conducted lessons to enable the students to incorporate new ideas on communication involving the three components of the robotics kit: the computer software, the infra-red, and the robot.

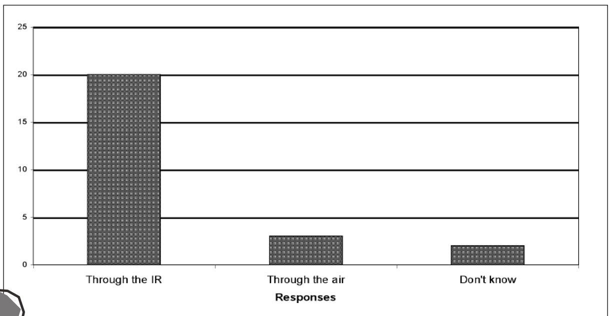


Figure 4. How we communicate with robots (B)

Following the planned experiences to introduce the students to the communication procedures with the robotics equipment, the students were asked once again how we communicate with robots and their responses are shown in Figure 4.

The students' responses indicate that they have altered their mental model of communicating with robots to include the transference of instructional information to the robot via the IR. While three students did not use the terminology of the IR, their mental model had been manipulated enough to include the concept of communication through the air. Two students may have altered their mental model from its previous state but were still operating with an incomplete mental model with their 'don't know' response. This may seem to be a good result for the majority of the students, but the reality is that two students would be engaging with the robotic equipment with unworkable mental models that would limit their predictive function.

Predictive functions of mental models

The predictive function of mental models involves student engaging with internal and external dialogue in problem situations. While mental models are created and reflected upon in working or short-term memory they are stored in long-term memory (Gentner & Stevens, 1983; Henderson & Tallman, 2006). Mental models are retrieved and run (Johnson-Laird et al., 1986; Norman, 1983; Payne, 1991) to find appropriate solutions. The more accurate and complete the mental model, the more predictive power it provides to guide possible scenarios suitable to the situation. Several mental models can be run simultaneously and any that prove ineffectual can be discarded or manipulated and refined in order that a workable solution is found.

Robotics is problem-based and learner-centred and involves students in a purposeful learning environment where they can construct their own meanings (Jonassen, 1995) and develop functional mental models (Norman, 1983) that inform them of sensible actions during the interaction (Bibby, 1992). The students should learn how a complex system operates by being better able to provide causal explanations (Milrad, 2002) for the robot's behaviour and being able to anticipate actions and explain the changes in programming or construction that are required for the desired action. If the predictive function of mental models is limited due to the inability to construct the causal relationship between the program and the operation of the robot, then student learning will be limited and their problem-solving efforts frustrated.

If we return to Stripling's (1995) idea of 'real learning' and how it occurs when a learner is confronted with an idea that can be incorporated into an existing mental model, we can see that for two of the students their potential for real learning is limited. The absence of a functional mental model of communicating with the robot has the potential to stifle their problem-solving efforts due to the decreased predictive power of the inaccurate mental model. The students may be holding a mental model of a Dalek when one that contains the abilities of the Terminator would be more appropriate!

Implications for design and technology classrooms

The mental models we create and manipulate are inherently epistemic (Norman, 1983) thereby forming the basis of how we express what we know. They are also personal and not easily comprehended by us, let alone known to others (Jonassen, 1995). However, the running of a mental model results in some physical action or performance (Jonassen, 1995) which can be observed, written down, or verbally communicated. Understanding their students' mental models enables teachers to identify what students already understand about the concepts they will be interacting with in the classroom (Stripling, 1995). This understanding enables a teacher to address erroneous or dysfunctional mental models which improves the relevance of learning experiences and student learning. Stripling (1995) goes as far to say that teachers 'will not succeed in changing students' limited or incorrect mental models unless the mental models themselves are addressed' (p.164).

How does a teacher determine the mental models her students are bringing to a new learning experience? From a sociological point of view, much of our knowledge is socially rather than individually constructed (Berger & Luckman, 1967). Our mental models, while individually created, are products and processes of our social and physical interactions with our environment and our internal and external dialogues. They can be externalised through discussion, debates, writing, and drawing: strategies that go beyond conducting a simple needs-analysis. Some teachers prefer to use regular journal entries that enable students to communicate their ideas and thoughts. Limited literacy ability may preclude some younger students from writing the necessary prose to communicate their mental models. In these cases, annotated sketches, already used by Design and Technology teachers, enable students to create a representation of their mental models of a domain or concept. Williamson (1999) found that concept mapping enabled students as young as nine years of age to demonstrate their 'cognitive knowledge accommodations' (p.29). Discussions can also illuminate the mental models of students. However, the ability to retain and reflect upon oral responses from a whole class may be an onerous task for most teachers. Whatever the strategy used, determining the mental models of students before, during, and after a learning experience enables the teacher to deliver instruction that ensures all students have the opportunity to develop functional mental models.

Re-imagining robots

It is 2007, you are ten years old and your teacher has asked you to brainstorm 'robots'. Your entire 'page' would probably be covered with words and graphical symbols that communicated your mental model of robots. This is what you would bring to the robotics, or Design and Technology, experience. Your page may be different from all others in the class, but what it represents is what you bring to the learning experience. From this moment, everything that happens in the classroom involves you manipulating, refining, or possibly discarding some notations, images, or links on your page. You will be generating more robust mental models that will enable you to understand the problems encountered, make choices between potential solutions, infer the probability of their success, and reflect on predicted outcomes. Your 'page' will help you communicate to others the learning journey you are experiencing through its display of the complex web of related understandings.

So, what do mental models have to offer the Primary Design and Technology teacher? Mental models offer the astute teacher an understanding of their students' imagining and re-imagining of a domain of knowledge. They enable the valuable communication of how students process knowledge and produce actions in relation to their problem solving activities in Design and Technology. Because mental models are individual and idiosyncratic, yet reflective of the real environment with which students interact, they permit teachers to plan for, mediate, and evaluate the learning journey of each student.

References

- Anderson T, Howe C & Tolmie A (1996)
  In J Oakhill & A Garnham (Eds.)
  Mental Models in Cognitive Science (pp. 247-273)
  East Sussex, UK: Psychology Press
- Barker P, van Schaik P & Hudson S (1998)
  Mental models and lifelong learning
  Innovations in Education and Training International
  35(4), 310–319
- Barker P, van Schaik P, Hudson S & Meng Tan C (1997)
  Mental models and their role in the teaching and learning of human-computer interaction. Retrieved February 25, 2004, from http://wheelie.tees.ac.uk/groups/isrg/papers/sedawc97/
- Berger P L & Luckmann T (1967)
  The Social Construction of Reality:
  A Treatise in the Sociology of Knowledge
  Garden City, NY: Doubleday
- Bibby P A (1992)
  Distributed knowledge: in the head, in the world or in the interaction. In Y Rogers, A Rutherford, & P A Bibby (Eds.),
  Models in the Mind:
  Theory, perspective and application (pp. 93-99)
  San Diego, CA: Academic Press Limited

- Byrne R (1992)
  The model theory of deduction
  In Y Rogers, A Rutherford & P Bibby (Eds.)
  Models in the mind:Theory, perspective and application (pp.11-28)
  London: Academic Press
- Carley K & Palmquist M (1992)
  Extracting, representing, and analyzing mental models
  Social Forces, 70(3), 601-636
- Carroll J M & Olson J R (1988)
  Mental models in human-computer interaction
  In M Helander (Ed.), Handbook of Human-Computer Interaction
  Amsterdam: Elsevier (North Holland).
- Craik K (1943)
  The Nature of Explanation
  Cambridge: CUP
- Gentner D (1998)
  Analogy. In W Bechtel & G Graham (Eds.)
  A companion to cognitive science (pp.107-113)
  Oxford: Blackwell
- Gentner D & Stevens A (Eds.) (1983)
  Mental Models. Hillsdale, NJ: LEA
- Greca I & Moreira M (2000)
  Mental models, conceptual models, and modeling
  In International Journal of Science Education, 22 1, 1-11
- Halford G S (1993)
  Children's understanding: The development of mental models
  Hillsdale, N.J.: Erlbaum
- Haycock A & Fowler D (1996)
  Mental models: Metacognitive structures
  Retrieved, December 30, 1998 from
  http://www.coe.uh.edu/insite/elec_pub/html1996/18theory.htm
- Henderson L & Tallman J (2006)
  Stimulated Recall and Mental Models
  Lanham, ML: Scarecrow Press, Inc
- Jonassen D H (1995)
  Operationalizing mental models: strategies for assessing mental models to support meaningful learning and design – supportive learning environments
  Pennsylvania State University. Retrieved November 26, 2003, from http://www.ittheory.com/jonassen2.htm
- Johnson-Laird P N (1983)
  Mental models: Towards a cognitive science of language, inference, and consciousness
  Cambridge: Cambridge University Press
  Cambridge, MA: Harvard University Press
- Johnson-Laird P N, Oakhill J & Bull D (1986)
  Children's syllogistic reasoning.
  The Quarterly Journal of Experimental Psychology
  38(A), 35-58
- Milrad M (2002)
  Using construction kits, modeling tools and system dynamics simulations to support collaborative discovery learning
  Educational Technology & Society, 5(4), (76-89)
- Newton D (1996)
  Causal situations in science:
  a model for supporting understanding
  In R Saljo (Ed.) Learning and Instruction
  6(3), (201-217)
  Great Britain: Elsevier Science Ltd
- Norman D A (1983)
  Some observations on mental models
  In D Gentner & A L Stevens (Eds.)
  Mental models
  Hillsdale, NJ: Lawrence Erlbaum Assoc
- Payne S (1991)
  Display-based action at the user interface
  International Journal of Man-Machine Studies 35, 275-289
- Pitts J M (1994)
  Personal understandings and mental models of information: A qualitative study of factors associated with the information seeking and use of adolescents.
  (Doctoral dissertation, The Florida State University, 1994.)
  Dissertation Abstracts International, 55(01), 4616A
- Renk J, Branch R & Chang E (1994)
  Visual information strategies in mental model development
  In D Beauchamp, R Braden & J Baca (Eds.)
  Visual Literacy in the Digital Age (pp.81-91)
  The International Visual Literacy Association
- Stripling B (1995)
  Learning-centered libraries:
  Implications from research
  School Library Media Quarterly, 23(3), 163-170
- Williamson J W (1999)
  Mental models of teaching:
  Case study of selected pre-service teachers enrolled in an introductory educational technology course
  (Doctoral dissertation, The University of Georgia, 1999)
  Athens, Georgia


A kite

The EdaDe in the Museum

PUC-PR – Pontifícia Universidade Católica do Paraná (Pontifical University Catholic of Paraná) Department of Design
UFPR – Universidade Federal do Paraná (Federal University of Paraná) Department of Design
UTFPR – Universidade Tecnológica Federal do Paraná (Federal University Technological of Paraná) Department of Design
Antônio Martiniano Fontoura – E-mail antonio.fontoura@pucpr.br Telephone +55 41 3342 2101or +55 41 99820772
Renato Bordenousky Filho – E-mail renato.b@pucpr.br

Abstract

This paper presents the results of the experience promoted by EdaDe – Education by Design associated with Heritage Education, developed in the Museum of the Pontifical Catholic University of Paraná, during the exhibition 'Dimensions of Design – 100 Classical Seats'. The exhibition took place in 2005 and it was brought to Brazil by the Göeth Institute. The experience was constituted by: oriented visitations, didactic materials related to the exhibition theme and EdaDe activities about design, history and material culture, conceived for children from Curitiba Primary schools.

Introduction

EdaDe or Education by Design is a pedagogic proposal that aims for the promotion and the formentation of the children's education by practical and reflective activities. The design in this context is understood as the human ability to create, to conceive and to build objects. In other words, it is the capacity that every human being has to transform ideas into reality, to materialize concepts. Under this point of view, we can say that all of us are designers.

The EdaDe proposal began with a doctorate research work accomplished frombetween 1999 to and 2002, in the Production Engineering Post-Graduate Program of Federal University of Santa Catarina (Brazil). The main objective of this research work was to investigate how the design cultures are formed. During the studies, we came across the educational field and identified the education as the best way to cultural propagation. We then focused our attention on the design of education for new generations.

In this paper we will show the EdaDE experience accomplished in the Museum of Pontifical Catholic University of Paraná, during the exhibition "Dimensions of Design – 100 Classical Seats", organized by Vitra Design Museum and promoted in Brazil by Göeth Institute. But before, we would like to consider some important words.

The Material Culture and the Design Culture

In 1871, Edward B Tylor (apud Larraya, 2003, p.25) affirmed that the word 'culture' could mean, in its wide ethnographic sense, as all complex that include knowledge, faiths, arts, moral, laws, habits or any other capacities acquired by the human being, as a member of a society.

We could understand the 'culture' as the group of all those procedures and human creations, not related to the natural instincts. The cultural environment includes the cities, villages, plantations, human relationships, habits, faiths, religions, music, technologies and the language.

Subsequently, our culture involves all things created by us, tangibles or not. It presents singularities that can vary from place to place. It is very interesting to observe that these singularities homogenize and characterize subcultures.

Allan G Johnson (apud DIAS, 2003, p.15), told us that 'culture' is the accumulated group of symbols, ideas and material products associated to a social system, a society or a family.

We can perceive that the creation of physical objects, artifacts, utensils, tools, furniture and buildings, makes part of the culture. From this understanding flows the concept of Material Culture. In other words, the Material Culture can be understood as the part of the culture or subculture represented by the workmanships and objects, created, built, used and consumed in that specific social context.

But, the Material Culture can be characterized as a way to well understand how the artifacts and objects are fit in symbolic and ideological wide systems.

Henry Glassie (1999, p.46) affirms that '… like a history, the artifact is a text, a way to show forms and a vehicle of meanings transmission'.

> *'The natural and the artificial things make part of human culture in such way that they represent social relationships, they carry values, thinks and emotions. But differently of the images, thoughts, speeches and texts, the things are not just representations; they have a physical presence in the world that provokes material consequences' (DANT, 1999, pp.1 – 2)*

The objects are, in this way, history tellers; they are vehicles of cultural and emotional transmission. They are not just colours, textures, raw materials, forms and functions. They are all these things and much more. They are histories, cultural contexts, emotions, sensorial experiences and corporal communications.

Actually, the Design Culture gets confused with the concept of Material Culture. The first one is implicit in the second. When we speak about the Design Culture, we are at the same time, referring to the group of human material creations (artifacts and objects) accomplished in a specific time and place and to the capacity developed by the members of that society to identify and to worship the practical, aesthetic and symbolic values of their creations.

To study design and to teach by design activities (tasks) exist ways of promoting the interaction between children and their own Material Culture and with the other people.

They learn by: observing, creating, analyzing, comparing, building, setting up, dismounting, registering, exploring, handling and studying the workmanship and objects from theirs and the other cultures.

The Heritage Education

The EdaDe can be promoted formally in the schools, by subjects (e.g. D&T in the British NC) or informally, by complementary programs, events and exhibition (e.g. the activities promoted by Design Museum in London).

In fact, besides the school, the museums are excellent places to promote EdaDe.

> *'All museums offer learn opportunities and entertainment. Education is one of the main functions of them. The effective management of the educational activities in museums can increase and progress those opportunities'* (Museums Galleries Commissions, 2001).

In these last years in Brazil, talks and discussions about the need and the importance of the 'Patrimonial Education' (Heritage Education) haves been developed. As HORTA1 (1999, p.6) the Patrimonial Education refers to "… an instrument of 'cultural literacy' that makes possible to the person to 'read' the world surround him, and to understand the social and cultural universe and the historical moment in that he or she is inserted".

We can understand 'patrimony' (in Portuguese) as all groups of natural or cultural goods with recognized importance in a specific place, lands, country or even for the humanity.

As still Horta (1999, p.9), 'the Patrimonial Education, can be applied at any material evidence or culture manifestation, be an object or group of goods, a monument or a historical or archeological place'.

The 'Patrimonial Education' is an ordinary practice in many European museums and happily, it has been more and more frequent in the Brazilian museums.

Without doubts, to exhibit objects (classic) of design and to offer monitored visits for children and youth is a way of the Patrimonial Education promotion. The EdaDe can contribute with this in a very special way;: elaborating and applying guided activities of design, during the visitation of the museum. Through them, the child can observe, learn and explore the cultural expressions. The student doesn't just visit the exhibition or see the collection; he or she gets a much more significant experience, in other words, a rich experience, replete of curiosity incentives and invitations to learning. The museum becomes something alive and dynamic; a place whose function is going besides the guard and conservation of the cultural goods; it becomes an active entertainment place and a learning offertory for the new generations.

In this context, the EdaDe and the Patrimonial Education become the same thing. They begin to have common objectives, that is, to create occasions to learn about the cultural process, their products and manifestations. These occasions increase the students' interests to solving significant problems of their personal or collective life.

The resulting products of the cultural process can serve as valuable information sources about the social relationships and the historical context in which they were produced, used and endowed with meanings. A complex system of relationships and connections are formed around the objects (relationships and connections of meanings, of creation processes, of production, of changes, of commercialization and of uses). To discover and to know this system, allows the person to give sense to the cultural evidences and to find out the way of the people's lives in the past and in the present, in a continuous cycle and transformer.

The Exhibition

Thinking about its educational function, the PUC Museum, by its Cultural department, accepted to include a complementary program of EdaDe, during the period of the exhibition called 'Designmaßstäbe 100 klassische Sitzmöbel', originally organized by Vitra Design Museum, Weil am Rhein, Germany.

The exhibition had an itinerant character and was already in Asia, Africa, Europe and America. It was conceived originally by Alexander Von VEGESACK and Matthias KRIES and organized by the German designer and architect Dieter THIEL. In that, a hundred miniatures of classic chairs were presented in a reduced scale (1:6). The miniatures were made by the Poles Miroslav MELERSKI and Thomas SCHWEIKERT. Among them some seats were designed before the year 1900 and others during the 20th century.

The exhibition was brought to Paraná by the Goethe Institute of Curitiba. The German trusteeship of the exhibition was of Matthias KRIES and in Curitiba was of the lecturer and designer Ivens FONTOURA. In Brazil, the exhibition was called 'Paradigmas do Design 100 Cadeiras clássicas' [Paradigms of the Design 100 Classic Chairs] and this was the first time that was offered a parallel education program was offered to the exhibition.

We know that the miniaturization always attracted and it continues to attract the attention of children all over the world. It seems that the universe is in their hands.

To play with little cars, dolls, little lead soldiers, dolls houses, in other words, to interact with smaller objects, which represent the real world, make part of the childhood of all of us.

The fact that the PUC Museum was exposing miniatures of classic design was a good opportunity to put into practice the EdaDe principles.

EdaDe uses in its practices, investigative activities, practical tasks and design and make assignments (Fontoura, 2002). To execute those tasks and to study the exposed miniatures was a way to facilitate the perception and the understanding of the facts and cultural phenomena related to the objects that they represents.

We believe that the ability to read objects, in this case, the miniatures of classic chairs, enlarges the human capacity to understand the world and it must be developed.

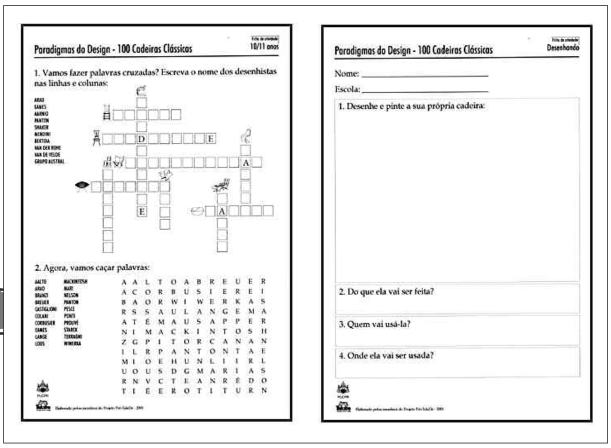
> *'Each product of the human creation, be utilitarian, artistic or symbolic, makes senses and has meanings. How to read and to decode its forms, contents and expressions should be learned'.* (Horta, 1999, p.9).

The EdaDe Activities

We tried to conceive some simple tasks, but significant, that should promote interactions among the children, the miniatures and the space of exhibition. It was also elaborated some by illustrated boards, printable charts and didactic games. In the elaboration and choice process of those materials, tasks and procedures of the monitored visits, was considered the age groups of children and the curriculum contents of the first four years of our primary school. We should point out that those decisions didn't impede the oldest children from playing and using the developed resources.

The proposed tasks can be classified as investigative activities. The tasks aim to develop the capacity of observation, to enrich the repertoire and the vocabulary of children, and to enlarge their knowledge about design. The exposed miniatures, the exhibition space, the developed resources, were the means used to promote the EdaDe experience in the Museum.

Figure 1. Example of a task chart



Four task charts were elaborated (Figure 1), one for children with 6 and 7 years old, one for children with 8 and 9 years old, one for children with 10 and 11 years old, and another that invited children of all ages to design their own chair. All charts were made in B&W to facilitate the reproductions in copy machines.

For instance, one of the proposed tasks was to seek in the exhibition a specific chair model among those exposed. When the chair was found, the children could stamp its image in another special chart received at the beginning of the visit. In this chart there were spaces to write pieces of information about the chair investigated. This was one of the ways used to motivate the oldest pupils during the visit.

Three games were designed and made (Figure 2), they were illustrated with pictures of exposed miniatures. For instance, in the 'memory game', pieces were there: the identification of chair, its year of creation and the name of its designer.

Figure 2. Games elaborated – 'memory game', 'domino' and 'gather and classify game'

A PowerPoint presentation about design for children was produced (Figure 3). Through the images presented (historic photographs) the objective was to show the context in which the chairs were conceived. It was also tried to establish, through examples, a possible 'taxonomy' of chairs (Figure 4).

Figure 3. Example of slide presentation used – Before 1900

Figure 4. Example of slide presentation used – Chair 'taxonomy'

It was necessary to qualify helpers and tutors to accompany the visitors. Among them students from PUC-PR and volunteers from other Educational Institutes were chosen. To train them, another PowerPoint presentation and printed materials about the exposition, history and design were made. The instruction happened in the Museum area before the opening day. Charts in A4 format illustrated with images of chairs, materials, technologies, chair 'taxonomy' and other pieces of information that should be used as didactic support were also made (Figure 5).

Figure 5. Example of chart illustrated – Similar but different.

Conclusion

Invitations were sent to primary schools (public and private) from in the Curitiba urban area. The EdaDe activities in the Museum were made available in the local newspapers. Visits should be scheduled with some anticipation. Lamentably the return was low in relation to the organizers' expectations. Even so, it was possible to apply the elaborated material, to accompany some visits and to evaluate the results of the proposed work.

Among the observations that were made, maybe the most important was: the receptivity and the children's active involvement during the visitations, which proved the validity of promoting the Patrimonial Education and the EdaDe.

References

- Centre Pompidou
  L'objet – qu'est-ce qu'un? Paris:
  Centre Pompidou / Dizajn, 2000
- Dant T
  Material culture in the social word
  Filadelfia: Open University, 1999
- Dias R
  Cultura organizacional
  Campinas: Alinea, 2003
- Durbin G et al
  Learning from objects
  s.l.: English Heritage, 1996
- Fontoura A M EdaDe
  educação de crianças e jovens através do design
  Florianópolis, 2002. 337p. Tese
  (Doutorado em Engenharia da Produção) –
  Programa de Pós-Graduação em Engenharia de Produção,
  UFSC, 2002
- Glassie H
  Material Culture. Indianápolis
  Indiana University, 1999
- Horta M L P et al
  Guia básico de educação patrimonial
  Brasília: Instituto do Patrimônio Histórico e Artístico Nacional
  Museu Imperial, 1999
- Laraia R & Cultura B
  um conceito antropológico
  Rio de Janeiro: Jorge Zahar, 2003
- Museums Galleries Commission
  Educação em museus. São Paulo
  Edusp / Fundação Vitae, 2001
- Science Museum
  Exploring design and technology. Londres
  Design Museum, s.d.
- Victoria and Albert Museum
  The 20th century gallery
  Londres: V&A, 1996
- Vitra Design Museum
  Dimensions of design – 100 classical seats
  Weil am Rhein : VDM / Goethe Institut, 1997

The Starting Point Approach to Design and Technology in Action – An Examination

University of Greenwich, Old Royal Naval College, Park Row, Greenwich, London SE10 9LS, United Kingdom
Keith Good – E-mail k.w.good@gre.ac.uk Telephone 01580 765601
University of Oulu, Finland
Esa-Matti Järvinen –

Abstract

This study examines the starting point approach (spa) to design and technology. This is intended to maximize creativity while being manageable for the teacher. The purpose of the study was to examine whether the children could do what the approach requires and in particular whether it promoted their innovative thinking. Data were collected during teaching sessions with 27 Year 6 children in London and rural Finland (ages 11 – 12). The theoretical framework of the study is qualitative in nature.

The participant researchers videoed sessions in their respective countries, that were taught to an agreed 'script'. This included guided brainstorming chaired by the researchers. Children were introduced to some technology and explored its use in the wider world. They were then shown how to make their own working example that was the starting point for their designing. After brainstorming, children went on to develop a wide variety of different projects of their choice.

In the UK and Finland, all children in a class are usually required to design products with the same purpose. In the study, the starting point approach allowed the children to design products with many different purposes within one class. They developed the starting point to fit with their own experience and interests or the needs of others around them. A major advantage of the spa is that it seems to reconcile the apparently conflicting demands of teaching specific skills and knowledge with whilst encouraging individuals to be as creative as possible. The common starting point was crucial to making this feasible.

Introduction

Creativity is arguably central to design and technology and much has been published on this (Kimbell, 2001; Spendlove, 2003; Davies and Howe, 2004). It is sometimes associated with genius but there are other interpretations. Benson (2004:138) writes that while teachers may have a future Picasso or Freud in their class, it is more likely that they will have children who have 'an original idea or solution that is original to themselves and not necessarily totally original'. This is what Craft (2002) calls the 'little c' – creativity that is within the reach of all children. The study described in this paper was based on the premise that all children are capable of a degree of creativity in identifying design problems and generating solutions to them.

The approach featured in this study had been used increasingly in the researchers' work with children, students and serving teachers in the UK and Finland. The spa model was used by Good (1987, 1988) and more extensively in his Design Challenge series of books (Good: 1999a, 1999b, 1999c, 1999d, 2000).

Most primary schools in England follow the Qualifications and Curriculum Authority (QCA,1988) schemes where the outcomes in a class all have the same purpose, for example the children are told to 'design a photograph frame'. In Finland one can see hangovers from handicraft education where pupils make artefacts almost to a 'recipe'. However, during the recent revision of the Finnish compulsory curriculum, technology was introduced as a cross curricular theme where children develop ideas and evaluate them.

The Starting Point Approach

The spa has some specific features which distinguish it from approaches where outcomes have a common purpose. In the spa, children are first introduced to specific technology and its applications in society. Then they are taught to make their own working example of this starting point, gaining knowledge and skills in the process. This involves what English teachers recognize as teaching "focused practical tasks". In the spa the resulting practical work is the starting point for designing. During group brainstorming led by the teacher, children develop a wide variety of different ideas for using the starting point. Unlike the usual approaches in the UK and Finland, some making precedes designing and children can design 'what they like,' as long as it is based on the starting point. The children have to select their favourite idea to make and evaluate. The spa seems to reconcile the apparently conflicting demands of teaching specific skills and knowledge with whilst encouraging individuals to be as creative as possible. The common starting point is intended to provide stimulus for the children and make diverse projects feasible for the teacher.

Purpose of the study

Essentially, the authors asked whether the children could do what the approach asked of them and if it helped them to develop projects with different purposes within the group.

Methods of inquiry

The theoretical framework of the study was qualitative in nature and based on interpretative skills and inductive analysis, whereby the researchers continually explored the relationship between data and emergent findings (Ritchie & Hampson, 1996). The chosen starting point was a pressure sensitive switch made from card and kitchen foil. The study included an open search for children's emerging ideas for ways to make a pressure pad go on. The researchers also wanted to see whether the children could apply this starting point in innovative and creative ways in their own environment.

The UK children taking part were from urban schools in the Children's University at the University of Greenwich. There were

16 children in the group, aged 11 – 12 years. The Finnish children were from Karhukangas Primary School, a small rural school in Haapavesi Township. All 11 children from classes 5 – 6 (11 – 12 year olds) participated in the study. Studies in UK and Finland were conducted following an agreed 'script' that was believed to epitomize the spa. It was seen as important that the children knew from the outset that they would be asked for ideas for using the pressure pad. This was so that subsequent activities could be used as stimulus and to give maximum time for ideas to emerge.

Phase 1
The basic concept of a switch was discussed. The children were shown a pressure pad and how to make their own working one.

Phase 2
The children were shown how the pressure pad worked and its characteristics. It was hoped that ideas might be provoked by focusing on the special qualities of the pressure pad, for example., toughness, thinness, operated by pressure. Every child then followed instructions to make their own pressure pads.

Phase 3
The children were asked to think of where pressure pads were used in everyday life and their ideas were recorded on a flip chart. This was intended to consolidate the concept of a pressure pad and allow one idea to provoke others. The researchers then encouraged the children to brainstorm as many ways as possible to make the pressure pad switch go on.

Phase 4
During the final brainstorming, children were encouraged to generate lots of new ideas for using a pressure pad. Again, the flipchart was used for recording purposes. These ideas were intended to stimulate design and make projects of their choice.

The research was focused on the following questions:
- Could children identify the existing uses of pressure pads in the world around them?
- Could children generate ways to turn pressure pads on in different ways?
- Could children find possible uses for their pressure pads?

The researchers assumed the role of participant observers. This procedure enabled them to be 'inside' the study, true to the nature of qualitative research (Erickson, 1986).

Data collected included brainstorming recorded on a flipchart, the children's notes and drawings and, photographs of the children's practical outcomes.

Analysis and results

Verbatim transcriptions were derived from the video recordings. Data examples presented in this article were analyzed by both researchers individually and also in the collaborative discussion in which the final interpretations were developed (see Ritchie & Hampson, 1996).

Empirical Assertion 1: The children are able to find existing uses for pressure pads in the world around them
The Finnish children came up with the following examples:
- Scales (weighing fruit, etc., in supermarkets).
- Car radios.
- Shop tills.
- Control panel for milking machine and feeding control in barn.
- Motor workshop – used to control engine hoist.
- Digital cameras.
- Cash point machines.

The English children came up with:
- Cash machines.
- Light switch.
- Mobile phone.
- TV remote.

Commentary

These examples demonstrate that the contributing children are able to find existing uses for pressure pads in the world around them and that the basic idea of the pressure pad was understood. The child who identified the pressure pads in the family barn could see the importance of the technology he was being asked to 'design with'. His understanding of the technology in his surroundings had also increased.

Empirical Assertion 2: The children are able to generate a wide range of ideas for turning the pressure pad on in different ways.
When asked to think of different ways to turn the pressure pad switch on, the Finnish children came up with the following ideas:
- Turn it over.
- Step on it.
- Lean on it.
- Knock on it.
- Put something on it.
- Throw something at it.
- Somersault on it.
- Blow on it.
- Drop something on it.
- Drive over it.
- Put a can on it, when rains fills it – the switch goes on.
- Put it between pages of a book.

The English children came up with the following ideas:
- Step on it.
- Sit on it.

- Squeeze it.
- Pinch it.
- Head butt it.
- Put some weight on it.
- Belly flop on it.
- Elbow it.
- Punch it.
- Touch it with your tongue.
- 'Fart on it'.
- Flick it.
- Kneel on it.
- Kick it.
- Throw it against the wall.
- Blow on it.
- Stamp on it.
- Drop something on it.
- Squirt water on it.
- Slap it.
- Run over it.
- Tiptoe on it.
- Close the window on it.
- Lay on it.

These were added to the flipchart and some were acted out by the teacher researchers to reinforce the suggestions.

Commentary

These ideas did not rely on previous knowledge or experience since the starting point was new to the children. They were already being creative as they came up with plenty of ways to close the circuit with the pressure pad, including possibly novel and innovative ones. This was important as it gave a fertile basis for generating ideas for using the pressure pad later. Some unusual or less obvious ideas came up, for example the Finnish child's: 'put a can on it, when rains fills it to a certain extent – the switch goes on.' The English child's 'throw the pressure pad against the wall', shows an interesting reversal of the normal pressing or throwing things onto the switch. Michalko (2001) devotes a whole chapter to reversal in his text on idea generation.

Empirical Assertion 3: The children are able to find possible uses for the pressure pad switch in their own environment.
When asked to think of as many uses as possible for the pressure pad switch, the Finnish children came up with the following ideas:

- Doorbell.
- Burglar alarm.
- It could be used in a game – a target on a wall.
- Under bicycle tyre (e.g. to warn of theft).
- It could tell you it was raining.
- A wind meter.
- Tell when you have fallen out of bed.
- Could tell you when something was full.
- Put pressure pad in door handle (to warn of sleepwalking).
- Knocking doorbell.
- Used inside the mailbox to tell when newspaper has arrived-indicates inside the house.
- Put on bird table to tell when birds come.
- Warns that a car is at your gate and you need to go and open it.
- To control a torch.

The English children came up with the following ideas:

- Control a remote control car.
- Under the door mat to turn on a tape recorder to scare people at Halloween.
- Stand a glass on the pressure pad to keep a night light on if you're scared in the dark. You could easily find your drink and you could use it as a light to help you read.
- An automatic door bell that no one would need to ring it and you'd know people were there… hide it under the mat.
- Put a weight on it and it'd give you light to work in the garden at night.
- A car goes over it and the bulb come on instead of speed cameras.
- Use it to tell which model car has won as they roll down a slope.
- A game for children. like a play mat.
- When they stop a lorry (truck), they might want the light on.
- If a driver was really tired there could be a buzzer to wake him when he drops off.
- A burglar alarm that goes off if the window shuts.
- When burglars put their hand in the letter box the thing would go off.
- Detecting when a dog gets out of its basket when it has been told to stay in.

Commentary

These 27 examples seem to show that the children were able to combine the concept and functioning of a pressure pad to produce innovative product ideas. Importantly, some of the children's ideas can be regarded as innovative, feasible and a basis for actual projects. Sometimes ideas came up that could not be made to work, at least at first sight. This was often because the essential nature of the pressure pad had been forgotten, for example pressure is needed so sound activation was impractical. The children were encouraged not to dismiss ideas too readily and sometimes an apparently impractical idea could be made to work with some creative thinking. It must also be realised that each idea listed could be the starting point for very many different designs. The children went on to explore these ideas through drawings, modelling and discussion and some were made into finished artefacts.

In idea 11, the child applies the idea of the pressure pad to the context of a mailbox and remote sensing. In Finland it is common for mailboxes to be at the boundary of a property. In this idea, a pressure pad in the mailbox would make a buzzer sound when the mail arrives, so alerting the householder. This idea was clearly related to her needs and she connected two existing products in an innovative way. This is an example of combinational creativity. Michalko (2001) devotes a chapter in his book on idea generating strategies to making novel combinations. It seems that the 'mailbox child' did this naturally. In this case, the Finnish teacher/ researcher, knew the context and so was able to appreciate the usefulness of idea. However, teachers may sometimes need to get children to explain the context for their ideas if they are to appreciate them.

Discussion

The data indicated that the children were able to make meaningful connections between their pressure pad and the world around them. This in itself has value, demystifying the technology by having the children build their own. When they were making the pressure pads, the children acquired information and skills on basic issues in electricity.

It was evident from the data that some of the children were able, at least to some extent, to apply the pressure pads in a creative and innovative manner as a response to the problems they identified for themselves. Importantly, it was not known beforehand what applications of pressure pads would emerge from the children's creative minds. The technological process did not just aim at discovery (as in science), but rather and more essentially, at children's innovations. In this regard, many of the children who took part in the study acted in accordance with the idea put forward by Adams (1993: 87): 'Successful inventors that I know are extremely problem-sensitive. They are tuned to the little inconveniences or hardships in life that can be addressed by the technology they know.'

Teaching technology should not be mere study of how technology works. Children need to be given opportunities for creative and innovative action. This is why the researchers wanted to focus the study on the innovative use of pressure pads in applications arising from the pupils' own ideas. This relates also to the concept of situated learning (Lave, 1988).

The spa seems to facilitate children's creativity in technology education to a greater extent than an approach where the purpose of the project is specified by the teacher. However, it is not so open that children have to search for a need or problem to solve without any support. The authors do not claim that using the spa is the only worthwhile approach to technology teaching nor that the applied method is the only way to foster children's innovativeness. Care should be taken that spa does not preclude children to identifying needs and problems without the support of a starting point. Less confident teachers may feel that they need to know the purpose of the children's projects in advance.

However it seems to the researchers that the spa offers a compromise between what the teacher and student can manage, what needs to be taught and what the student would choose to do. By giving opportunities for students to identify their own problems and design their own solutions, the spa seems likely to increase their perception of technology education as relevant. This approach is primarily aimed at maximizing creativity but it may also help motivation and behaviour. The children can be said to have greater ownership than when the purpose of projects is are imposed. The spa seems to offer a way of allowing individual children to identify their own design problems and for outcomes with different purposes to be designed and made within a class. Thanks to the shared starting point, this can be done while maintaining the sanity of the teacher.

References

- Adams J L 1993
  Flying Buttresses, Entropy, and O-Rings
  The World of an Engineer
  Cambridge (MA). Harvard University Press
- Benson C 2004
  Professor John Eggleston Memorial Lecture 2004
  Creativity Caught or Taught?
  DATA, 9(3) 138-144
- Craft A 2002
  Creativity and Early Years Education
  Continuum, London
- Davies D & Howe A
  How to Trainee Primary Teachers Understand Creativity?
  In: Norman E W L, Spendlove D, Grover P & Mitchell A eds.
  Creativity and Innovation –
  DATA International Research Conference 2004
  Warwickshire: DATA. 41-54
- DFEE & QCA 2004
  Department for Education and Employment and Qualifications and Curriculum Authority, Design and Technology. The National Curriculum for England. London: Department for Education and Employment.
- Erickson F 1986
  Qualitative Methods in Research on Teaching
  In: M.C. Wittrock (Ed.), Handbook of Research on Teaching
  Third Edition (pp.119-161)
  New York, NY: Macmillan Library Reference

- Good K 1987
  Starting CDT
  London, Heinemann
- Good K 1988
  Starting CDT- Projects
  London, Heinemann
- Good K 1999a
  Exciting Electrics
  London, Evans
- Good K 1999b
  Amazing Machines
  London, Evans
- Good K 1999c
  Moulding Materials
  London, Evans
- Good K 1999d
  Super Structures
  London, Evans
- Good K 2000
  Design Challenge Teacher's Book
  London, Evans
- Kimbell R 2001
  Creativity, Risk and the Curriculum
  DATA, 5(1), 3-4
- Lave J 1988
  Cognition in Practice
  Mind, mathematics and culture in everyday life
  New York, NY: Cambridge University Press
- Michalko M 2001
  Cracking Creativity
  California: Ten Speed Press
- QCA 1998
  Design and Technology:
  Scheme of Work for Key Stages 1 and 2
  London: QCA
- Ritchie S M & Hampson B 1996
  Learning in the Making: A Case Study of Science and
  Technology Projects in a Year Six Classroom
  Research in Science Education, 26, 391-407
- Spendlove D 2003
  Gendered perceptions of Creativity and Design and Technology
  In Spendlove D & Norman E W L, eds.
  DATA International Research Conference 2003
  DATA, 2003.99-106

Playing with Designing: Ways in Which Young Children's Play Influences their Capabilities as Emergent Designers

Canterbury Christ Church University College, Canterbury, Kent, England
Gill Hope – E-mail gh21@cant.ac.uk   Telephone 01795 474959

Abstract

This paper reports on observations of how children's early play styles and role-playing experiences impact on their emerging design capabilities.

Young children actively engage in 'being' a whole number of adult roles: postman, taxi driver, and so on. They have skills that will enable then to 'be designers': knowledge of how things come apart in their hands, how to construct products from components (e.g. Lego), how things look from different angles, and how different materials respond under pressure. Plus they have cognitive skills that are important for emergent designers (imaging, wondering, tolerating ambiguity).

Gender differences appeared in the way design activities were tackled that were reflections of the observations of different play styles at a younger age. There appears also a strong correlation between the play opportunities provided in school and the way in which design tasks were tackled. The paper concludes with suggestions for encouraging emergent designers to develop their design capabilities.

Introduction

The UK National Primary Strategy 'Excellence and Enjoyment' has triggered changes in many Key Stage 1 classrooms. Building on good practice in Foundation Stage, many Year 1 children spend part of their day engaged in child-initiated activity. Play is now seen once again as a vehicle for learning. For those of us old enough to have been teaching in the 1970s there is a strong sense of déjà vu. For example:

> *"play is the principle means of learning in early childhood… children gradually develop concepts of causal relationships, the power to discriminate, to make judgements, to analyse and synthesize, to imagine and to formulate. (DES 1967: para. 523)*

> *"Although accepting that children learn and develop through play and that play is a motivating force for children's learning, many teachers are pressurized by the very full first school curriculum and large classes to neglect play as a means of teaching" (Manning & Sharp, 1977: 7)*

In such literature on children's play, categories such as sensory-motor, dramatic, fantasy and constructive were used to classify the kinds of activities in which children were involved (Factor, 2004). Inherent in many of these activities are the skills of the designer and many of the statements from the literature on young children's play have resonance with the language of designing. For example:

> *"Play is so dramatic and fun partly because it shows us that the meaning of any object is not clear-cut and definitive. It contains some ambiguity, uncertainty and capriciousness, and it is subject to change due to social action." (Berg, 1999: 16, his italics)*

This improvisational aspects of children's play, in which reality and fantasy are blended and stretched, often collectively (Lobman, 2003) also parallels the best of design practice. Dillon and Howe (2003) reject both linear and cyclic models of design because both are "flat" and down-play creativity, chance and serendipity, preferring to see design as narrative, as an unfolding story, which mirrors children's play scripts. Ken Baynes's (1989) memorable phrase 'designerly play' neatly expresses the purposive nature inherent in many activities undertaken by young children exploring both physical and social worlds.

Playing at being a designer

Children play at being all sorts of roles: a postman, a nurse, a wizard, a monster. To be a postman demands understanding of what the role entails, a few props (a suitable bag and some envelopes) and some imagination (chair-arms and or sideboard drawers as letter boxes). To be a wizard might demand the re-arrangement of the entire room into a cave, draping everything with sheets, taking bowls and spoons and accomplices (dolls) inside; the whole structure being totally private and to last for ever.

Constructing this alternative world is just one aspect of designerly play. Playing with cars, dolls, trains, farms and other small toys enables children to have control over a complete environment. Cutting and folding paper creates new worlds from simple materials (Kress.1997). For example, a boy in my Year 1 class brought a 'ghost' to school that he had made at home. It was simply a scrunched up tissue with another tissue draped over, tied with thin elastic, long enough to hold and bounce the ghost in the air. By 10 o'clock everyone in the class had one and were creating ghostly dialogues.

Designers need to be able to tolerate ambiguity, to make one thing stand for another, to imagine possible outcomes and be accepting of the ones that work, and to move freely between fantasy and the everyday world (Stables, 1992). These skills, along with negotiating with others, assigning and accepting roles within shared action, agreeing to solutions proposed by others, and other group skills essential for working in design teams are honed in role play corners, play grounds and back gardens.

Being able to turn things around in the mind's eye, to imagine an object upside down, deciding if it will fit in a desired space, or whether it can be transformed into something else, are skills that are acquired in the early days of play. Babies turning a rattle around in their hands and mouth are learning about topology as well as material properties. Throughout childhood this ability to turn things around in the mind's eye develops in conjunction with manipulation of play objects in a range of narratives, (eg Can Big Ted fit in the dumper truck?), that are foundational to designerly thought.

Pre-school children are curious about how things work and come apart. Some things can be put back together again and some are left for adults to find to shout about. Children's interests in adult pursuits are frequently diverted through the introduction of substitutes. At a young age, my son played with a plastic tool bench with bright coloured screws and spanners for far longer than a simple exploration of the interaction of the components could account for. Almost the last thing he made with a construction kit (at age 12) was a fully working model of a lathe from Technical LEGO, after he had 'helped' Dad put together the latest acquisition for the workshop.

Gender – an unlikely window

It was whilst looking at possible gender differences in the design capabilities of Year 2 children that I realised that their approaches to design tasks mirrored gender differences in play styles amongst the Year 1 classes that I taught. Put stereotypically, the Year 2 boys used design strategies that were mirror images of the play styles of the Year 1 boys, and the girls likewise. Put un-stereotypically, there is a strong connection between playing and designing styles, that can be observed even across one year's age gap.

Browne & Ross's (1995) observations of young children in free play activities broadly resonated with my own observations in my Year 1 classroom. In their account, girls tended to gravitate towards drawing and making small items at tables; boys sprawled across the floor playing with construction kits. Despite the caveat that such observations tend to support stereotypes, gendered play styles were observable within the design styles of my Year 2 research subjects.

Boys

In Browne & Ross' account, boys were observed building models with construction kits, brmm-brmming them around briefly and then taking them apart to make something else. My observations were that boys play and talk through the construction of complex structures, creating the fantasy and its vehicle together, integral with the social action. The vehicle-in-progress is imbued with features (for example, rocket boosters) and the story-line is put on hold whilst essential construction takes place. The narrative is played out in speech and action, especially when in parallel or conjunction with other players.

This design narrative transfers to emergent writing activities. Figure 1 shows an example by a boy in my Year 1 class. The children were making books and although Jason has produced virtually no writing, he talked constantly to his friend Michael throughout the session as he drew his unfolding fantasy adventure story, which I so regret not capturing on audiotape.

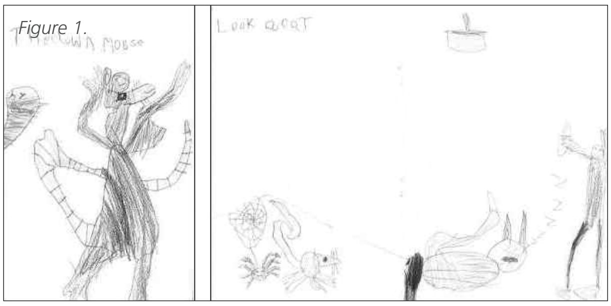


Figure 1.

Figure 2 shows Jason's design thinking a year later: It expresses his ideas for how Frosty the Snowman could reach the shop on the other side of the valley after the ice on the lake has thawed. He is clearly engaged in the fantasy of the task. Strange fish inhabit the lake, just waiting, no doubt, for the unwary Frosty to put an icicle in the water.

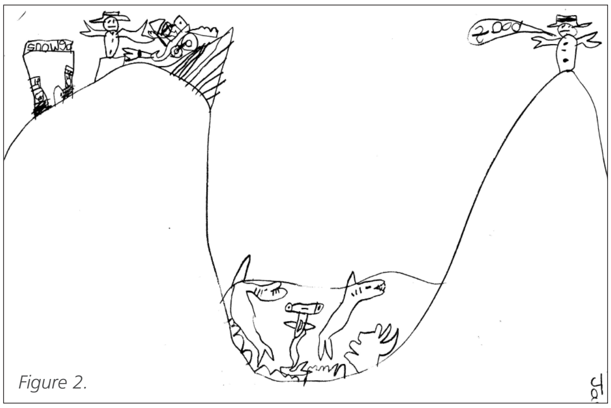


Figure 2.

This on-going development of design narrative, especially in conjunction with others was readily observable amongst the outgoing, sociable main boys' group in a Year 2 class. They talked their way through every Design & Technology activity. They freely shared and commented on each other's ideas in the same way as they would play with a pile of LEGO. Statements beginning with words such as "I'm going to have one that…." would immediately elicit responses. Other boys would make evaluative suggestions, add other ideas, try out the idea themselves, take it further and report back. Three boys spent a whole lesson trying to resolve one boy's idea for an overhead supported tunnel to solve the Frosty problem. In making a 3-dimensional maze to help Theseus to escape from the Minotaur, one group of boys created snake pits and staircases with piles of bones at the top. They were sparking off each other, sharing both ideas and techniques for folding card.

Several of my de-briefing conversations at the end of a design activity illustrated the extent to which children discussed their ideas at planning stage. This was not 'copying' but co-operation and the apparent randomness of some of the boys' design drawings was due to swapping ideas. Such design by discussion facilitated design development and, through peer support, enabled boys such as Noel (who had limited language and academic skills) to succeed as a designer. For, example, I had a video clip of his friend, Craig, prodding Noel's drawing with his pencil and saying "what you could do is…". Craig was always full of helpful suggestions to others. He appeared in my videos several times discussing what others could do to develop their ideas and he was a main catalyst for spreading good ideas around the classroom.

Girls

In contrast to the boy's' obsession with constructions that were immediately taking apart, the girls in Browne & Ross's study tended to make simple structures to support social interaction. In my observations, girls frequently created just sufficient play-props to maintain the story-line. For, example, exploring the dressing up box, Carly (aged 5) gave a piece of black cloth to Shannon, keeping a larger piece for herself. Putting hers round her shoulders, Carly said:

> *I'm the wizard. You're the 'prentice. Now, go and fetch the water (unceremoniously shoving a large plastic pot into Shannon's hands) and there's the broom (pointing at an imaginary boom in the corner). I'm busy making the spells!*

Whilst sitting making things as a group, my Year 1 girls kept a weather eye on what each other were doing, monitoring each others' output and appropriating good ideas without comment, often whilst talking about something else. For several weeks, making baskets out of paper was a favoured free choice activity. Across the weeks they developed expertise in attaching handles with staples, cutting intricate designs into the sides before assembly, developed stylized hearts and flowers as decorative features. They did not, however, discuss these with each other and their on-task conversation was limited to negotiating sharing resources. They rarely commented on each other's ideas. They simply incorporated each development into their own work.

One notable example was a development in figure drawing. One day, Lauren drew a human figure as one continuous outline instead of discrete parts, which was standard procedure amongst the rest of the class. Two other girls watched with almost startled interest. No comments were made but these two discretely tried out the technique. One of the girls playing in the role play area passed by, glanced, observed, said nothing, but used the same technique herself in a different context the following day.

This discrete appropriation of other's ideas was mirrored in the working methods of the main girls' group in one of the Year 2 class. They talked far less than the boys, usually on the practical (sharing pencils or Sellotape) or apparently superficial (colour, decorative features) yet their good ideas appeared within each others' work. They made only occasional comments to each other about their design ideas yet these denoted awareness of their merit. For example, this brief exchange whilst drawing ideas for an Easter Egg Holder seems almost meaningless:

> *Natasha (to Ellie): I'm doing a rabbit.*
>
> *Ellie: That's a good idea. (said in an almost dis-interested tone)*

However, Natasha had developed a detailed plan with pop-up rabbit's ears coming out of her Easter Egg Holder as it opens. Once this girls' group started making their holders, several (including Ellie) included Natasha's rabbits' ears in their own product. The idea also appeared in some of the boys' work via the itinerant Craig.

In contrast to the boys' ability to transfer their construction play styles to the task of designing, the skills the girls transferred were those of the paper-play table. They did not appear to be transferring the rich narrative world of the role-play corner, which they frequently dominated in Year 1. Their abilities in constructing joint fantasies were as strong as the boys (tears over Laura having more turns than was deemed fair digging with the bucket and spade in the canvas 'sand' on the floor of 'Treasure Island', for example). Yet it was unusual to observe girls really playing with design ideas in the free-flowing social way that the boys appeared to do. There were, of course, notable exceptions to the generalization, in both boys and girls in both Year 2 classes, but these tended to be children outside the main social groupings.

What would have happened if I had purposely created mixed gender groups? Unfortunately, that will have to wait for another time. These reflections surfaced after the data collection in the classroom was complete.

Talking, playing and designing

My colleague Sue Hammond, whose research is in the development of emergent writing skills, has contributed much to my thinking about young children's designing. She talks about the importance of children seeing themselves as writers and of the importance of providing writing opportunities within role play situations (setting up Travel Agent's rather than home corners, for example). If we are to develop children's design skills, then perhaps we need to encourage them to see themselves as designers. Lobman (2003) titled her paper on improvisational play "What should we create today?" which seems an exciting way of presenting design (as well as play) opportunities to children. I recently overheard a conversation between three colleagues discussing the use of open-ended questioning to promote creative responses. The art specialist said "Wouldn't it be wonderful if we said to children, what shall we design today?"

I was struck by the comment, not just because it was so close to Lobman's title but because it diverges widely from the 'fitness for purpose' closed design tasks that we so often present to children. It caused me to examine my own practice and my understanding of creativity in Design and Technology. Make a travel bag for Pandy? – perhaps he'd rather stay at home than risk ending up in Dartford Lost Property Office like he did when Mrs. Hope was three!

Children's creativity often seems the antithesis of the adult version. Adults frequently seem to be asking *"What can we use for this?"* whereas children's play thinking often begins from *"What can we use this for?"* Moyles' (1989) chapter on play and problem solving seems to involve far more adult-led activities and guiding of children's thinking than does the rest of her book. The reason appears to be in the setting of the problem and the ownership of the task. One of my early experiments with Pandy's travel bag illustrates this. The activity was my idea (of course, I was the teacher). The children had to design a travel bag for my toy Panda's summer holiday needs and make it from thin card. My Year 1 class entered into this fantasy without demure. Most of them drew a bag shape on the card and cut it out and could not understand at all why I expected a two-sided object that could have things literally put into it. It wasn't their problem they were trying to solve. It was my fantasy one – so why did I expect anything other than a fantasy answer? Next year's class were the ones who made baskets: two sided, handles, decorated with hearts, tissue paper flowers, sequins… It was their problem they were solving.

An insightful reflection on gendered learning, presented by Katz (2003), is apposite for Design and Technology activities. Eshewing neurological explanations of boys' poorer performance in academic subjects, Katz hypothesizes that girls suffer in silence better than boys. She claims that the most vulnerable boys are those growing up in cultures who images of masculinity are to be "agentic":

> *"i.e. to take action, initiative, to demonstrate strength and assertiveness, rather than the easier, passive, accepted submissive of the female in the formal classroom and in the culture in general."*
> (Katz, 2003:17)

I could see reflections of Katz's hypothesis in my boys and girls and in the transfer of their prior learning to Design and Technology. The boys saw the activity as a chance to be agentic. They created a fantasy world around the theme of Theseus and the Minotaur, drawing on their experience with computer and video games and of their play experiences of trying to reconstruct these games with LEGO or other toys. The girls' relevant prior learning consisted of a repertoire of paper and scissor techniques. They did not bring to the task their rich role-playing skills because these were the skills they saw as relevant, and in any case, they rarely played at being trapped in mazes being cornered by monsters.

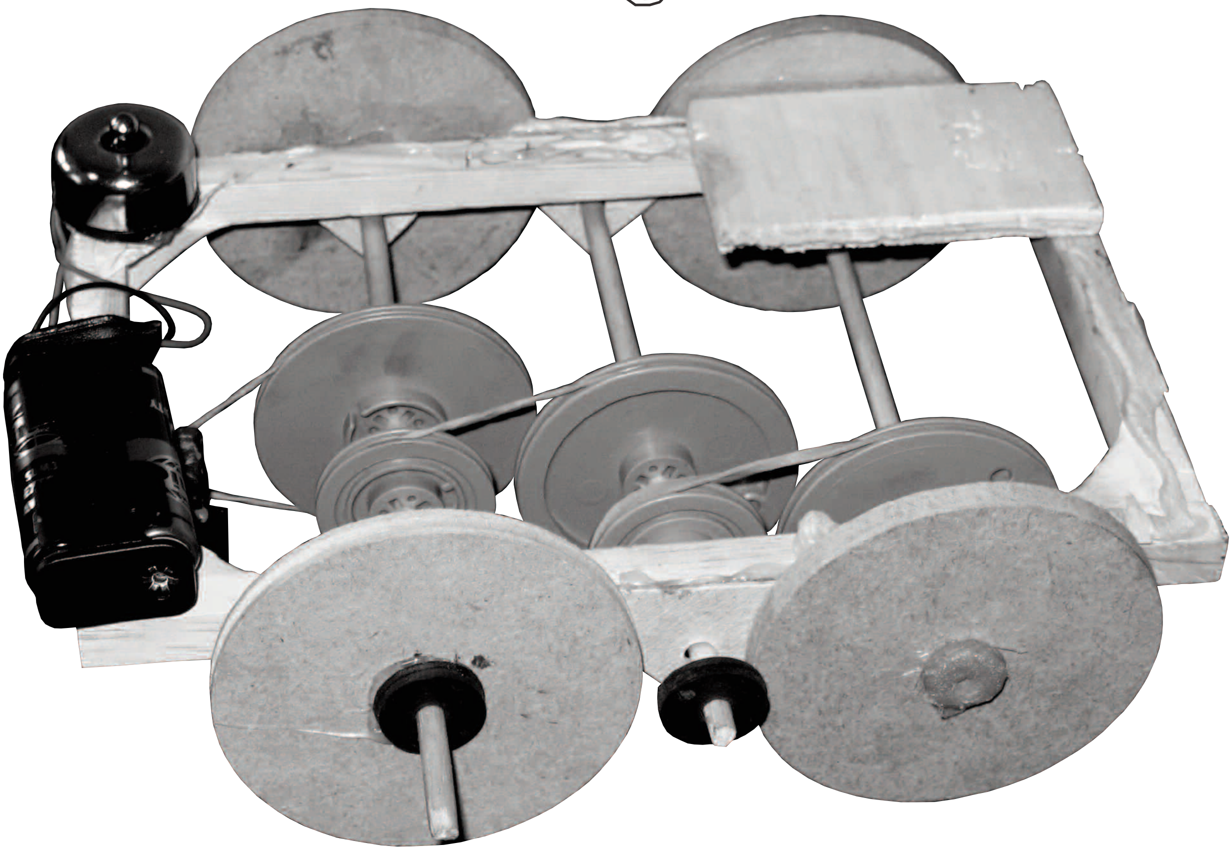
Conclusion

This paper has been filled with stereotypes, for which I apologise but do not recant. Stereotypes have a useful function as social mirrors. The paper has been littered with anecdotes, but they are memorable instances that have enabled or challenged my thinking. This paper is part of my on-going battle with the question of what it means to be creative, especially within Design and Technology, within appropriate learning situations designed by adults for young children. I am convinced that closed problems lead to a closed view of design processes and of design solutions, and that there is a dichotomy between closed problems and open avenues. I believe there is real danger in pushing children into structured problem-solving too young and of failing to really utilize, rather than pay lip-service to, the skills they already have and that they exhibit whilst playing.

Curiosity, fascination and mobility of thought are, say Brice Heath & Wolf (2004) "rich deposits of human capacity" and foundational to creative thought. Small children appear to have these in abundance. The big question, for education as a whole, and for Design and Technology in particular, is in how we stimulate and expand those capabilities. Winnicott (1991) asserts that creativity is central to mental health, whereas compliance is a "sick basis for life" (p.65). However, there is still much woolly thinking, especially about such words as "creativity" and "play" (which we agree are a good thing without unpicking what we mean by these terms). The implications for children's learning cannot be decided upon until we know what we mean, and can present cogent arguments for their goodness. Meanwhile, young children continue to play, to subvert our tidy 'design-and-make' tasks, and to be creative in ways that we do not anticipate or predict.

References

- Baynes K 1989
  The Basis of Designerly Thinking in Young Children
  in Dyson A, Looking, Making and Learning
  London; Kogan Page
- Berg L 1999
  Developmental Plat Stages in Child Identity Construction:
  an Interactionist Theoretical Contribution;
  in David T (ed.) International Journal of Early Childhood,
  Vol 31, No 1; Sweden; OMEP (Oganisation Mondiale pour
  L'education Préscolaire)
- Brice H & Wolf S 2004
  Visual Learning in the Community School:
  Hoping for Accidents: media and techniques
  London; Creative Partnerships / Arts Council
- Browne N & Ross C (995
  Girls as Constructors in the Early Years:
  promoting equal opportunties in maths, science and
  technology; Stoke on Trent; Trentham
- DES (Department of Education and Science) (1967)
  Children and their Primary Schools (Plowden Report)
  London; Department of Education and Science
- Dillon P & Howe T 2003
  Design as Narraitve:
  Objects, Stories and Negotiated Meaning; Atkinson, D. (ed.)
  The International Journal of Art and Design Education
  London; Blackwell Publishers
- Factor J 2004
  Tree Stumps, Manhole Covers and Rubbish Tins:
  the Invisible Play-lines of a Primary School Playground;
  in Childhood Vol. 11, No.2
  Sage Publications
- Katz L 2003
  The Right of the Child to Develop
  and Learn in Quality Environments
  in Samuelsson I P & Lewis A (eds.)
  International Journal of Early Childhood, Vol.35, No.1; Sweden
  OMEP (Oganisation Mondiale pour L'education Préscolaire)
- Kress G 1997
  Before Writing: Rethinking the Paths to Literacy
  London; Routledge
- Lobman C 2003
  "What should we create today?
  Improvisational Teaching in Play Based Classrooms
  Early Years Vol.23, No.2; Carfax Publishers
- Manning K & Sharp A 1977
  Structuring Play in the Early Years at School; London; Ward
  Lock / Schools Council
- Moyles J R 1989
  Just Playing? The Role and Status of Play
  in Early Childhood Education
  Milton Keynes; Open University Press
- Stables K 1992
  The Role of Fantasy in Contextualising and Resourcing Design
  and Technology Activity
  in Conference Proceedings IDATER92
  Loughborough University
  Department of Design and Technology
- Winnicott D W 1991
  Playing and Reality (2nd. Ed.)
  London; Routledge



Designing Better Worlds? Values for Vision through Primary Design and Technology Education

University of South Australia, GPO Box 2471, Adelaide, South Australia 5001, Australia
Steve Keirl – E-mail steve.keirl@unisa.edu.au

Abstract

If the world could be a better place, does Primary Design and Technology Education have a role to play? This paper argues that the world(s) we inhabit are so as a result of design activity. Thus, if we deemed it important enough, we could design our world(s) differently.

To achieve such an end is to entertain particular visions – of alternative futures and alternative pathways to those futures. Design is a powerful educational entity and human tool and one of its potentials is its capacity to enact change – to change one set of circumstances into another. In doing so, value-judgements and value-decisions are made.

This paper explores the relationship between ethics and design in our lives and investigates the kinds of values we might promote in a Design and Technology Education for the future. Nine 'visioning values' are put forward and, it is argued, they may both serve to enhance future world(s) as well as to empower Design and Technology Education's importance to twenty first century curriculum thinking.

Introduction

To imagine or talk of 'better worlds' is to take a value position. The premise (with optimism) is that things could be better. It is also to imply that it is possible to act in ways that will actually achieve such a goal. This paper explores the idea that there may be some values we could nurture through Design and Technology (D&T) education to help young people's journeys into the future.

The paper argues that each of: technologies (designs), designing, and education are values rich and are therefore problematic in that people do not readily agree about them. It also seeks to show that the three can be considered in some futures sense. With an eye on the world as it is yet to be (surely very much the concern, even a duty, we might hold for our primary school children), it is argued that there should be an ethical basis to the kind of ways we look forward or (en)vision the future.

Given the technological and designed nature of our worlds and environments, the case is made that primary Design and Technology Education can play a role in promoting several identifiable values which would help children's capacities in designing, in their futures-thinking, and in their ethical reasoning.

Nine tentative 'visioning values' are each presented with some explanation and argument. Although most will be readily recognised by primary Design and Technology Education practitioners, consideration should also be given to the interplay of these values. Critical interaction with these thoughts is sought.

The place of ethics

Ethics and political organisation: In organising our communities and societies, we act politically and the most ethically defensible form of political system is democracy. For this paper, two points must be made. First is the idea that democracy is in some way the rule of the people (a highly problematic claim it is accepted). Second is the view that democracy is seen as an ideal. It remains sought-after, is unobtainable, but what matters is its continuous pursuit. Thus, it remains ethically defensible in that it is/should be responsive to ethical arguments in the cause of improvement (for a better world).

Ethics and education: In order to maintain a democracy it becomes necessary to have a supportive education system. Thus, as White (1973) has shown, to keep a democracy democratic we need an education both in and for democracy. Implicitly, the education system itself must be democratic. If it cannot totally be so because of the maturity of children, it can find many ways to model democracy and to serve the children's needs democratically.

Ethics and the environment: Locally and globally we have extensive evidence that the environment is not at its best. That this is a concern is an ethical matter. In asking if it is 'right' that we exploit resources, or pollute, or leave a future that is in some ways less than it currently is, we apply an ethic of living to ourselves and to future generations. This ethic of living is not ethereal. It is at once of us and of the environment.

Values in technologies and designs

To explore the ethical issues so central to our living on/with the planet we embrace value judgements. Cases are made on the basis of value. The values we live by and which others use can be categorised in many ways – for example: religious, secular, communal, material, moral, non-moral and so on (Frankena, 1973). If we look at technologies and designing we see multiplicities of values at play. While there are some who would argue that technologies, designs and the act of designing are 'neutral' the case against such positions, that is, that these phenomena are values-rich, is very well developed. As Feenberg's (2002) text introduction says:

> *Modern technology as we know it is no more neutral than medieval cathedrals or the Great Wall of China; it embodies the values of a particular industrial civilization and especially those of elites that rest their claims to hegemony on technical mastery. We must articulate and judge these values in a cultural critique of technology. By doing so, we can begin to grasp the outlines of another possible industrial civilization based on other values. [My emphasis] (Feenberg, 2002:v)*

In Buchanan & Margolin's (1995) collection, the editors comment on the writings of three contributory authors, *'…(who all) recognize…that the problem of design ethics must be rethought.'* Two of these, the editors comment, see design embedded *'…in a philosophy of moral action…'* (Buchanan & Margolin, 1995:xxiv-xxv). Also, Fry (1995) refers to our one-ness with the ecological crisis: *'We are the crisis: it is our creation…Our actions, dreams, desires and demands drive it.'* He sees design as both cause of the situation we are in (have created) and as the way forward with solutions. Design *'…ride(s) the line between creation and destruction.'* He argues that:

> *…design's acknowledged and celebrated forms have been attached to explicit economic functions and cultural appearances that lack any ability to engage in critical reflection, especially of design's impact on the social and the environmental fabric of our world. [Again, my emphasis] (Fry, 1995:190-191)*

Seeing inter-relationships

There are commonalities between technology and ethics: both are contestable fields begging rational discourses; both are values-rich; both share interests with democratic theory; both have an interest in matters of determinism and free will; both beg sophisticated understandings about 'choice'; and, neither is an explicit or properly understood educational reality. But what of the bringing together of ethics, (through values) and design? Other commonalities show their potential. Both can serve the future well (even if this is not the case at present) – they are projective. Both are about weighing up competing values and, as a result of this weighing-up, both seek to establish BDCs – a best defensible compromise. Both are considerate of the consequences of intentions and acts. Both deal with uncertainty – outcomes are neither pre-determined nor self-evident. And, neither ethics nor design can guarantee a simple 'right' or 'wrong' solution.

Design and technology education and values

For several decades, 'values' has been seen as a complementary dimension of D&T along with, notably, knowledge and skills (Grant, 1983; Archer & Roberts, 2005). The case has been made that D&T curriculum must be articulated in values-rich ways and not in the mythical 'values-free' or 'neutral' way (Keirl, 2000).

To suggest that D&T can be values-free or that it can constitute an education by valorising some stakeholder values and marginalising others (Layton, 1994) is either completely to misplace what education for democratic life may be about or it is to train and/or indoctrinate. D&T educators have a challenge to enact a values-rich curriculum which is holistic, dynamic and critical. Such a curriculum serves both ethics and democracy (Keirl, 2006).

As Hill (n.d.) says: 'If values education is to avoid becoming indoctrination, the minimum requirement is that one aim be to equip students to *critically interrogate the values acculturation both they and others have undergone* so that they may make an informed choice concerning the values by which they themselves will live.' [My emphasis] (Hill, n.d:5).

Future-focussed, ethically driven principles are increasingly promulgated in the professional world of design (for example, Mayall's [1979] 'Ten Principles in Design'; Buchanan & Margolin, [1995]; McDonough's 'Hannover Principles' [1998]). So how, through values-rich Design and Technology Education education, might primary school children learn by *'…critically interrogat(ing) the values acculturation both they and others have undergone'?*

Visioning values

In their ways, the positions presented above attempt to address the ultimate (future-focussed) ethical question *'How should we live?'* So how can Design and Technology Education contribute? The suggestion here is that it can do so by recognising the kinds of values that encourage and support vision, that is, visioning values. This is not to say that these values will necessarily be omnipresent in D&T practice – there are dozens of competing values at work in the field. But, by developing an ethos that nurtures students' dispositions to (en)vision, the ultimate question becomes more tenable as an educational, and political, focus.

The future, it seems to me, can be seen in a couple of ways. First, there is the Future (Big 'F') – that which is 'out there' for us all. It is massive and unknowable and we are, collectively (if passively) creating it now. There are also futures (little 'f') which each one of us has and which, together, combine to contribute to the Future. Clearly, we have greater personal control over our personal future and our local collective futures than we do over the Future. How we shape what we can control (futures) will shape the Future.

By looking at the stages of any technology's existence it is possible to consider not only the values at play but to understand the relationship of the stages to many other people and facets of social organization. The four stages to consider are i) intention – the point at which only the thought or proposal to design and/or make takes place. Thus: why design/make? What will be the consequences of going further? etc; ii) design – the act of moving from ideas and thoughts into shaping and the 'how to' bring the idea-thoughts into reality; iii) manifestation – the bringing-to-being of the design, the making perhaps; and iv) use-application – the ways in which the technology is adopted/put to use, or otherwise.

Visioning values could play their part especially at the intention stage where, as a minimum, any technological proposal is critiqued through ethical questioning. At all stages values can be espoused or exposed and such activity could contribute to richer D&T practice as well as richer general education for all students.

What could constitute a visioning value? For the purposes of this paper, a value is taken to be something to which we attribute worth. Thus a visioning value is one which Design and Technology Education can use to the advantage of futures-focussed thinking and design. There are nine tentative candidates:

Imagination

While imagination is often celebrated in connection with young children's play and work, there is a sense in which education can suppress it – that is, we might celebrate the concept in a feel-good sense but do we value imagination as a cultural asset? In a climate of testing and grading, is imagination fostered? Imagination is about 'thinking-otherwise' and about considering as possible that which, culturally or socially, might be considered im-possible or impossible or un-'realistic'.

Imagination, if valued and fostered, is powerful educationally for both the child and for learning in general. It has a special value to designing but not especially to critiquing. Imagination can be the seed of technological intention.

Creativity

There are many senses of 'creativity' and it has been extensively explored for over half a century. From Koestler (1964) to Csikszentmihalyi (1997), the concept, recognised as a highly significant form of human activity, is seen across a spectrum of value from the existential to the economic (Keirl, 2004). Education, through different activities (not least, D&T), is in a position to develop many facets of creativity. One very important facet is that of liberating self-empowerment for the student. When the creative is valued it must not be so in a tokenistic sense. That is, bringing students' creative work to fruition in some meaningful way is particularly fulfilling for the individual. The bringing-into-being of ideas and designs is projective – forward-acting. With guidance, students learn that their creativity is legitimate and that it can lead to change.

Empathy

This is what Hill (n.d:3) describes as signifying a capacity to 'feel into' the conscious states of other persons. For the designer and designing the value of empathy is often what brings the success of a design. It is also empathy that allows our humanity to be shared – across cultures or boundaries. This is not to claim that empathy is the domain of some people(s) and not others. Nor is it to mis-use empathy as an instrument of homogenisation. In seeking (or designing) a future of intercultural, inter-species and inter-generational peaceful co-existence, empathy may be a key value.

Critiquing

This activity is vital to quality Design and Technology Education for and about our world. The action of critiquing is about question-asking of products – to explore the values which informed them and their designs. Developed as a valued trait in school children it is about integrity, honest opinion and positive interaction – with all involved in the various stages of a technology's life as well as with each other in our classrooms and communities. Inevitably, this involves interrogating, challenging the status quo, challenging proposals, and exhausting possibilities positively. (As one of three 'strands' [along with Designing and Making], critiquing has now undergone five years of development in the South Australian Design and Technology curriculum (DETE, 2001a&b)).

In the mind's eye

This more specific mental capacity has long been recognised (Glegg, 1971; Ferguson, 1992) but its value to visioning is as a mind-tool for specific purposes. The capacity to build in the mind, to create, engineer, and rehearse is something which can serve students and society well. To develop this capacity allows for much trialling and testing – it is a particular way of running a mental model (Edwards-Leis, 2007). It, too, is projective. Further, in developing such capacities in children, we enhance the possibility that higher quality design communication can take place between individuals about their world. Developing a richer design culture in the citizenry assists futures thinking.

Foresight – hindsight

To understand these two values individually and in their articulated sense is to acknowledge history – a significant tool for futures thinking too. There are rich antecedents in the mythology of Ancient Greece with the stories of Prometheus, Epimetheus and Pandora. We would certainly decline to leave our collective futures and the Future to the remnant of Pandora's Box – hope. In taking up the pro-active position that we can influence the future, we do so, we would argue, with foresight informed by hindsight. Here, the writing of Shenandoah (1995) is recalled when he talks of 'looking behind' (to see the generations who follow us) in order to look ahead.

Ethics

Although a central theme to the case of this paper, 'ethics', as a practical matter for human philosophical pursuit, remains largely on the edge of education. Many would claim it is 'there' but the absence of any explicit addressing of ethics, whether in education as a whole or Design and Technology Education education in particular, rather leaves it open to neglect. This is unsatisfactory if the future, technology and democracy are to be framed in democratic (ethical) ways. By keeping the key ethical question 'How should we live?' central to decisions about designed technologies and about education, we keep open a doorway to preferred futures for better worlds.

Confidence

Confidence is to be valued and nurtured in children if they are to believe they can make a difference. By contrast, the more we inhibit or fail to celebrate confidence in our young, the greater the disempowerment and, potentially, the alienation they feel from society. Confidence is needed to make bold choices about giving up some ways of life in preference for others. Confidence supports the expression of will. It is an aspect and shaper of students' identity. Importantly, it is a contributor to, and partner of, optimism.

Idealism

Idealism has been noted as a component of understanding democracy in terms of ethics – as the sought-after ideal. By understanding the life-enhancing value of the pursuit of ideals it is possible to seek the imagined better life and to move towards it at an evolutionary if not revolutionary pace. But such a life and the pursuit of it is an ethically defended end and path. To recognise democracy as ideal and education as ideal is to acknowledge their imperfections. Such is the case for any designed technology. As a visioning value, idealism is the shaper of the goal (future) for which best defensible compromises are the means for getting there.

The potential interplay of visioning values is patent to the practising teacher but this is not to say that each, on its own terms, should not be celebrated. Selected comments from the literature both recognise and inform this interplay. Raphael (1984:66), on moral philosophy talks of 'imaginative sympathy'. Mackay (2004:239-240) suggests that *'Morality is the work of the imagination: making moral choices is a creative act that, like all creative acts, requires courage and involves risk.'*

Warnock (1998:120) sees teachers helping students *'…to discover that there is such a thing as private morality, the ethics of conscience and of possible ideals'*. Addressing moral education she comments: *'Important though…explicit ethical teaching is, I would give a high priority to the development of a child's imagination, indeed without this a child will have no safeguard against the deadening cynicism which is the enemy of morality.'*

Conclusion

Clearly, some of what has been offered here is of a tentative nature but this does not negate the potential of visioning values for achieving better worlds. Design is never about perfect solutions and, like ethics, it is in constant pursuit of the best defensible compromise over competing values. Design is the articulation of values but it is also what Mayall calls *'the great integrator'* (Mayall, 1979:1).

To celebrate visioning values in education could be both to serve a richer society and to enhance the ethics of design. Here is a prime example of Primary Design and Technology's excellent potential to be central to the general education of all students whilst also enhancing Design and Technology's integrity.

References

- Archer B & Roberts P (2005)
  'Criteria, Objectives and Competencies'
  in Archer B, Baynes K & Roberts P (2005)
  A Framework for Design and Design Education:
  A reader containing key papers from the 1970s and 80s,
  Loughborough University
  The Design and Technology Association, Wellesbourne, UK
- Buchanan R & Margolin V (Eds.) (1995)
  Discovering Design:
  Explorations in Design Studies,
  University of Chicago Press, Chicago
- Csikszentmihalyi M (1997)
  Creativity: Flow and the psychology of discovery and invention
  HarperPerennial, London
- Department of Education
  Training and Employment (DETE), (2001a)
  South Australian Curriculum Standards and Accountability
  Framework (SACSA), URL: http://www.sacsa.sa.edu.au
- Department of Education, Training and Employment (DETE)
  (2001b), South Australian Curriculum Standards and
  Accountability Framework,
  (Hardcopy version), DETE Publishing, Adelaide
- Edwards-Leis C E (2007)
  'Distributed cognition in the middle years: using a forum
  format to elicit mental models of assessment'
  Proceedings of Australian Association
  for Research in Education, Adelaide
  http://www.aare.edu.au/o6pap/codeo6.htm
- Feenberg A (2002)
  Transforming Technology:
  A critical theory revisited
  Oxford University Press, Oxford

- Ferguson E (1992)
  Engineering and the Mind's Eye
  The MIT Press, London
- Frankena W (1973)
  Ethics, Prentice-Hall
  Englewood Cliffs, N.J.
- Fry T (1995)
  'Sacred Design 1: a re-creational theory'
  in Buchanan R & Margolin V (Eds.) (1995)
  Discovering Design: Explorations in Design Studies
  University of Chicago Press, Chicago
- Glegg G L (1971)
  The Design of Design
  Cambridge University Press, Cambridge
- Grant M (1983)
  'Craft, Design and Technology'
  in Whyld J, Sexism in the Secondary School
  Harper & Row, London
- Hill B (n.d)
  'A Rationale for Teaching Values'
  in Values in Education (National Professional Development Program Values Review Project) App. 3
  Association of Independent Schools of Western Australia
  Osborne Park, WA
- Keirl S (2000)
  'W(h)ither, and whose, values in technology education'
  in 1st Biennial International Conference on Technology Education Research 2000 Proceedings, Technology Education Research Unit, Griffith University, Qld
- Keirl S (2004)
  'Creativity, Innovation and life in the lily-pond:
  Nurturing the Design and Technology family while keeping the alligators fed. DATA International Keynote Address'
  in The Journal of Design and Technology Education
  Vol. 9, No. 3, Autumn 2004, pp.145-160
- Keirl S (2006)
  'Ethical technological literacy as democratic curriculum keystone'
  in (Ed.) Dakers J R (2006)
  Defining Technological Literacy:
  Towards an epistemological framework
  Palgrave Macmillan, Basingstoke
- Koestler A (1964/1975)
  The Act of Creation
  (Picador edition), Pan Books, London
- Layton D (ed.) (1994)
  Innovations in Science and Technology Education
  Vol. V. UNESCO, Paris
- Mackay H (2004)
  Right and Wrong: how to decide for yourself
  Hodder, Sydney
- Mayall W H (1979)
  Principles in Design
  Design Council, London
- McDonough W (nd)
  The Hannover Principles:
  Design for Sustainability, McDonough and Partners
  Charlottesville, Virginia, USA
  cited in Ellyard P (1998) Ideas for the New Millennium
  Melbourne University Press, Melbourne
- Raphael D D (1984)
  Moral Philosophy
  Oxford University Press, Oxford
- Shenandoah L (1995)
  'Seven Generations' in Schaef A W (1995)
  Native Wisdom for White Minds
  Random House, Milsons Point, NSW
- Warnock M (1998)
  An Intelligent Person's Guide to Ethics
  Duckworth, London
- White P A (1973)
  'Education, Democracy, and the Public Interest'
  in Peters R S (ed.), (1973) The Philosophy of Education
  Oxford University Press, London

Ten Years of Primary Design and Technology Teacher Education in South Australia: More Head, Less Hands, Always with Heart

University of South Australia, GPO Box 2471, Adelaide, South Australia 5001, Australia
Steve Keirl – E-mail steve.keirl@unisa.edu.au
Denise MacGregor – E-mail denise.macGregor@unisa.edu.au

Abstract

This paper addresses the conference theme of 'Ten years on…' by reporting developments and issues that have arisen in Primary Design and Technology (D&T) Teacher Education in one Australian university over the same period.

As a major Primary D&T provider in Australia, the University of South Australia School of Education has undergone a decade of considerable change – of the kind affecting all universities (globalisation, markets, new policy directions etc). In the same period, D&T curriculum design has also moved significantly.

This paper describes some of the principal changes and innovations that have occurred in Primary D&T education at the University. Some context – historical, curricular and political – is presented and the paper addresses matters of demography, program (degree) and course (subject) design, pedagogy, innovation, influences, challenges and opportunities.

Having described the evolution of the D&T developments, the paper concludes with summary reflections and it speculates on what the next ten years might bring.

Introduction

The University of South Australia is the largest of the three Universities in the state of South Australia with 33,722 students, 1,012 academic staff and five campuses. The School of Education offers undergraduate and postgraduate education programs, ranging across early childhood, primary, secondary, and adult education. Three years ago the University closed one of its largest campuses (Underdale) and relocated staff and students. This paper reports on the work begun in Design and Technology (D&T) Education at Underdale which now continues at the Mawson Lakes campus.

In 1997, the School of Education (Underdale) was mid-way through the delivery of Australia's first dedicated suite of Technology Education courses for pre-service primary teachers. These courses were delivered across a four-year degree period with the first cohort starting in 1995 and graduating in 1998. Reflections on this significant innovation were reported to this conference in 1999 (MacGregor, 1999).

Since that significant beginning, many developments have occurred and circumstances have changed in ways that have reshaped what is on offer and how it is offered. The paper opens with contextual information on the contemporary historical and political background to the national and state curricular developments. It then describes the University's restructuring, the programs (degrees) and courses (subjects), and the staffing and student demographics. Having profiled the developments we then reflect on the principal changes and their significance. The paper concludes with our consideration of the coming ten years.

The changing world and education

The period being addressed has witnessed significant change in the political, social and economic spheres in which universities operate. Globalisation has taken its course. The 'knowledge economy' has driven the 'knowledge society' and, in turn, new forces seeking to shape education in schools (Hargreaves, 2003). Universities have continued to compete for students in new markets while also seeking to be efficient and maintaining standards.

In line with some countries (though not with others) Australia is witnessing growing engagement of governments at state and national levels in education (to the extent that 'standards', civics, literacy, numeracy etc are being foregrounded on a daily basis in the media and in current federal electioneering). 'Curriculum wars' are engaged with a keen battle raging between Outcomes Based Education (OBE) and a 'back-to-basics' return to 'traditional disciplines' and the testing of knowledge of them (Killen, 2006).

Curriculum development across Australia has taken both professional and political paths. Professionally, teachers and academics have together contributed to rich and purposeful debate around curriculum design (see, for example, Harris and Marsh, [2005]). Politically, education now finds itself at the centre of party politics – more so than it has ever been. However, where the professional and the political have met for almost two decades, and with some degree of harmony, has been in the area of curriculum. There are signs that this harmony is under threat of erosion.

Curriculum influences nationally

In 1989 Australia's State and Territory education ministers agreed to national goals for education across the country. The innovations (AEC, 1994a&b) included the proposal that curriculum be structured around eight 'Learning Areas' (one was Technology). As MacGregor (1999) reported:

> *A major contributing factor in the conception and development of Primary Technology Education courses at the University…was the introduction of Technology Education into Primary Curriculum. (p.86)*

Here was a long-sought recognition which, in turn, gave identity to the field in the bigger curriculum picture. Being new has its accompanying difficulties but these are compounded when set against such elements as the 'big three' of English, maths and science. As Williams and Keirl (2001) reported from a national research study into Technology Education across Australia: '…in the case of primary education, technology had not generally been part of school programs, and primary teachers have little experience to draw on to develop programs.' (p.154), and,

Technology education was traditionally an 'elective' area in secondary schools and is a 'new' area in primary schools. Because of this it is often perceived as a less important learning area, and this perception has been slow to change. (p.155)

Curriculum in South Australia

South Australia adopted the 1994 innovations and the Technology Statement and Profile began to shape both curriculum in schools and the University's teacher education programs (MacGregor, 1999). Design was given greater emphasis in a process of design-make-appraise (DMA) and the underpinning theory of the curriculum was outcomes – rather than content-focussed (see, for example, Griffin, 1998). The new attention to outcomes and the profile of the individual student contrasted the prior emphasis which was teacher-centred and system- and grade-focussed.

In 2001, a new curriculum policy – the South Australian Curriculum, Standards and Accountability (SACSA) framework (DETE, 2001a&b) – was introduced. Being a framework, this policy again respected the professional judgement of teachers in assessing the outcomes of students' learning. Building on the Statement and Profile, SACSA developed a new emphasis on critiquing along with designing and making. Interwoven with these three 'strands' were five cross-curricular Essential Learnings – Communication, Futures, Identity, Interdependence, and Thinking (Keirl, 2001b). The new policy also introduced a name change for the Learning Area: Technology Education became Design and Technology Education.

University restructuring

Institutional reorganisation happened at various levels in this period. The former Faculty of Education became one school in a much larger (8000+ students) Division of Education, Arts and Social Sciences. A decade ago the University introduced its Graduate Qualities – generic dispositions deemed to be of value to all students regardless of their study focus. (These 'qualities' are now expected to be thoroughly integrated with course delivery.) A review of the whole of the University's education programs and practices (Reid & O'Donoghue, 2001) considered markets, offerings and locations, and opportunities came to restructure teacher education.

What had previously been an undergraduate Junior Primary/Primary program (hereafter BEdJPP) became a Primary/Middle years program; the Bachelor of Education Primary/Middle (hereafter BEdPM). This change influenced the content and number of D&T courses offered, the gender balance in the program, staffing, and resourcing. Course offerings in D&T have become more diverse in addressing middle years' needs, for example, offering food and textile technologies, futures technology and Information and Computer Technology (ICT).

The new BEdPM program is underpinned by core principles such as: professional competence; wellbeing; social justice; futures thinking; sustainability, education for community living (place-based learning); and, sound pedagogical reasoning that isthat isthat is enquiry-based. (The BEdJPP program had no such explicit principles).

Course design and development

The influence of all the factors noted above has led to extensive revision of the D&T courses offered.

Both degrees are/were of four years duration with a total unit (points) value of 144 units. The courses under discussion are of 4.5 units value. Within the degrees, two course arrangements exist, each with its own role. Core courses are compulsory for all students and each degree has (had) only one such course. Further General Studies courses are specialised suites of courses and with a particular Learning Area as happens with D&T.

BEdPM students complete a combined Professional Pathway and 'specialist' teaching practicum experience. D&T students teach D&T as a specialisation in a primary or middle school setting during their final practicum for half of their teaching load. In such a specialist role students teach D&T to five classes assuming responsibility for planning, delivering and assessing the work of over 120 students. Many also assume responsibility for establishing a specialist teaching area and purchasing resources. The regard in which these students are held has often meant they are sought after to establish new programs, to lead in-service professional development, or to take up offers of employment.

Core courses

D&T Education is currently offered as a compulsory 4.5 unit curriculum core course. (Previously this was linked to the teaching of Arts Education, was delivered in Year One and was afforded only 2.25 units.) It occurs in the Year Two and is 'linked' to a practicum placement in schools thus providing greater pedagogical relevance and context.

For the majority (75%) of students the core course is their only exposure to D&T in their degree. As a direct reflection of the current political climate, proposals are being mooted to increase core courses in Maths and Literacy. This may reduce D&T offerings and many years of good work.

Table One: Comparative General Study Courses 1997 and 2007

1997 Technology Education via Design-Make-Appraise	2007 Design and Technology Education via Critiquing, Designing and Making
Imagineering-Creative Construction Awareness of the concepts of Technology, Technology Education and Technological practice. Process of Technology developed through problem solving tasks. Issues of safety, resources and skill development.	**Design and Technology 1** Broad and basic introduction to D&T – curriculum, pedagogy, assessment through Critiquing, Designing and Making.
Materials for Design, Make and Appraise Reflecting the DMA pedagogical framework via activities around a breadth of materials and their properties to enable successful production of design solutions.	**Materials Technology** A greater diversity of materials and critiquing, designing and making techniques. Greater emphasis on integration of resistant materials, systems and control technologies.
Technology and Us Explorations of how technology interacts with culture, society and the environment.	**Technology and Society** Broadly similar with greater emphasis on developing authentic learning experiences through Place-Based projects.
Information Highways Computers and related technologies for primary and secondary: multi-media applications; relationship between information and learning; computer; computer as learning tool.	**Information Highways** Currently under review, while content has evolved over the decade the title is outdated for current and emergent ICTs. Greater emphasis now on critiquing appropriateness of ICTs used in schools.
Technology By Design/Through Invention Practical project-based design work through liaison with schools, community, industry.	**Technology-Innovation and Invention** Current and future technologies and associated issues. Research and debate of technological impacts.
Technology: Negotiated Study A negotiated activity matching student interest. Research project or community/industry design project work.	**Professional Pathway/Professional Application and Reflection 4** Application of knowledge, skills and values developed throughout D&T General Studies in school practice. Deepening insights of quality D&T for general education of all students. Students as and change agents for D&T.

General studies

In the BEdPM program students can study from two to six D&T courses. The majority enrol in six. It is the general study courses that continue to facilitate deep understanding and specialisation in Design and Technology. Over 150 students are currently enrolled in D&T general studies. Ten years ago six general study courses were offered and this has now increased to eleven. Table One illustrates the six original courses and their current counterparts.

These D&T General Study courses are new to the BEdPM program:

- Foundations in Design and Technology Workshop Knowledge
  Practical D&T techniques for years 7-10. OHS&W, basic machinery, tools and skills.
- Computer Graphics for Engineers (School of Mechanical Engineering)
  Engineering and education students collaborate in problem solving experiences. Techniques for visualisation including CAD and drafting.
- Food and Society (School of Health Sciences)
  Food production and the environment. Achieving an ecologically sustainable food supply. Food legislation, choice, social and cultural influences, health.
- Human Nutrition (School of Health Sciences)
  Fundamental nutritional science. Relationships between food, nutrition and health.
- Idea Generation Methods for Designers (School of Art and Design)
  Design as core pedagogy for D&T. Theories of idea generation; creative thinking techniques; relationships of ideas and image development.

Staffing and students

The increase in courses offered has had major implications for staffing and resource funding. As courses have become more specialised in content, greater numbers of sessional staff (often practising teachers) and lecturers from other schools (see above) within the University have been employed. In her 1999 review, MacGregor noted that school-based sessional staff '…brought with them a wealth of knowledge of current technological practice' (p87). Collaboration was also highlighted:

> *The opportunity to develop and maintain long-term rich professional relationships with practising teachers has impacted greatly on the content and delivery of the courses that were offered to Technology Education pre-service teachers. (MacGregor, 1999:87)*

Sessional staff continue to bring with them rich knowledge and collaboration is still central to the effective planning and delivery of D&T courses. However, it must be acknowledged that the content of courses taught elsewhere in the University are not generally delivered using a D&T pedagogy (by which we mean one modelling critiquing, designing and making in a holistic way and which is transformative rather than transmissive in style).

Significantly, over the decade, D&T lecturers have deepened their knowledge and research – through exploring new pedagogies, pursuing advanced studies, publishing, and attending D&T, and other, education conferences.

Students and their prior knowledge/experience

Several of the general studies courses are also offered to students in other pre-service education programs. The interaction of students from a range of programs enables a shared and more holistic understanding of D&T to develop, breaking down some of the traditional approaches that depended on the 'making' focus of Technology Education of the past. The change in program focus has significantly increased the number of males and mature-age students enrolling in the program. This has meant the type and depth of prior knowledge that students bring is richer. The level of computer literacy in the last ten years has risen significantly. More students have extensive computer knowledge and have used a range of software programs to design and present ideas. Many students are well beyond basic word-processing and are proficient in web-page authoring, 3-D drawing, robotics and clay animation. These technologies are growing in popularity in both primary and secondary schools and are readily adapted to design-based pedagogy.

Greater numbers of students entering the program have trade qualifications and related work experience. Ten years ago most entrants were year 12 school leavers and were generally passive recipients, who listened intently and questioned little. Innovative critiquing and designing pedagogies both validate students' prior learning and life experience as well as lead to much enquiry-based learning. A decade ago Technology as a Learning Area was just emerging in the Primary Curriculum. Until this time, technical studies, with a focus on skill development in the use of a range of materials, had been taught in Secondary schools only. Now, the majority of students begin courses with a more informed understanding of Design and Technology; students generally have a greater understanding of the concept of design and the importance of critiquing.

For the promotion of D&T today, the greatest advocates are the graduates of the General Study courses. The level at which students value their learning resulted in the highest Course Evaluation Instrument (CEI) of all the courses offered in the BEdPM. When these students graduate they take with them a broad and holistic view of D&T, and help ensure that the Learning Area remains relevant, vibrant and, most importantly, valued as a domain of learning.

Over the last ten years there has been an increase in the number of students who choose to take Honours. Each year fifteen BEdPM students in their final year of study are offered Honours. Half of these students have completed courses in the D&T General Study. Each year two or three students complete their honours research in the area of Design and Technology. This research contributes to the growing body of knowledge in, and the status of, the Learning Area. It also informs both lecturers' and students' knowledge, understanding and pedagogy.

Looking back...

In our teaching we use a Venn model of integration of head, hands and heart to illustrate their co-dependence as quality D&T practice. We use this schema here to reflect on how, a decade ago, D&T courses were much more 'practical' – concerned with making. This is not to decry making, rather, it is to signify the affirmation of designing as central practice and critiquing as vital for the necessary questioning of technologies (Keirl, 2001a). This is the direction that D&T has taken in South Australian education.

Another three-set Venn diagram would show the interplay of the university D&T team, the SACSA developments, and the pre-service course developments across the period. Events have not unfolded either randomly or in isolation from each other. They have evolved as a synergy. Each area of growth, whether human, policy or planning, has fed another. Professional knowledge growth; curriculum evolution from DMA to CDM through Essential Learnings; and, university course development have all fed one another in dynamic ways.

The profile of the students has changed and they arrive not only as part of a much richer cohort, but also with knowledges and with perceptions of technology different from those held by their counterparts ten years ago.

Not only has course development continued to value the input of the professional knowledge of practising teachers but it has opened new cross-program dialogues, the fruits of which are only beginning to emerge. The innovations embrace many positives: the closer interplay of D&T with reflective practice in school placements; the CEI successes and the growth in Honours activity through D&T; the long-overdue appointment of another permanent lecturer; and the first iteration of a new foundation course for all D&T students.

Looking forward...

If the past ten years could be described as responsive development – responsiveness to political climes, to professional reflection, to curriculum development, and to social change – then so might the next ten. But that is not to say reactive – after the fact. If head, hands and heart apply to the next decade of

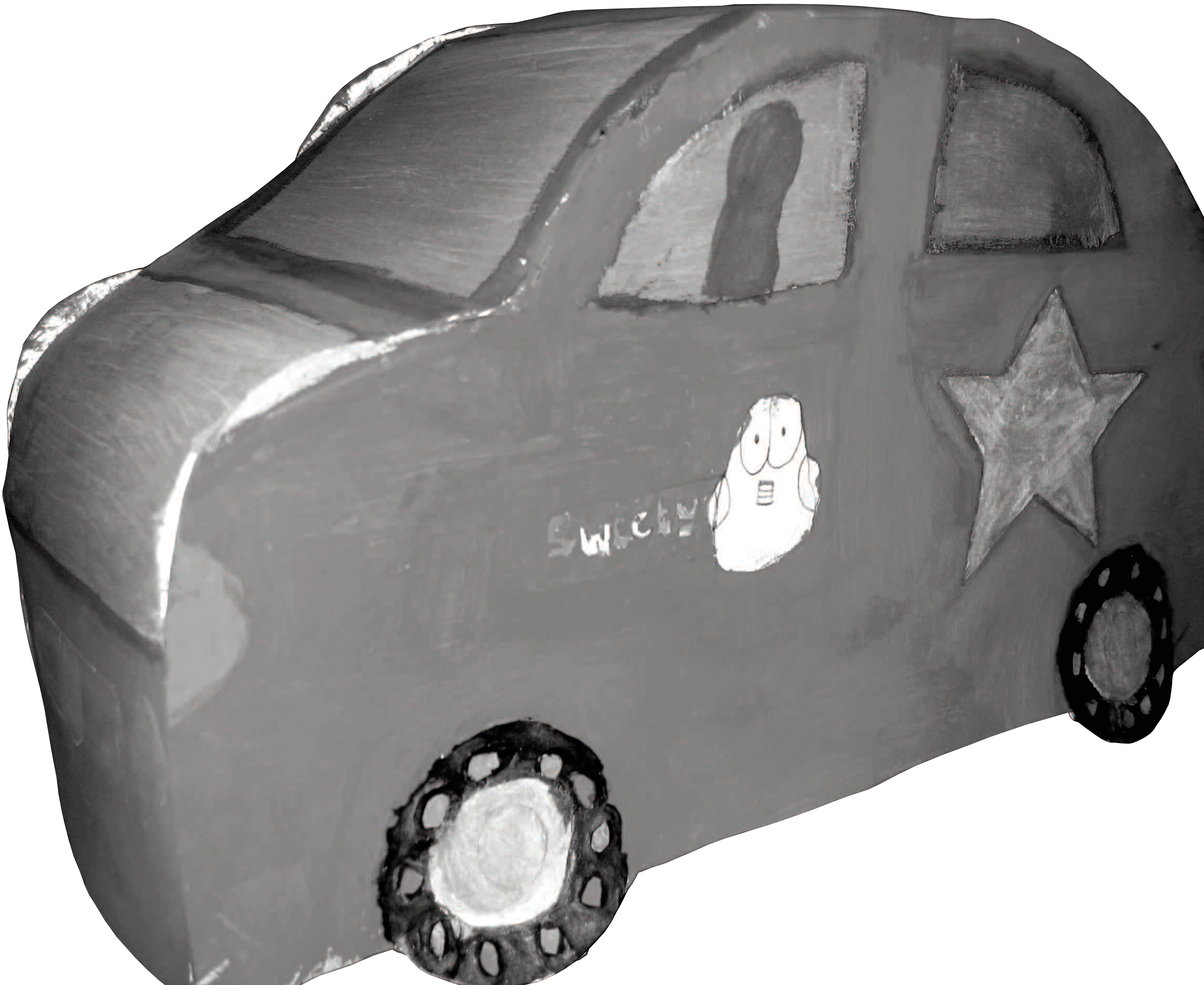
D&T practice, how can these be qualified? We would suggest that the head warrants not only analysis of the political but also professional contributions to policy within and beyond the university. The hands are about practical action in course design and delivery. Meanwhile the heart must be about confidence in D&T's curriculum place and about vision for what it has to offer in the future.

D&T is now positioned with some strength and viability but there is no room for complacency. We would argue that some of this strength is because of its capacity to defend a place in general education. Thus, as each of the Graduate Qualities, Essential Learnings and the BEdPM core principles have appeared D&T, because of its very nature, has had no difficulty in articulating them. Such adaptability is necessary for a field which is without the privilege of English, maths or science. In times of curriculum wars between OBE and a 'back-to-basics' fundamentalism, astute determination will be needed for D&T survival. It can be argued (eg Keirl, 2002) that were D&T to 'disappear' as a school 'subject' because of curriculum restructuring around Essential Learnings, it would still have a highly defensible role in that curriculum.

The future need not be seen as a lottery or beyond our control if D&T can be continuously redesigning itself in response to astute reading of political and curriculum trends. Perhaps …it may move from 'responding to' to 'informing' such trends.

References

- Australian Education Council (1994a)
  A statement on technology for Australian schools
  Curriculum Corporation, Carlton
- Australian Education Council (1994b)
  Technology – a curriculum profile for Australian schools
  Curriculum Corporation, Carlton
- Department of Education
  Training and Employment (DETE), (2001a)
  South Australian Curriculum Standards and
  Accountability Framework (SACSA)
  http://www.sacsa.sa.edu.au
- Department of Education,
  Training and Employment (DETE) (2001b)
  South Australian Curriculum Standards and Accountability
  Framework, (Hardcopy version)
  DETE Publishing, Adelaide
- Griffin P (1998)
  'Outcomes and Profiles:
  Changes in teachers' assessment practices'
  in Curriculum Perspectives
  Vol 18, No. 1, 1998
- Hargreaves A (2003)
  Teaching in the Knowledge Society:
  Education in the age of insecurity
  Open University Press, Maidenhead, UK
- Harris C & Marsh C (eds.) (2005)
  Curriculum Developments in Australia:
  Promising initiatives, impasses and dead-ends
  Openbook, Adelaide
- Keirl S (2001a)
  'Critical beginnings for Design and Technology education-why and how might critiquing be a key component of children's learning in the early and Primary Years?', in (eds.) Benson C & Till W (2001), Proceedings of Third International Primary Design and Technology Conference
  CRIPT, University of Central England, Birmingham
- Keirl S (2001b)
  'Design and Technology and the five 'Essential Learnings' of a new curriculum framework', in (Eds.) Norman E W L & Roberts P H (2001), Proceedings of the International Conference on Design and Technology Educational Research and Curriculum Development
  Loughborough University, Loughborough, UK
- Keirl S (2002)
  'Against the provincialism of customary existence: issues arising from the interplay of 'essential learnings', design and technology and general education', in (Eds.) Middleton H, Pavlova M & Roebuck D (2002). Learning in Technology Education: Challenges for the 21st Century, Proceedings of the 2nd Biennial International Conference on Technology Education Research 5-7 December 2002, Parkroyal Surfers Paradise, Gold Coast, Queensland, Australia. Centre for Technology Education Research Griffith University, Qld
- Killen R (2006)
  Effective Teaching Strategies:
  Lessons from research and practice
  Thomson Social Science Press, South Melbourne
- MacGregor D (1999)
  'Initial Teacher Education for Primary Technology Education in South Australia: Innovations, reflections and futures'
  in (eds.) Benson C & Till W (1999)
  Proceedings of Second International Primary Design and Technology Conference
  CRIPT, University of Central England, Birmingham
- Reid A & O'Donoghue M (2001)
  Shaping the Future: Educating Professional Educators
  Report of the Review of Education at the
  University of South Australia
- Williams P J & Keirl S (2001)
  'The status of teaching and learning of technology in primary and secondary schools in Australia'
  in (Eds.) Norman E W L & Roberts P H (2001)
  Proceedings of the International Conference on Design and Technology Educational Research and Curriculum Development
  Loughborough University, Loughborough, UK



What is the Impact of Design and Technology on Non-fiction Writing?

Giles Junior School, Durham Road, Stevenage, Hertfordshire, SG1 4JQ
Davinder Kaur Khangura – E-mail divikaur@hotmail.com

Abstract

This study investigated the impact of design and technology on children's non-fiction writing. In a Hertfordshire primary school, children in class A were asked to watch the teacher and then write instructions of how to make a simple cam model. They were not able to assemble the materials until they had completed the instructions. Four Class B children were asked to first assemble the materials to make a simple cam model and then asked to write instructions about how to make it.

Qualitative data was collected, children were observed during the designing and making process and when completing the questionnaires. Children's instructional writing was assessed by the class teachers, in order to establish the impact of d&t on children's instructional writing.

I aim to show that d&t can play an influential role in aiding learning and skills in Core subjects such as Literacy. I hope to promote cross curricular links within my school.

Introduction

Background

School A, is a two-form entry Junior School in Stevenage with approximately two hundred and forty children. Our feeder school is based on the same site but is entirely separate. There are a significant number of children joining School A throughout Key Stage two. Such inconsistencies impact on the teaching and learning of design and technology (d&t). Children's learning experiences vary from little to high-quality from Young Engineer's Club (after-school club). Therefore, I have identified two mixed ability Year 5 classes to study aiming to disclose the impact of d&t in their non-fiction writing.

Choice of unit

Unit 5C; Moving Toys was chosen for evaluation, which is taught in the autumn term and therefore corresponds with my assignment timetable. The Moving Toys unit will be taught by myself (Teacher A), twice to two different year 5 classes in succession.

The revitalisation of d&t through staff training has drawn some focus on how School A can use such foundation subjects in Core subjects of the curriculum. Although some staff members are now confident in teaching d&t, some are reluctant to make cross-curriculum links and are even unsure on how or where to link skills. Some teachers in School A are also unclear about the role of writing in d&t, often writing without reason or purpose. Lunt (2005) asks whether writing tasks in d&t is a purposeful activity or just more paperwork. I am aiming to show how d&t can play an influential role in aiding learning and skills in Core subjects such as Literacy. If teachers acknowledge how design and making can lay the foundations for successful writing, such reluctances may reduce and open the doors to linking d&t across the curriculum and appreciating the importance of d&t as a vital learning tool in core subjects.

Methodology

Two classes in year 5 were chosen to investigate the impact of design and making on instructional writing. Prior to the d&t lesson all children in year 5 had been taught about instructional writing and key features about language and organisation needed. However no independent writing took place to ensure all ideas were collected from the d&t lesson later that day.

Session 1 for both classes (one hour each)

Introduction to cams; as part of the lesson children were shown how to make various cams with different movements of the cam follower. Teacher A demonstrated how to make this activity in a Focus Practical Task.

For Class A (first session to take place), children were asked to watch the teacher and then write instructions of how to make a simple cam. Children in Class A were able to see the materials and equipment needed, but not assemble them until they had completed the instructions.

For Class B (second session in succession to Class A) children were asked to first assemble materials to make a simple cam, that had been demonstrated by Teacher A. following the design and making Class B was asked to write instructions about how to make a simple cam.

Twelve children completed the questionnaire at the end of the session from each class, to share and discuss their ideas, as suggested by Trebell (2005). The children were randomly selected by teacher A with equal number of females and males were used. William & Wiersma (1999) discusses how participants need to be randomly selected for research in order to make valid interpretations of the results found.

Qualitative data is considered to be more efficient for when working with children and the semi-structure of this research study (Lankshear & Knobel, 2004).

Teacher B was asked to read and comment on the instructional writing. Teacher B's oral feedback on the children's work was recorded and thus written comments were noted on the back of the children's piece of work.

My aim was to identify a relationship between the research question and the data collected. The children's comments and answers to the questions, and teacher B's comments all provided the most significant evidence to classify how d&t can impact on non-fiction writing.

Unit of work

In the previous lesson children were introduced to cams, they were shown examples of cams and cam follower (CF). As a class we identified CF and their movements specific to their shapes. Children were taught that a cam works on a CF. The aim of the lesson was to investigate the shape of cams with movement of cam follower.

Moving Toys (Designing and Making process Session)

The children were shown by Teacher A, and then asked to design and make their own cam with their own choice of a cam follower.

Focus Practical Task; using a large piece of card, glue on two pieces of wood at the top of the card. Then place a small piece of card over wood to hold cam follower (lolly pop stick). Hole-punch a hole using heavy duty drill near the bottom of the card. Place cam shape and hold with split pins.

This task was employed as it strengthens children's understanding about what cams are and the movement of cams. Thus children are taught key vocabulary such as cam, cam follower.

Instructional Writing

Instructional writing was chosen for the focus writing task due to the experience and investigating skills needed. Palmer (2001,p2) discusses all different types of non-fiction writing, but highlights;

> *'there are many occasions across the curriculum when children carry out activities which can become the content for writing instructions, for example design and technology: how to design and make an artefact'.*

She emphasises the importance of children's writing being based on their own experience, thus a vital tool to improve writing skills. I decided to choose instructional writing as the writing task rather than other areas of non-fiction writing, as I feel this type of writing allows more scope to investigate the impact of design and making on writing. Furthermore at the 9 day d&t course, my Food tutor was discussing the use of children following instructions when baking and said; 'with food, children can put instructions in context…' This enhanced my decision to focus on instructional writing.

Results

Analysis of Findings and Teaching Implications

The comparison between children's instructional writing was distinct and it was apparent to the other Year 5 teacher and myself, which children used designing and making skills to write instructions. Children who did not make their own cam model before writing instructions significantly struggled with the task. Children who firstly made a cam model were easily able to write clear and correct instructions.

It was evident to the children, teachers and teaching assistants that the struggle to write instructions was based on the lack of experience to make the actual object. I made notes of the comments and conversations while children wrote the instructions and then completeded the questionnaires.

Child A clearly said; 'Miss, how can I write instructions, if I didn't make it, I don't know the steps?' Order of step was a feature on our Class Success Criteria and children were very clear that they had no technical knowledge of making the cam model. Furthermore Child B continued 'you wouldn't need instructions of something you wouldn't make'. Child B here focuses on the reason of instructional writing; the child is aware that instructions are a tool to aid making and constructing. However writing instructions without prior constructional experience makes the task of writing almost useless and ineffective. I asked the children when was the last time they or someone they knew used instructions to make something. The children replied with discussion about Christmas day, when their parents used instructions to make their toys. I asked the children to then discuss why it may be important to make something first then write instructions of how to make it. The children replied with comments such as 'It's really important Miss, it doesn't make sense if you don't.'

Furthermore several children commented on memory and forgetting how I made the cam model. Moreover, suggesting that motor skills are necessary to capture visual facts and steps of making. Children seemed to easily know the names of tools, material and order of steps, when they made the cam model themselves. These children seemed to use the correct vocabulary, which aided learning in Literacy and d&t. The other children showed a lack of technical vocabulary and therefore missed this learning opportunity. Children continued to comment on the difficulty of writing these instructions, suggesting that it was common sense to make something and then write instructions.

Teacher A and B discovered that children who made the cam model before writing instructions, gained from the experience of design and making, such advantages included using correct technical vocabulary, steps ordering the stages, clean and precise sentences. The other children, who did not make the cam model before writing the instructions, wrote ambiguous and incorrect instructions, that lacked quality and less features from the success criteria. Incorrect vocabulary was often used, some children completed the instructions making steps. Low ability children struggled the most and produced the least work.

Higher ability children tried their best and did write some correct steps, but instructions were often too long. This task did not allow children to achieve well, Level 4 writers were producing Level 3 work.

Evaluation

Teaching and Learning

There was significant impact of design and technology in non-fiction writing. Children who experienced d&t skills, by making a product, benefited from practical work and high-quality writing was then produced in a writing task. Children who did not experience making the Moving Toy (product) were unable to write adequate instructions and achieved less in the writing task. There was a significant and positive link between d&t and writing in a cross curriculum context.

I used the pattern-matching process to gather this information, as suggested by Yin (1994). This process involved matching significant patterns such as repetition of actions and comments and thus looking for logical trends. A more efficient approach is described by Fetterman (1989) who suggests that data such as observation notes need to be organised and sorted into categories, where information can be compared and contrasted. Perhaps this process could have provided more comprehensive results if more time was available to gather information A.

The delivery of d&t in School A has not been steady or consistent since the introduction of the National Curriculum. Like the continual revision and changes in the status of d&t in the QCA (1998a), as quoted by Benson (1999). The teaching of d&t is often interrupted and thus devalued and therefore I question the current practice to continue to raise standards.

Benson suggests a number of factors that contribute to quality and successful delivery of this subject. These include a supportive head; School A is fortunate to have a head that has spent time and money to raise standards by offering training to each teacher and thus three teachers have now attended the 9 day course. Nonetheless, as discussed earlier, regular training or updating is needed as teacher's confidence has lessened when teaching in other year groups. International research by Rogers (2005) found that teacher's confidence is increased when (students) gain more understanding of the product children are designing and making. She reports (P;117);

> *'so you are confident in yourself as well as being able to answer children's questions and helping the children develop their understanding …'*

There is a clear and key link with experience and confidence which needs to be explored by teachers as well as children.

A proactive coordinator is another factor; however as the writer of this assignment and thus a d&t coordinator I feel my evaluation may be biased. Nevertheless, since my taking on this new role, I have provided staff with planning, support and advice and, resources. Following my 9 day course I will be taking a staff meeting to distribute further ideas and tips gained on the course, my support with teachers is often discussed informally in the staffroom over lunch. I often debate on whether I motivate, and increase confidence in staff, as time is limited. Such analysis of my role questions whether I am the 'person' who Mike Ive (1999), emphasises to lead the development of this subject.

Being a well resourced school that celebrates children's work in assemblies and on displays, School A fulfils other fundamental factors. In all, quality in teaching and learning is often greater in some areas in the school in comparison to other weaker areas.

Cross curricular links and writing in D&T

When d&t was introduced into the primary curriculum, it was emphasised that in order to develop as a subject it must be taught at the appropriate primary level (Williams & Jinks, 1985). D&t was linked to the philosophy of primary education key concepts; first hand experience, integration and process. Williams & Jinks in 1985 (p.22) point out that in order to solve design problems;

> *'work will stretch across the curriculum from planning skills, precise measurement, re-search skills to formal description writing on craft work.'*

A straight forward and clear link in the primary curriculum, is depicted by Williams & Jinks. However, I feel in the 2007 this linkage in the curriculum is uncertain and almost not recognised. I agree that skills used in d&t are also found in Numeracy and Literacy. Teachers must be aware when teaching the subject, but may find it time consuming to draw these links with children in lesson time. Nevertheless the education wheel is turning and more cross-curriculum links are emphasised for integration in primary education. Such links will have to used and illustrated directly to children and in planning.

Hope (2004) describes a children's design as a journey of exploration and outlines the role of writing in d&t (p.89);

> *'In Key Stage 2, children need to learn to use drawing and writing to record what is useful to themselves.'*

Furthermore, she adds that writing along with drawing and researching aids children's thinking process and develops their d&t skills. Also, writing and drawing can support speaking and listening skills that are interlinked in the Literacy hour.

Moreover research by Howe (1999) directs to have a Visual Literacy Strategy. He agrees that the introduction of the Numeracy and Literacy hour was time consuming, but connects key skills in these Core subjects with skills used in d&t (Howe P215);

> *'the two subjects facilitate development in children important, life enhancing skills such as observation, aesthetic awareness, discrimination and critical thinking.'*

Howe makes a fundamental connection between these skills to d&t, he argues that such a positive association could develop into visual literacy. By combining skills of evaluation and exploration. Furthermore, discussion by Harris & Wilson (2003) indicates that cross-curricular link can raise standards of achievement in d&t (p.169);

> *'Literacy – The development of technical vocabulary is essential for effective participation in d&t…*
>
> *Numeracy – d&t has obvious links with mathematics e.g. for measurement, calculation and data analysis.'*

Cross-curricular linking of subjects creates a stimulating and inspiring view of children's learning; nonetheless such linking is perceived as difficult by teachers since the pressure of the Core subject hours and SATS. Bowen (1999, p.36) names such pressure as; 'a squeeze on the foundation subjects.' Research by Bowen only found that d&t 'could be supportive of literacy activities' (p.38). However no concrete reasoning was involved in this research and thus his study was focussed on planning rather than a more broad perspective.

As considered earlier d&t was introduced in the national curriculum to fulfil three key concepts and thus to enable children to use e.g. writing skills to solve design problems (Williams & Jinks, 1985). If Harris & Wilson also state that the development of technical vocabulary is fundamental to teaching d&t, I question why is this association unclear to schools and not evident to teachers? Daker (2005) suggests that that curiosity element that contributes to technological literacy does exist in the classroom but is not exercised. Perhaps it is the responsibility of the class room teacher to recognise these elements and use them effectively.

The fundamental impact of d&t in children's learning

The first national curriculum for d&t was published in 1990's, like many primary teachers it was perceived to not be 'easy to access' (Benson, 2000, p.1) which added to the value and creditability of this subject. The DATA outlined and supported the links to other subjects such as Citizenship, Literacy and Numeracy. D&t was seen to prepare children with life skills for the future and provide them with initiative when dealing with others' viewpoints, in all building a mature and independent individual who has the skills to face a range of situations in the future. I feel that the essence of this subject is almost wasted in school; however I am pleased to say that School A is recognising the importance of this subject. Like Mike Ive & Clare Benson suggested, a number of factors are needed to be considered to create this ethos in a school, understanding the nature of d&t, a supportive Headteacher and coordinator and so forth.

Future Implications

The future at the school gives cause for optimism after a number of years where d&t was not a high priority. Following the 9 day training provided for three members of staff, the exchanging of good practice has started and will continue in staff meetings. The findings from this assignment have added to the value of d&t in the school, the Literacy coordinator invites such cross curricular links and is implementing them in year 3 and 4. We have asked teachers to base non-fiction writing such as instructions, explanation and recount on experience from d&t lessons.

I would like to end this on thoughts based on research gathered by Lunt who investigated whether writing tasks were a 'purposeful activity or just more paperwork?' My answer prior to this assignment would have been that writing in d&t can be a waste of time. Following this assignment my answer has changed to an alternative viewpoint; some non-fiction writing in Literacy can be a waste of time, if it is not purposeful and thus connected to children's first hand experience. Both d&t and literacy lessons can be revitalised by using cross-curricular links.

This reflection of d&t in school A has enabled me to recognise how school A is continually moving forward with the d&t aim for the children to enjoy and love d&t.

References

- Bendall T (2006)
  Getting the balance right (2)
  Developing design & technology in primary schools – beyond the QCA scheme
  Data Practice, no. 1, pp.34 – 37
- Benson C (1999)
  Quality in the making
  Second International Primary Design and Technology Conference
- Benson C (2000)
  Teaching and Learning Design and Technology
  A guide to Recent Research
  London: Continuum
- Bowen R (1999)
  Primary School Design and Technology in the
  Era of Literacy and Numeracy
  Second International Primary Design and Technology Conference

- Draker J (2005)
  Arguing for the Development of Technological Literacy
  Fifth International Primary Design and Technology Conference
- Fetterman (1989)
  in Lankshear C & Knobel C (2004). A handbook for Teacher Research; from design to implementation
  Open University Press. McGraw-Hill Education
- Harris M & Wilson V (2003)
  Designs on the Curriculum?
  A Review of the Literature on the impact of Design and Technology in Schools in England
  The Journal of Design and Technology Education
  The Data Journal. Vol 8. No. 3
- Hope G (2004)
  Teaching Design and Technology 3-11
  The Essential Guide for Teachers
  London. Continuum
- Howe A (1999)
  A Visual Literacy Strategy-Why not?
  The Journal of Design and Technology Education
  The Data Journal. Vol 4. No. 3
- Keirl S (1999)
  The Fruits of Technology Literacy:
  Wild varieties or crops of mass production?
  Second International Primary Design and Technology Conference
- Lankshear C & Knobel C (2004)
  A handbook for Teacher Research;
  from design to implementation
  Open University Press. McGraw-Hill Education
- Lunt J (2005)
  Pupil's views of writing tasks in design and technology:
  Purposeful activity or just more paperwork?
  Fifth International Primary Design and Technology Conference
- Ive M (1999)
  in Benson C (1999) Quality in the making
  Second International Primary Design and Technology Conference
- Palmer S (2001)
  How to teach writing across the Curriculum at Key Stage 2
  Fulton Publishers. London
- Qualification and Curriculum Authority (2000)
  Design and Technology. DfEE
- Rogers M (2005)
  Using Artefacts and their Stories to
  Develop Design and Technology Capability
  Fifth International Primary Design and Technology Conference
- Trebell D (2005)
  Creativity through intervention
  The Key Stage 3 Design & Technology framework
  Data Practice, Issue 2, pp.7 – 9
- Williams P & Jinks D (1985)
  Design & Technology 5-12
  London & Philadelphia: The Falmer Press
- William & Wiersma (1999)
  in Lankshear C & Knobel C (2004)
  A handbook for Teacher Research
  from design to implementation
  Open University Press. McGraw-Hill Education
- Yin (1994)
  in Lankshear C & Knobel C (2004)
  A handbook for Teacher Research
  from design to implementation
  Open University Press. McGraw-Hill Education

Investigating Pupils' Perceptions of Writing Tasks in Design and Technology

CRIPT, University of Central England, Birmingham, Faculty of Education, Attwood Building, Perry Barr, Birmingham, B42 2SU, England
Julie Lunt – E-mail julie@julielunt.co.uk Telephone: +44 (0)1873 880776

Abstract

Writing has traditionally been an element of children's activity in most subjects of the primary curriculum. In design and technology, children's writing is often combined with other forms of representation such as drawing, talking and working with materials to create multimodal texts. What meaning do children make of these writing tasks as an element of their experience of learning and participating in design and technology? What is their reaction to them?

Children are increasingly seen as key stakeholders in education and central actors in the teaching and learning situation with very particular insights to offer us to help us develop our understanding. This paper presents initial findings from the analysis of interviews with 65 children, aged 9 – 11, from three primary school classes in England. The data was collected as part of a larger on-going collaborative action research based study.

The findings show that these children's views of writing tasks in design and technology are influenced by their construct of design and technology as a goal-oriented activity built around the creative act of designing and making a product. The children were more positive about the writing tasks they experienced in design and technology when the tasks were closely related to this creative act; were a relevant form of writing; presented an appropriate level of challenge; and did not impact too heavily on the time available for making.

Introduction

Since the mid 1990's, government policy in England has driven a greater emphasis on raising standards in literacy, and official and professional guidance has encouraged primary teachers to incorporate writing tasks in foundation subjects such as design and technology (e.g. SCAA, 1997; DATA, 1999). Design and technology is acknowledged to be a popular subject with children and it has been widely promoted as a motivating context for meeting wider educational goals such as literacy skills. However, there is a possible tension created when writing tasks become a major feature of teaching and learning in design and technology, particularly for upper Key Stage 2 pupils (aged 9 – 11 years) (Stables et al, 2000).

This paper will provide an overview of writing in design and technology before reporting and discussing the initial findings from an analysis of interview data with children, aged 9 – 11, on their perceptions of writing tasks in design and technology in general, and their perceptions of writing tasks in a specific unit of work.

Writing in design and technology

In design and technology, children's writing is usually brief and is often combined with other forms of representation such as drawing, talking and working with materials in multimodal texts. It typically comprises of lists, labels, annotations, notes in table form, bullet points and web diagrams. These forms of writing do not correspond closely with the objectives set for this age group by the National Literacy Strategy (DfEE, 1998) which tend to emphasise impersonal writing and extended prose.

In the literature for design and technology, the activity of writing has received little attention compared to drawing. There are a small number of studies that treat design and technology as a motivating context for developing children's writing skills (e.g. Stables et al, 2000; Spendlove and Stone, 2002). Earlier studies by the author have focused on writing as a form of representation that might aid children's thinking and learning in design and technology. These have identified teacher purposes for writing tasks in design and technology (Mantell, 2003) and have investigated the reasons children give for writing tasks being helpful to them (Lunt, 2005).

Until recently, design and technology featured in the literature for primary writing as a context for developing literacy skills, for example, writing a puppet play for puppets created in design and technology (Seberry and Seberry, 1998). More recently, greater attention has been given to the types of writing that children naturally engage with as part of learning in design and technology (e.g. Bearne, 2002). Language plays a central role in learning and writing has a range of cognitive as well as communicative functions. Socio-cultural theories of learning, influenced considerably by Vygotsky (1962, 1978) and Bruner (1986), draw attention to the ways in which the tools and sign systems of a society, such as speech and writing, shape and make possible our thoughts. Moreover, our own thinking and problem-solving can be represented as a model with the help of these psychological tools, allowing them to become the object of our conscious deliberation, planning and decision-making (Kozulin, 1998).

Researching pupil perspectives

There are very few research studies that focus on primary pupils' perceptions of their experience of design and technology in school. However, outside design and technology there is a growing body of work that gives children's perspectives a central position in the research process. These studies show that children are competent reporters of their own experiences and often show considerable maturity in their observations and analysis of their experiences (e.g. Hallam et al, 2004; Ruddock and Flutter, 2004).

There are a number of limitations and challenges involved in eliciting pupils' perceptions of their experience in school (Rudduck and Flutter, 2000). For example, the views of more articulate pupils might be better represented than those of pupils who find it more difficult to express their views, and the selection of data collection methods needs to be appropriate to the children participating in the research.

Methodology

The findings presented here are based on data collected as part of a larger collaborative study between myself and three teachers and their mixed age classes (9 – 11 year olds) in three small rural primary schools in England. Interviews were conducted with 31 pairs of children and 1 group of three before and after a unit of work. In the first interview before the unit of work the children were asked about design and technology lessons in general; in the second interview they were asked to comment specifically on their views of the unit of work. Paired interviews were used rather than individual questionnaires to enable discussion between children and a deeper probing of pupil perceptions.

The interviews were recorded on to audiotape and were transcribed verbatim. The data were analysed using the constant comparative method in which thematic categories are generated and modified through repeated readings of the data until saturation point is reached.

Findings

How did these children view design and technology?

The analysis reveals that these children regarded design and technology very positively. What they valued most about their experience of design and technology was overwhelmingly the opportunity for making. The other most frequently cited aspects were doing things for themselves, the practical nature of their activity in design and technology, learning new things, creating products and solving problems.

How did these children view writing tasks in design and technology in general?

When asked for their views of writing tasks in design and technology generally, the majority of children were positive and regarded them as purposeful. Most pupils regarded writing tasks which were directly related to the designing and making of their product as helpful to them, providing the balance between writing and other activities of design and technology, especially making, was maintained. Pupils gave a variety of reasons for writing tasks being helpful to them which have been categorised and are presented here in descending rank order:

- Create a record we can refer to.
- Help us to plan and make our product.
- Help us to learn and understand.
- Prepare us for the future.
- Help us to improve our writing.

(Lunt, 2005: 66)

How did these children view specific writing tasks in a unit of work?

In the interviews conducted after the unit of work, children were asked questions related to each of the writing tasks they had experienced. The children were asked to comment on what they thought of the writing task, why they thought their teacher had asked them to do it and to grade the task according to its helpfulness and level of difficulty. The children were also asked about their views of the amount of writing across the unit of work and were invited to suggest any changes they would make to the writing tasks.

The children were involved in a variety of writing tasks in their particular unit of work which are summarised in Figure 1. The writing tasks in all the schools were introduced and directed by the teacher and were carried out on an individual basis.

What were these pupils' feelings about their writing tasks?

The interviews were coded for children's affective responses to the writing tasks. Positive comments included 'fun', 'interesting', 'cool', 'wicked'; negative comments included 'boring', 'I didn't enjoy this one'. In every school the large majority of responses were positive. Pollard et al (2000) found that fun and interest were the criteria most used by children to determine which activities and subjects they liked. For the children in this study, fun and interest were strongly associated with design and technology itself. Sometimes it was difficult for them to separate out their experience of the writing tasks from an accompanying practical activity. This could be interpreted as a limitation of the children or the interviewer or as a successful integration of practical and written tasks by the teachers.

How did these pupils judge their writing tasks?

The interviews were coded for evaluative judgements. Positive comments included 'very good', 'useful', 'it made you think hard', 'it gave you an idea'; negative comments included 'it didn't help us', 'it could have been better', 'I think we needed to get on with our models'. Most of the children's evaluative judgements related to the role of the writing tasks in helping them to successfully design and make their product. Overall, design drawings received the most positive judgements with the exception of the final design drawing in School 1. In this case, the final design drawing was regarded by many children as a 'neat copy' whereas the final design drawing in School 3 was regarded as a development tool in designing and making their product. It would appear that the key difference in School 3 was that the children had made a mock up in between the two design drawings which had helped them to get valuable new information to inform their final design drawing.

How helpful did these pupils find the writing tasks?

The children graded each writing task on a standardised scale. These ratings were used to determine the relative helpfulness of each writing task in each school as shown in Figure 2.

Figure 1. An overview of the writing tasks in each unit of work showing their relationship to different types of design and technology activity

	Investigating and evaluating products (IDEAs)	Focused practical tasks (FPTs)	Designing and making assignment (DMA)
School 1 Project: Fairground rides	1) Fairground rides sketches with labels, arrows used to signify type of movement	2) Electrical circuits diagrams with labels and comments 3) Pulleys worksheet diagrams with labels and comments, arrows used to signify direction of movement – worksheet frame	4) First design drawing drawing with labels and annotations 5) Final design drawing drawing with labels and annotations
School 2 Project: Fairground rides	– –	1) Pulleys diagrams with labels and comments	2) Design drawing drawing with labels and annotations; written list of materials 3) Evaluation and steps (completed after making) instructions presented through annotated drawings and written comments; evaluation in bullet points – frame modelled by teacher
School 3 Project: Textile containers	1) Thinking about familiar objects, written notes presented in table form 2) Collecting ideas – good/bad points written notes in table form – worksheet frame –		3) Specification writing in bullet points or short paragraph 4) First design drawing drawing with labels and annotations, list of materials 5) Mock up paper mock up which some children annotated with measurements and written labels 6) Final design drawing drawing with labels and annotations, list of materials 7) Step by step plan (completed before making – only children who had time did this writing task) annotated drawings and written comments

Figure 2. Writing tasks in rank order of helpfulness from the most helpful to the least helpful	
	Writing tasks in rank order of helpfulness
School 1	4) First design drawing 1) Fairground rides 2) Electrical circuits 3) Pulleys worksheet 5) Final design drawing
School 2	2) Design drawing 1) Pulleys 3) Evaluation and steps
School 3	6) & 7) Final design drawing and Step by step plan 4) & 5) First design drawing and Mock up 1) & 2) Thinking about familiar objects and Good points/bad points 3) Specification

The children also made incidental comments about the helpfulness of the writing tasks when answering other questions in the interview. These were coded and incorporated into the overall analysis. The children found writing tasks which helped them to design and make their product the most helpful, followed by those that created a record to refer to and those that helped them to learn and understand. There were very few references to preparing them for the future or helping them to improve their writing (Lunt, 2005). The least helpful writing tasks were those which were deemed to be irrelevant or unnecessary or were seen as fulfilling the teachers' purposes rather than their own.

What did these pupils think about the quantity of writing?

The majority of children in each school thought the amount of writing was about right rather than too little or too much. Surprisingly, the children who were the most satisfied with the amount of writing in their unit of work were those in School 3, who did the most writing tasks and had the tasks which involved the most writing. Looking at the data as a whole I would suggest that this was influenced by the teacher's explicit attempts to integrate the writing tasks as much as possible with the designing and making process.

What did these pupils think about the level of challenge of the writing tasks?

The children were asked to grade each writing task on a scale of 1 to 4 from 'very easy' to 'very difficult'. Very few children judged any of the tasks to be very difficult. The children in School 1 who judged their writing tasks least positively overall had the highest numbers of the 'very easy' rating. It is possible that these children might have responded better to a greater level of challenge in their writing tasks.

What issues were raised by these pupils?

Three main issues were raised by these pupils about their writing tasks – time, relevance and control. Children from each of the three schools mentioned pressure on time to complete their products. For them, time assigned to making was not only enjoyable but necessary if they were to achieve their goal. Sometimes writing tasks were seen to threaten that and where time was at a premium, the children's priority was definitely making. However, some children also talked about pressure on time in relation to their writing tasks. They would have liked more time to complete them or not to have had to rush. Time pressure has been identified by other studies into children's perceptions of their experience in school particularly since the introduction of a standardised curriculum (e.g. Pollard et al, 2000; Ruddock and Flutter, 2004).

Positive and negative comments about relevance were closely related to the extent to which the writing task helped them to design and make their product. However there were also comments related to differentiation, especially from the children who were more able. These children said they would have liked writing tasks more suited to their abilities in design and technology.

Negative comments about control were made by children who found particular writing tasks constraining or who found teacher interruptions unwelcome. Positive comments related to being able to do things for themselves and to make their own decisions, for example, deciding how to set out their own work. A sense of autonomy has been found by many researchers to be closely associated with a greater level of learner engagement (Rudduck and Flutter, 2004).

Discussion

The majority of children in this study regarded writing tasks in design and technology positively although there were some differences between the three schools and between individual children in each school. A significant factor in pupils' perceptions was the relevance of the writing task to the successful achievement of their designing and making assignment. McCormick and Davidson (1996) highlight the central place that the creation of products has in the domain of design and technology and the motivational effect that has on pupils. The pupils in this study confirm that view. The children's comments about the helpfulness of the writing tasks were directly related to the contribution they made to the specific creative act of this unit of work, rather than to wider educational goals such as learning how to design. The writing tasks judged least positively by the children were those where they could not see a clear purpose to benefit themselves as designers and makers.

The children's comments reveal that they valued both the process and products of their writing when they were closely related to their designing and making. Many children talked about particular writing tasks making them think and moving their ideas forward. They also spoke of the outcomes of their writing tasks as external objects that could help them, e.g. it tells you what to do; if you forget, you can just get it out and it helps you to remember. The children kept their work in a design folder or worked in an A4 size design book. However, they did not appear to view these explicitly as a design portfolio, rather as a repository for all their work related to the project (Barlex et al, 2005).

The writing tasks in these three cases did not show teachers making close links between writing and specific literacy objectives for this age range from the National Literacy Strategy (DFEE, 1998). Only one writing task, the Evaluation and Steps in School 2, had a literacy focus. This took place in a literacy lesson which might have contributed to its generally positive rating, as the children were expecting a literacy activity and it did not compete with time for designing and making. An increased emphasis on multimodal texts in literacy (QCA, 2004) might provide teachers in the future with more opportunities to use literacy lessons to enhance children's skills in using design and technology genres, such as annotated drawings.

Conclusion

The findings from this study suggest that children are motivated by design and technology because of its distinctive character. Their views of writing tasks in design and technology are grounded in their construct of the subject as a goal-oriented activity built around the designing and making of a product. Writing tasks that are perceived to contribute to meeting their goal are more likely to be judged positively. The amount of writing and level of difficulty were of secondary importance for these children. It would appear that there are certain genres of texts, some of which combine drawing with other forms of representation, which are viewed by children as forming a natural part of design and technology.

This study raises further questions about the role of writing in the processes of learning in design and technology and in the processes of designing. What can the activity of writing offer to children? When is it better not to ask children to write? What are effective ways of teaching designing skills when children are so focused on their goal of making their product? It also raises questions about the definition of literacy. Current debates in literacy education highlight the emergence of new forms of literacy which place much greater emphasis on multimodal texts. What role might design and technology play in a future literacy curriculum?

References

- Barlex D, Welch M & Taylor K (2005)
  'Never Keep Your Ideas in Your Head:
  Elementary pupils' views of portfolios in technology education'
  In Benson C, Lawson S & Till W (eds.)
  Excellence through Enjoyment:
  Fifth International Primary Design and Technology Conference,
  Birmingham: CRIPT, 11-14
- Bearne E (2002)
  Making Progress in Writing
  London: RoutledgeFalmer
- Bruner J (1986)
  Actual Minds, Possible Worlds
  Cambridge, MA: Harvard University Press
- DATA (Design and Technology Association) (1999)
  Developing Language through Design and Technology
  Wellesbourne: DATA
- DFEE (Department for Education and Employment) (1998)
  The National Literacy Strategy: Framework for Teaching
  London: DFEE
- Hallam S, Ireson J & Davies J (2004)
  'Primary pupils' experiences of different types
  of grouping in school'
  British Educational Research Journal, 30, 4, 515-533
- Kozulin A (1998)
  Psychological Tools: A sociocultural approach to education
  Cambridge, MA: Harvard University Press
- Kress G & van Leeuwen T (2001)
  Multimodal Discourse: The modes and media of contemporary
  communication. London: Arnold
- Lunt J (2005)
  'Pupils' Views of Writing Tasks in Design and Technology:
  Purposeful activity or just more paperwork?'
  in Benson C, Lawson S & Till W (eds.)
  Excellence through Enjoyment:
  Fifth International Primary Design and Technology Conference
  Birmingham: CRIPT, 65-68
- McCormick R & Davidson M (1996)
  'Problem solving and the tyranny of product outcomes'
  The Journal of Design and Technology Education
  1, 3, 230-241
- Mantell J (2003)
  'Teachers' Perceptions of Purposes for Writing Tasks in Design
  and Technology at Key Stage 2'
  In Benson C, Martin M & Till W (eds.)
  Designing the Future:
  Fourth International Primary Design and Technology Conference
  Birmingham: CRIPT, 112-115
- Pollard A & Triggs P
  with Broadfoot P, McNess E & Osborn M (2000)
  What Pupils Say: Changing Policy and Practice in Primary Education
  London: Continuum

- QCA (Qualifications and Curriculum Authority) (2004)
  More than words:
  Multimodal texts in the classroom
  London: QCA
- Rudduck J & Flutter J (2000)
  'Pupil Participation and Pupil Perspective:
  'carving a new order of experience"
  Cambridge Journal of Education, 30, 1, 75-89
- Rudduck J & Flutter J (2004)
  How To Improve Your School:
  Giving pupils a voice
  London: Continuum
- SCAA (School Curriculum and Assessment Authority) (1997)
  The Use of Language: A common approach
  London: SCAA
- Seberry B & Seberry J (1998)
  "My Priority is Language': A design and technology project'
  In Bearne E (ed.) Use of Language across the Primary Curriculum
  London: Routledge
- Spendlove D & Stone L (2002)
  'Learning from BPRS – improving boys' attitudes to writing
  through design and technology'
  In Norman E W L (ed.)
  DATA International Research Conference Proceedings
  Wellesbourne: DATA, 161-170
- Stables K, Rogers M, Kelly C & Fokias F (2000)
  Enriching Literacy through Design and Technology
  Evaluation Project: Final Report
  London: Goldsmiths College
- Vygotsky L S (1962)
  Thought and Language, translated by
  Hanfmann E & Vakar G
  Cambridge, MA: MIT Press
- Vygotsky L S (1978)
  Mind in Society:
  The development of higher psychological processes
  Cole M, John-Steiner V, Scribner S & Souberman E (eds.)
  Cambridge, MA: Harvard University Press

Conceptions of Simple Machines and their Functionality: A Study for the Enrichment of Technology Education in Primary Schools

University of Oldenburg, Germany
Julia Menger – E-mail julia.menger@gmx.de

Abstract

Although children often experience the influence of technology around them, there is not much room given to an education in technology in the conception of scientific education at primary schools (cp. Strunk et al. 1998). The aim of the study presented here is to create a situation that enables and motivates children to actively and purposefully work on questions of technical procedures. This ability is necessary to understand technical procedures (cp. Soostmeyer 2002, p.72).

The study starts with the investigation into the pre-knowledge of 9 – 10 year old children about simple machines (lever, inclined plane, pulley and pole) and how they work. Based on these results a suitable surrounding for further studies will be created in which students can start to develop theories and experiment on applying them.

1 Design of the investigation

The overall question to be answered is:

- Which ideas do students of the 3rd or 4th form have of simple machines?

This question can be subdivided according to three fields:

- Which simple machines do the children know and how do they use them?
- What do the children say about how the machines mechanically work?
  - What is their knowledge based upon?

There are of course different ways of dealing with the topic. This becomes all the more important as the issue is rather complex and the children quite young. The interviews are conducted in groups of 5 children (9 – 10 years old) and are divided into two parts:

Phase 1: Construction of simple machines (in the group)
The students' task is to put a heavy bucket onto a box.

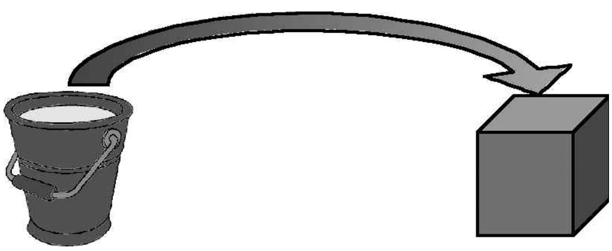


Figure 1. Students' task

Several materials can be used to solve the problem (a broomstick, a wooden board, several rolls, rolling board, adhesive tape, measuring tools, ropes, wedges, a log). The children shall freely use the material as helpful tools, simple machines are not provided. Thus the aim of the observation is to find out how they make use of the material and which simple machines they build.

After the group having come to some solutions, each child makes a sketch including a description.

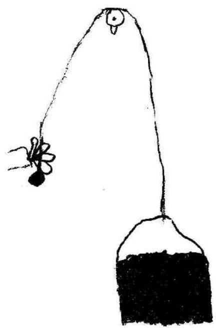


Figure 2. Fixed pulley

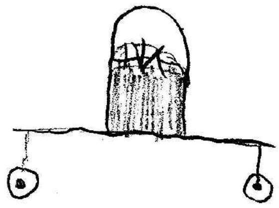


Figure 3. Interview of the group

Asked about their constructions the children try to explain how the tools helped to make the transport of the bucket easier. They compare their solutions, find parallels and differences and refer these to their everyday – life.

2 Evaluation results

The first evaluation of the data reveals that the children have already seen or experimented with simple machines. Thus they find several sensible solutions as to how they move the bucket onto the box. The children preferably choose machines with rolls (all 8 groups chose the rolling board (Figure 2), 6 use the fixed pulley (Figure 3).

In half of the interviews the children distributed the weight of the bucket by hanging it on a broomstick which they carried (Figure 4). An inclined plane (Figure 5) was used as frequently.

Figure 4. Broomstick

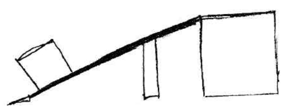


Figure 5. Inclined plane

In the interviews the students explained what made it easier to transport the bucket and what they already knew about the simple machines.

The excerpts from the interviews deal with the question of why the bucket could be transported more easily.

The rolling board

- Girl 1: Because you don't have to carry the weight yourself, you only have to push the board.
- Girl 2: Exactly.
- Girl 3: That's what I wanted to say.
- Boy 1: And the rolls, that easifies it again because.
- Girl 3: It rolls.
- Boy 1: Yes, it rolls then, and you can do it more quickly or so.
- Girl 3: Push it.

In this excerpt, two – frequently mentioned – reasons are given as to why a rolling board makes the transportation easier. A girl explains that pushing a board is easier than carrying the bucket. And a boy adds that the rolling of the wheels helps a lot. So two categories become visible in the explanations: 'Pushing is easier than carrying' describes the means of transport, whereas the statement 'The wheels roll' denotes the movement of the rolls. In many cases this was explained with even more detail.

The fixed pulley

- Girl 1: Because there we could pull together.
- Boy 1: (nods).
- Girl 2: (silently laughing) Teamwork. Then it was not as heavy as if we had done this alone.
- Boy 1: The block and pulley is again a wheel and then, it is flexible and you can pull the rope more easily. Because the pulley rotates them.

For many children the fixed pulley was a help because they could pull together and thus share the weight. Furthermore – like with the rolling board – they pointed out that the movement of the roll makes the pulling of the rope easier. In analogy to the explanation 'Pushing is easier than carrying' the definition 'Pulling is easier than carrying' can also be found in this interview.

Many children had already come into contact with a fixed pulley as a tool to lift weights, either at construction sites, in industrial estates, on farms or on TV. And they found analogies with anchors, wells or mountain climbing.

The pole

Answering the question why a pole makes the transportation of the bucket easier, the children named two reasons mainly: Similar to the fixed pulley the children also saw an advantage in the use of a pole that the weight can be distributed so that the single child has to carry less. The children also remarked that they had a better grip on the pole than the handle of the bucket. This would not reduce the weight for the single child but it would not seem as heavy. It was interesting to see that many children believed that a rope would be as useful as a pole.

In contrast to all the other simple machines, this technique of transportation was unknown to the children, so their analogies were taken from former times with a less advanced technology (e.g. to carry water, deer after a hunt, sedan chairs).

The inclined plane

- Boy 1: When you climb stairs you cannot pull anything up there. Or when you walk up a hill you can pull something behind.

Many children gave an example to show the lightening of the weight; they especially mentioned ramps to pull boats or cars up. The boy quoted above compares a staircase and a hill. If you do not use a board to construct an inclined plane, there will be no chance of pulling the weight up. Only if you use the board will you get something like a hill and can be able to pull the bucket up.

Another boy put the bucket on a table which was higher than the box and built an inclined plane down from the table to the box. His explanation contains a working basis for the setting up of special concepts.

- Boy 2: Well, our idea with the table I put down the board like that (he means the inclined plane) went well because the bucket is heavy and then it can slide down.

So he states that the bucket can slide down also because of the weight of the bucket.

3 Conclusions

The investigation proves the connection children have to simple machines. As they have seen them in their surroundings they can purposefully use them to transport a heavy weight. Remarkably the children did not apply the lever and the block and tackle. The children's explanations prove a correlation of their imaginations and professional ideas. The children recognize important causes of a lightening of the weight (e.g. the turning of rolls, the distribution of weight on several persons and the insight that some movements can better be co-ordinated than others). What they are still lacking is a structuring of the experiences. Very often they just enumerate their attempts at an explanation without a logical connection. This is where teaching can help, basing building on the students' imaginations and structuring what they have already learnt by with the help of observation and testing.

4 Suggestion of a teaching unit on 'simple machines'

This suggestion is based upon the constructivist teaching strategy of Driver and Scott (cp. Driver, Scott 1994).

After a short introduction the pupils' imaginations are activated by the help of an concrete task similar to the one presented in the investigation above, which is to be discussed in a group. The students become aware of their imaginations and discuss them. Afterwards the pupils present their solutions and argue why they think them effective. Thus an exchange in the form is possible, and the teacher gains an insight into his pupils' imaginations.

In the second phase the experiences shall be extended. The investigation proved a variety of ideas the pupils had, notwithstanding a repetition of some (e.g. that it does not play a role if the bucket is carried with a rope or a stick). Based upon this variety a learning area can be built in which the students can concentrate on the question 'What happens, if…?'. But the teacher has to make sure that on the one hand the pupils can individually learn in an open atmosphere, and on the other hand he must prevent them from adding up experiments without a conception. The students must be guided via structured and precisely put tasks so that they can structure their concepts and extend them.

The third phase comprises a critical reflection of their initial constructions on the pupils' part. They denote parts that can be improved and name well-developed ones. They directly apply what they learnt in the second phase and link all their findings. Additionally they can try to compare the single simple machines or add new solutions.

References

- Driver R & Scott P
  Schülerinnen und Schüler auf dem Weg zum Teilchenmodell
  In: NiU-Physik 5 (1994) Nr. 22, S. 24-31
- Soostmeyer M
  Genetischer Sachunterricht
  Unterrichtsbeispiele und Unterrichtsanalysen zum naturwissenschaftlichen Denken bei Kinder in konstruktivistischer Sicht.
  Baltmannsweiler: Schneider 2002
- Strunk U et al.
  Der naturwissenschaftliche Sachunterricht in Lehrplänen, Unterrichtsmaterialien und Schulpraxis – Eine quantitative Analyse der Entwicklung in den letzten 25 Jahren
  In: Zeitschrift für Didaktik der Naturwissenschaften 4, H. 1 (1998), S. 69-80

The Potential Conflict within Design and Technology: Creativity versus Practical Skill Acquisition

Inger Morris – E-mail ingermorris@hotmail.com

Abstract

Earlier this year I completed an MA module focusing on Design and Technology in Primary Schools. The focus of my study was the QCA Year Three topic: Moving Monsters. The children who were involved in this topic were split into two classes, each containing twenty eight children. Both teachers are NQT's in their first year of teaching and it was interesting to note the differences in teaching styles and the effect of this on the way the two classes approached the topic. One teacher, whom I shall call Teacher A, completed an Arts degree before training to be a teacher, whilst the other, Teacher B, has a History degree. As I looked at how the topic was being taught and learned, I became aware of a potential conflict between the new skills that were required and the creativity which was desired. This became the focus of my study.

Introduction

The curriculum area of design and technology is a complex one. It combines several different skills areas into one and we need to be aware of all of those areas when considering how a topic should be taught. There is the artistic element of creating a product which is appealing both to oneself and to others; the scientific element which represents the practical application of the finished product and the discipline of design, which I would argue is separate from the artistic element. The Year Three pneumatics topic involves all of these areas and requires both the children and their teacher to combine them into a successful whole. The nature of pneumatics means that the element which causes something to move (the air) is invisible and this therefore required the children to work with an abstract concept which they could apply in a practical sense. Unlike the 'mechanism' topics of KS1, where cause and effect can be seen to be linked together physically, whether by levers, or by string which is wound or pulled, the pneumatics topic requires an understanding of an invisible process which causes something to move.

Is it more important that the children really understand the principles of pneumatics, the physical reality, or that they are creative with their designs and apply a basic knowledge of pneumatics, concentrating more on what they might wish to happen without necessarily having the skills to make it so? Of course both are important, but I would argue that at the age this topic is taught it is more important for the creative ideas to be encouraged. We are, after all, engaged in equipping the next generation to be successful.

Our aim must be to create a nation where the creative talents of all the people are used… (Blair, 1999)

Presumably this disregards whether the creative thought is accompanied by technical ability, as the more creatively the world is seen by all, the more creative it must become.

What are the right conditions for creative growth? Harrington (1990) brings the factors of process, people and the physical environment together with a theoretical framework of the 'Creative ecosystem'. He uses the biological ecosystem as an analogy. Just as a balanced ecosystem can sustain life so a creative ecosystem could be said to sustain creative output. (Howe, Davies and Ritchie, 2001)

The more people are capable of little 'c' creativity, the greater chance there will be that those capable of big 'C' creativity are nurtured and allowed self expression.

Little 'c' creativity, which is often used as an indicator of ability to deal with incremental change, problem-solving and the ability to adapt to change, is more likely to be what educators will see from students on a daily basis; whereas big 'C' creativity remains far more elusive… (Spendlove, 2005)

This would imply, therefore, that the need to allow the children to be creative outweighs the importance of them fully understanding the concept of pneumatics, meaning that the teaching should contain both elements but that the focus should be on encouraging the children to take risks and make mistakes in order to foster the courage to be different and therefore be able to generate original thought.

This is, perhaps, particularly important in a school such as the one in my study, where 85% of the children are second language speakers, the majority of whom are from Pakistani families whose parents moved to Britain before having children. Most are from the Mirpur region of Pakistan, a farming area where the adult literacy rate is around 12%. A high percentage of the parents are illiterate and most of the mothers cannot speak English. The children's home lives are generally starved of stimulus or meaningful interaction with adults. They are rarely taken anywhere or encouraged to explore or question the world around them and this leads in turn to a huge lack of general knowledge. They struggle to be creative or see beyond the obvious in most areas as they have had little opportunity to develop these skills.

This is where a subject such as design and technology comes to the fore, as it allows children to work from their own knowledge base without too much need for language. A child can recognise and therefore relate to the technology of an object, provided enough concrete examples are given, and then absorb them into a widening understanding of this object and its possible permutations without recourse to complex verbal communication.

From the children's view point, certainly, the chance to create in this case was far more important and exciting than carefully studying a new concept. The children placed making far higher than planning when questioned before the topic began and their evaluations showed a fixation on the creative process rather than the success of the pneumatic system. However, for the children to use the pneumatic system creatively, they had to first understand it. Questioning at the beginning showed that a few had some concept of the force of air but for most it was something that had not yet been considered. Both classes were given the opportunity to explore devices using pneumatics or air to function and this enabled most to develop an understanding. As they took this concept into creating simple pneumatic devices in order to understand how they worked, they were thrilled to discover that they could create a system that would move something. They had moved from exploring a ready made device, which would of course work 'properly', to creating their own and were therefore excited to discover that this also worked. One group discovered that it was possible to make the plunger of a syringe fire across the room by blowing hard into the other end of the tube. This was a really visible effect and therefore became very popular. Some groups designed pneumatic systems for their monsters that worked on the principle of blowing into the tube, rather than having a sealed pneumatic unit. This made the movement far more noticeable than those systems that were sealed, as more air could be added to the system in order to achieve the desired effect. The teacher chose not to interfere with these groups and allowed them to continue with this idea, despite the fact that they were not creating a closed pneumatic system and were therefore moving away from the learning objectives. She felt it was more important that the children enjoyed the topic and made a successful model.

When I questioned them before they started the topic, most of the children placed the making element higher than the planning element for both enjoyment and learning purposes. This is classic of children at this age, for whom practical experience is generally the preferred route to understanding. For them, the experience of doing far outweighed the thinking about the subject. In fact, Piaget argued that it is necessary to 'do' in order to develop the means to think.

His often cited, deceptively simple, statement that 'Thought is internalized action' declares his view that the analysis of human knowledge and intelligence must begin with a consideration of motor activity and practical problem solving. (Wood, 1999)

When we 'do' something, the experience is stored away in our memories and we can then draw on them when thinking. For children to learn and therefore start to think in abstract terms it is necessary for them to have enough practical experiences to draw on in order to be able to create abstract suppositions about a similar situation. These experiences must also be repeated over a period of time in order for them to be absorbed fully. The child's brain must develop a new neural pathway linking those ideas or enabling thinking in that particular way before they can really use that knowledge in an original way.

According to Piaget, providing the prior experience but not allowing time for physical growth will do no more than teach the child very specific responses to a very specific stimulus. The underlying mental structures will not have changed, so in general, no useful learning will have occurred. (Ault, 1977)

In the six areas of Bloom's Taxonomy of thinking, questions relating to knowledge of the subject are seen as the simplest and most answerable of the question types. These require children to draw upon practical experience and knowledge in order to answer questions. Often the questions have right/wrong answers and are about simple cause and effect. This is necessary before the next level of questioning can be reached. In other words, it is necessary to understand a concept or a concrete experience before it can then be adapted, modified, used creatively and then evaluated. When we ask children to 'plan' their model in detail before beginning to make it, we are asking them to work through all those stages of thinking in an entirely abstract way, they are in a sense evaluating before they have begun.

The disadvantages (of designing before you start) are in the level of cognitive development required to utilize such a technique due to the knowledge base required with regard to the handling of materials (and their properties). (Hope, 2005)

This perhaps explains why when children are forced to design in detail before experiencing the concept physically, they often struggle to create a design; create a design which bears no resemblance to the finished product; or cannot move beyond the suggestions made by the teacher and will copy these without really understanding the underlying concept. It is essential that teachers are aware of this and plan sufficient activities for the practical understanding to take place. It is all too easy for a teacher to understand the topic, using their highly developed skills base, and therefore assume that the children will understand it too without having to explore it in much detail.

When I questioned the children in class A about their models towards the end of the making stage they were keen to show me how their model worked and most showed an understanding of how they had made the model move.

When it came to their written evaluation, however, they were much more concerned with how the model looked and what had been difficult to make.

> *…children will become much more critical and dissatisfied with their artwork as they reach a stage of development known as 'the gang stage' or 'dawning realism'.* (Lowenfield and Britten, 1995)

The concerns were with the model making process, and the pneumatic systems' success or failure was seen as far less important.

The frustration caused by the difficulties encountered in the making process show that the children have passed the stage of simply being content with creating something. They must have had a pre-conceived idea of what they wanted to create in order to know where the failures occurred and this implies that they were able to work through the levels of thinking necessary to design before making, even if much of this was subconscious.

In addition to language and number, the development and communication of design concepts depends on 'imaging' and modelling. This is the human ability to make and use sketches, drawings, plans, scale models, mock up, prototypes and the like to represent, shape and evaluate what is and what might be. (Baynes, 2006)

Children at this age are generally more reluctant to spend time designing before making, perhaps because they have become aware that their drawing skills are not adequate to represent what they want, unlike young children who are quite happy to produce a drawing that in no way represents others perception of the real thing. Perhaps this reluctance is also because they feel they will be tied to create what they have drawn, rather than freely adapting and changing their ideas as they work. It is also less satisfying, apart from perhaps to the skilled artist, to represent something through a drawing, rather than something which can be held and touched, particularly when it is known that that part will come next.

It seriously delays the start of the activity, which is the sensually satisfying part of the task, and appears to delay that final completion of the task – time is spent doing nothing. (Hope, 2005)

However, the children must have created a mental design of their monster that was sufficiently detailed to allow them to evaluate against it, showing that they are developing the ability to design before making.

In order for creativity to take place, several elements have to be present. As has been shown, the children needed enough experiences of the pneumatic process in order for them to begin to apply the concept in an abstract way.

Another key element is that creativity is demonstrated and encouraged. The classroom environment has to be secure enough for the children to feel confident about stepping beyond known boundaries.

Teacher A is confident in her own creativity and in fostering it within her class. She is able to allow the children to be autonomous within the classroom and can allow 'chaos' to happen in order that creativity may occur.

> *…risk taking is an intrinsic part of creativity and requires attention to be paid to the support and ethos within the classroom.* (Howe, Davies and Ritchie, 2001)

Her manner with the children was relaxed but firm and she had no issues with behaviour whilst I was present. She appeared calm and unflustered even when the room was filled with wet paint and bits of card and there was no teaching assistant present. The children proved very able to tidy up proficiently and were generally on task and enthusiastic about their work. In contrast, teacher B does not see herself as creative and has a much more disciplinarian approach with her class. She found it difficult and stressful to have 'chaos' within the room and said afterwards that she struggled when a teaching assistant was not present. The children were encouraged to work quietly and individually when coming up with ideas for a moving monster and were then asked to share their ideas with their group. Although many found it hard to come up with an original idea alone, the fact that they could share ideas meant that they were able to draw on more knowledge and so come up with a group plan that drew on the ideas of the individuals.

The class who are quietly sitting drawing 'design ideas' are locked into the confines of their own imagination's capacity and they will produce a limited range of stereotypical ideas. The class who talk and discuss and swap ideas freely when planning…will have a rich resource of borrowed, shared and negotiated ideas that can be changed and adapted as work proceeds. (Hope, 2005)

She had no problems with behaviour but the children were less involved with their work and seemed more anxious. When I was present I was aware that many of them constantly sought reassurance that what they were doing was 'right' and struggled with their ideas.

The teacher must not perpetuate the expectation that some children are unlikely to succeed in design and technology, either explicitly or by not challenging children's self-perceptions. (Howe, Davies and Ritchie, 2001)

At no point was I aware that teacher B had explicitly implied that a child might fail, however, the children's anxiety about failure was evident and implied either that the teacher had not given them sufficient time to absorb the concrete principles of pneumatics before moving them on, or that the children felt they would be judged and were therefore less secure with being creative. Teacher B said afterwards in the questionnaire that she did not feel confident before teaching the topic, that she felt it was resource and time heavy and that next time she would be sure to plan around the support timetable more carefully. Class B were also unable to finish the topic as the teacher became ill at the end of term. She is hoping to give them some time during a topic week to create their monsters.

This difference in approach by the two teachers did not result in one class succeeding and the other failing, nor did it prevent the children enjoying the unit of work but it did show a difference in the way the children approached the work. Those with the confident teacher were more confident and engaged. They were less concerned with making 'mistakes' and enjoyed using the pneumatic mechanism to create something new. Those with the less confident teacher still enjoyed their topic and understood the principle of pneumatics, but were less confident when applying this to their own creation and were anxious about getting it wrong.

Allowing the children to be creative also means allowing them to risk failure and here the teacher must employ skills that are used in all areas. Each child must be encouraged to become individual and to create 'original' work and yet they need to be supported through this. Some children will be able to fail, decide what went wrong and work around it without their intrinsic self worth being affected. For others, however, the fear of failure means they would rather not risk anything at all.

To deny choice, freedom and responsibility does not value the child as a person. Granting these to children who do not want them, and who cannot or will not handle them, creates anxiety, a sense of failure and loss of dignity. Clearly the nature of the teacher's intervention is central but problematic. (Tickle, 1990).

Looking at the confidence of the children in class B compared to class A, I would conclude that although both teachers were able to allow their classes to be creative, teacher B's lack of confidence with the topic meant that she was less able to support those whose confidence was also low because her worry meant that she would give them the safe solution rather than suggest several less safe ideas that could be used more creatively. Teacher A, on the other hand, was able to give support to the less confident children in her class whilst still encouraging them to be creative. This conclusion in no way reflects on each teacher's capabilities in other areas but does, I feel, reflect on the experiences of Design and Technology that children have throughout their school lives.

For me, the issue that this research brought up was one of creativity. It has clearly been shown that motivation and self-belief are essential for creativity to happen and that these are affected by the approach of the teacher to the topic and to teaching in general.

> *…intrinsic motivation is highly conducive to creative acts whilst extrinsic motivation is almost always detrimental. Regardless of age group these findings have remained consistent and from which Hennessey (1996) has identified five 'sure fire killers' of intrinsic motivation and creativity: expected reward, expected evaluation, surveillance, time limits and completion; an unfortunate truth being that these identified 'killers of creativity' resemble the current orthodox approach to education in the U.K.* (Spendlove, 2005)

This paints a negative picture of education, suggesting that it is almost impossible for children to be truly creative in school. I would argue, however, that these negative effects can be moderated if not completely removed by the approach of the teacher and the school. Provided the teacher creates a 'safe' environment within the class group, in which it is possible to show yourself or your work without fear of crippling judgement, children will develop the skills to deal with the views of others and will have the self-belief to take these on and use them in positive ways. The issue of reward is also subjective. All children should be praised for the effort they have put in, not just for the success of the finished product, and the fostering of self-belief will enable children to reward themselves, rather than feeling that they must compete for first place. In order for this to happen, teachers must be aware of the needs of the individuals within the class and be able to respond to those needs.

Creative teachers, who in turn will be well placed to support and motivate creativity in children, will themselves flourish only with support, encouragement and opportunities for professional development. (Howe, Davies and Ritchie, 2001)

The focus must therefore be on fostering an environment within school where teachers are encouraged to be creative and to approach the curriculum creatively. The balance between this and ensuring that the whole curriculum is still delivered is always a tricky one, but with enough open minded thinking it is possible. Without this, those teachers who are naturally creative in their approach will either become demoralised and leave the profession or will put aside their creative thinking in order to meet expectations. Those who are less in touch with their creativity will never have the opportunity to develop it and education will indeed become a place where intrinsic motivation is next to impossible, to the loss of us all.

References

- Ault R (1977)
  Children's cognitive development.
  Piaget's theory and the Process Approach
  Oxford University Press
- Baynes K (2006)
  Design Education: what's the point?
  in Design and Technology Education:
  An International Journal. 11.3. Graphic Solutions Group
- Blair A (1999)
  in NACCCE. All our futures. DfEE
  in Spendlove D (2005) Creativity in Education: A Review
  in Design and Technology Education:
  An International Journal. 10.2
- Hope G (2005)
  Teaching design and technology 3-11
  Continuum Publishing Group International
- Howe A, Davies D & Ritchie R (2001)
  Primary design and Technology for the Future
  Creativity, Culture and Citizenship
  David Fulton Publishers
- Lowenfield & Britten (1975)
  in Howe, Davies and Ritchie (2001)
- Spendlove D (2005)
  Creativity in Education: A Review. in Design and Technology
  Education: An International Journal
- Tickle L (1990).(ed)
  Design and Technology in primary school classrooms
  The Falmer Press
- Wood D (1999)
  How children think and learn
  Second Edition. Blackwell Publishers

Auditing Design Decisions in Food Technology: Experiences of Initial Teacher Primary Design and Technology Students

Roehampton University, Erasmus House, Roehampton Lane, London, SW15 5PU
Marion Rutland – E-mail m.rutland@roehampton.ac. Telephone 02083923509
Sue Miles-Pearson – E-mail s.miles-pearson@roehampton.ac.uk

Abstract

The paper presents work carried out at Roehampton University with primary student teachers building on two previously reported small scale research and development projects (Barlex and Rutland, 2004; Rutland, Barlex and Jepson, 2005) with specific reference to food technology. The projects focused on the impact of deliberate interventional curriculum strategies aimed at enhancing the design ability and design teaching skills of trainee teachers on a one year post graduate certificate of education (PGCE) initial teacher education (ITE) Design and Technology (D&T) course.

Initially, the paper briefly refers to the background of the research activities including a summary of the findings from the two projects. It outlines the development and refinement for food technology of a conceptual model to enable student teachers, teachers and pupils in schools to audit the design decisions made in a design and making activity (DMA).

This paper focuses on a food technology module taken by Year 2 BA Primary Education with Design and Technology student teachers at Roehampton University in Autumn 2006. A decision was made to introduce the design decisions model for food technology during the course and evaluate how it was used by the students and its effectiveness as a tool to audit and track the students design making decisions during their food technology coursework project. The paper reports on the findings based on the design portfolios and course work presented by the students.

The paper concludes by considering the potential impact of using the design decisions model for food technology in a simplified form in the primary classroom.

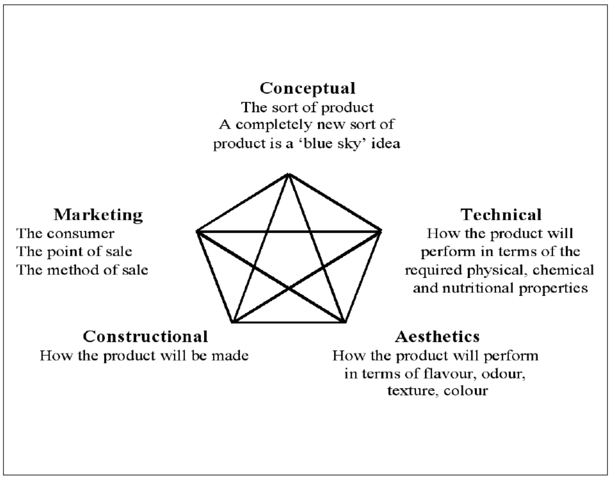
Background

The paper presents work carried out at Roehampton University with primary design and technology student teachers and builds on two previously reported small scale research and development projects (Barlex and Rutland, 2004; Rutland, Barlex and Jepson, 2005) with specific reference to food technology. Both small scale research and development (R&D) projects were funded by the UK Teacher Development Agency (TDA). They arose due to concerns that those entering ITT PGCE courses in design & technology (D&T) have different backgrounds and experiences of designing (Lewis, 1995, 1996, Rutland 1996, 1997, Tufnell, 1998, Ofsted 2003). Ofsted (1998, 2000) has reported consistently since the introduction of D&T into the National Curriculum in England that designing skills lag behind making skills. In primary schools it has been reported that 'some designing activity is dull and boring…with a rigid sequence of activities involving too little direct experience with tools, materials and ingredients' (Toft, 2007).

The two R&D projects (Barlex and Rutland, 2004) were based on the concept of the use of deliberate interventional curriculum strategies and their impact on initial teacher education and classroom practice. The focus for both projects was on the impact of a piece of curriculum development designed to provide experience and acquisition of designing skills for one year PGCE trainees that could subsequently be used in teaching designing as part of D&T lessons at Key Stage 3 (KS3) during teaching experience.

Key findings from the first research project included the ability of trainees to develop insights into the requirements of teaching designing and their use of these insights in developing effective practice. However, of relevance to this paper, it was notable that some trainees found particular difficulty in developing both their own design ability and to engage in teaching designing in school. This was particularly true for those with a background in food studies and systems and control and food technology became the focus of the second research project. The first research project had used the model to identify and audit the sort of design decisions that pupils can make when designing and making products developed during the Electronics in Schools initiative (Murphy et al, 2004). As a result of the group discussion in the first project one student commented that 'designing in food is different as it is a simultaneous activity'. For example, when different foods are used in a product it affects both the technical, aesthetic and constructional properties of the product. It was found necessary to modify the model (see Figure 1) to clarify the design decisions taking place under the headings of the model and take into account differences in approaches and technical language traditionally used in food technology.

Figure 1. Modified model for design decisions in food technology



The findings from the second project (Rutland, Barlex, 2006) indicated that food technology initial teacher training courses should include a significant experience for the trainees of designing with food and they should be encouraged to develop these strategies and experiences in their school placements. In addition, they should be encouraged to use the model themselves to audit the designing decision opportunities in their school projects and their pupils should use the model to support their own designing activities.

The focus of this paper was the decision to introduce the design decisions model on a Food technology: Healthy Eating module taken by Year 2 specialists BA Primary Education with Design and Technology student teachers at Roehampton University in Autumn 2006. The intention was to evaluate its use by the primary students and its effectiveness as a tool for the students to track and identify their design making decisions. The paper outlines briefly the strategies used by the tutors on the course and reports on the findings based on the design sketch book presented by the students.

Methodology

The course provides D&T students with a base of subject knowledge in food technology and enables them to extend and develop their capability. It provides the knowledge, understanding and skills required to design and develop food products and the use of ICT within food technology is an integral part of the course.

Students who successfully complete this module will:
- Understand how to design in food.
- Understand and be able to apply the knowledge and skills related to the chemical, sensory and nutritional properties and characteristics of food.
- Use a range of food preparation techniques and processes.
- Select ingredients, modify recipes, combine food to design food products.
- Use ICT for nutritional modelling, costing of food products, product profiling and graphical representation.
- Develop and present a food based design brief.

In the Part 1 of the assessment there is a practical project (60% – 1,500 words equivalent). The design brief set was:

> *'A supermarket has asked you as a product designer to develop a food product for a target market that will promote well-being'.*

The students are required to produce a design sketchbook showing the stages in the development of the final food product with photographs, pictures, illustrations, sketches of the food product/s and tasks undertaken.

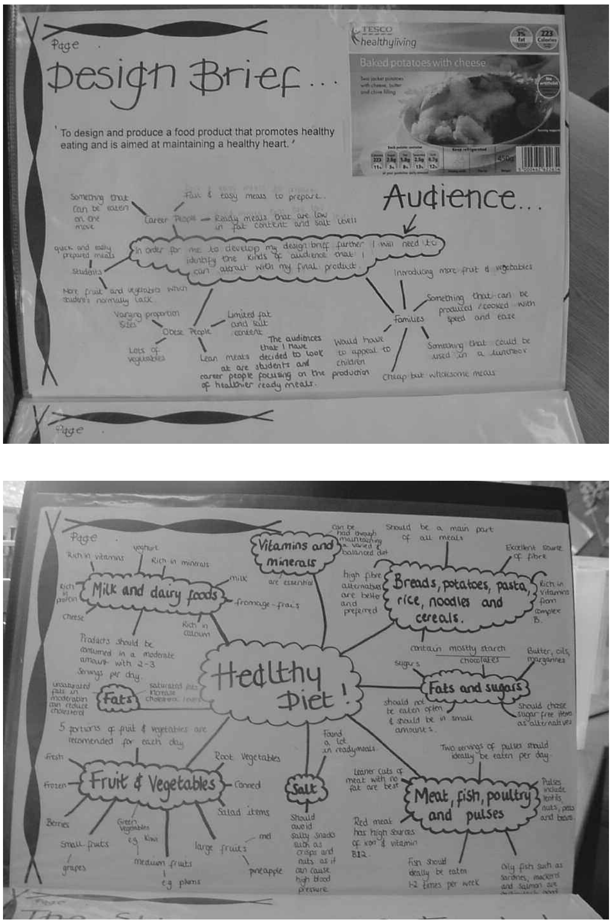
There are five 3 1/2 hour sessions. The background of the students varies considerably. There is one food technology module in the three year course as primary D&T teachers have to be able to teach across the specialist areas. All the students will have GCSE and A Level qualifications in one or two areas of D&T, but not all will have followed food technology courses prior to the course. In session 11 the students are introduction introduced to the concept of food technology and food product development. They work in groups to complete a simple design and make activity in food e.g. 'Mama Pasta' Project that includes product analysis and the concept of designing in food. In session two 2 they are introduced to the design based healthy eating project and they work in groups to complete a range of focused practical tasks (FPTs), or interventions that cover basic food science, sensory analysis techniques, basic food processes and simple research techniques. The work is shared by the whole group and the concept of 'starter' recipes are introduced for students to work on in the following session. They choose a 'starter' recipe to modify and begin their development of their individual design brief. Nutritional analysis software is used to analyse their food product and evaluate it against their developing brief.

The food technology design decisions model was introduced at this stage as a tool for the students to evaluate their food product for the concept, target market, technical, aesthetic and constructional decisions that had been made. The students were expected to develop their brief and produce at least three food products that addressed the brief. The model was used as a formative tool to structure their thinking and help them make effective choices that could be developed further. They were asked to record these early activities in their sketch books as evidence of the potential use of the approaches and techniques. Finally, they choose one food product to refine, develop a specification and present their final product for evaluation using the design designs model.

Findings

A range of briefs were developed by the students from the initial brief set in the assessment. They included:
- Healthy daytime snacks or puddings that could be combined with yogurt, ice cream or extra fruit.
- Food products for professional people with a busy life and interested in keeping healthy.
- Healthy snacks for 'people on the go'.
- Snacks that will promote well-being to children in primary school.
- Food products for students that promote healthy eating and maintain a healthy heart.
- Snack products for students on a low budget and containing healthy and low fat ingredients.
- Healthy ready meals for students and business people.

This range does reflect the personal interests of the students as busy trainee primary school teachers but the emphasis on health is clearly identified. Figure 2 shows how one student focused on healthier ready meals for students after brainstormed the target markets of students, people with busy careers or obese problems and families. Brainstorming was a technique discussed in an early session and used by the majority of the students to develop their initial thinking. Annotation for the best students was thoughtful and helpful (Figure 3).



Figures 2 and 3. Brainstorming activities

The first three sessions included intervention tasks for the student to be introduced to, or revisited techniques and knowledge that would be useful to them when developing their products. The Mama Pasta activity in session 11 was essentially a product analysis task where the students in groups analysed a range of four pasta ready meals in groups before developing one for a specific target market using fresh ingredients. They were introduced to star profiles as a technique for analysing their product against the design decisions of colour, texture, flavour and smell (Figure 4). Again, useful annotation was a key requirement. The model for design decisions introduced at this stage was used to analyse their product for the design decisions they had made under the headings of concept, technical, aesthetic, constructional and marketing to support their thinking (Figure 5).

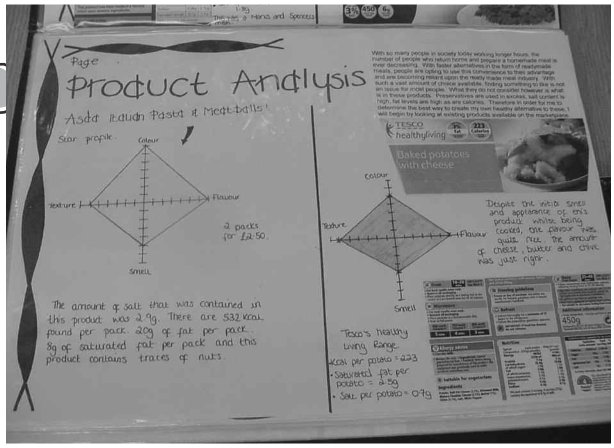


Figure 4. Star profiles

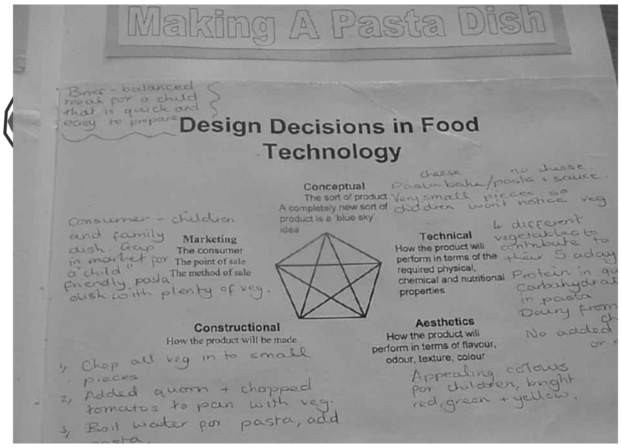


Figure 5. Use of the model for design decisions

In the second session the focus was on covering a range a of knowledge, understanding and skills. Again the students worked in groups and shared their findings at the end of the session. Figure 6 records the work of one of the students.

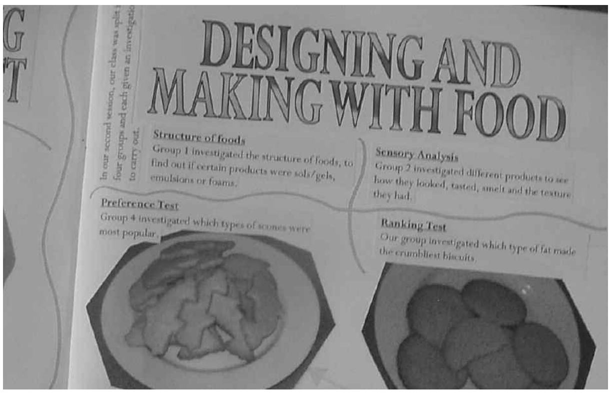


Figure 6. Focus practical tasks

Session 3 introduced the concept of 'basic' or 'starter' recipes that students could adapt and modify to develop their first sample product for their brief. A computer l analysis tasks evaluated the product for its nutritional content (Figure 7). For each of the three samples they were expected to develop, they used the model for design decisions as a formative tool to evaluate and monitor their thinking and design decisions made, and provide evidence for further developments (Figure 8).

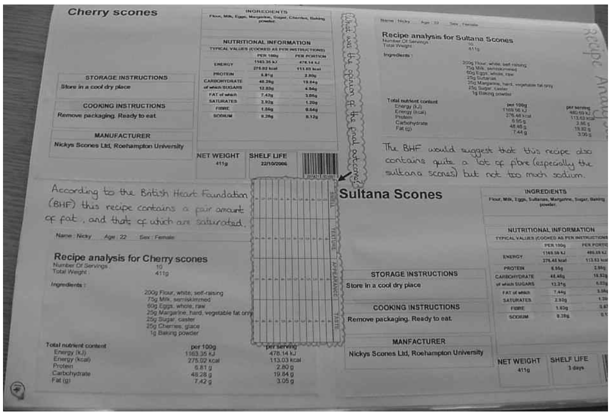


Figure 7. Nutritional analysis

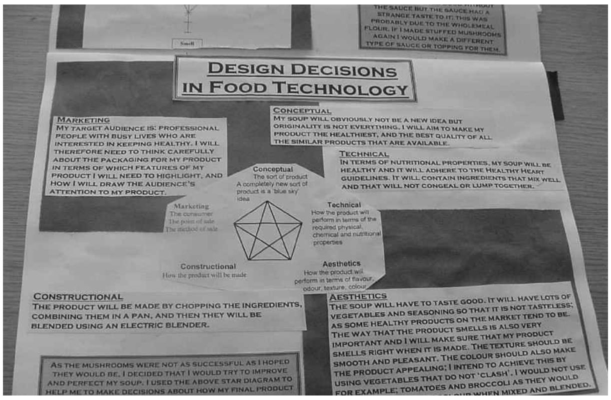
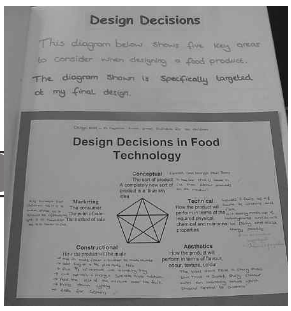
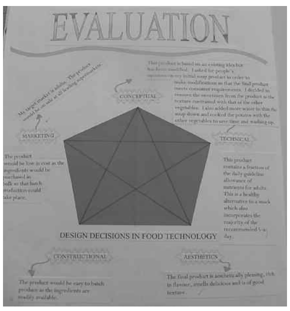


Figure 8. Use of the model for design decisions

Finally, the students used the model as a summanative tool to evaluate the design decisions of their final product against the brief that they had written (Figures 9 and 10).

Figures 9 and 10. Use of the model for design decisions





Discussion

The initial work was within the secondary sector. However, this paper presents how the design decisions model was used successfully with primary students and considers its potential for primary children in schools.

The outcomes from the students' food technology projects were more varied than in previous years. The use of the design decisions model had widened their choices and provided a constructive tool to guide their independent learning and thinking. There was a reduction in repetitive modification of one food product, which is a common problem in food technology course work. The use of deliberate interventional activities in the first three sessions had developed key knowledge, understanding and skills that the students could build on and use in developing their briefs. These factors, that are required for successfully designing and making, are closely related to the four features of the model for design decisions. The Mama Pasta session focused on conceptual and marketing factors and how they provide a focus for D&T activities. In addition, basic design decisions such as colour, texture, flavour and smell that affect the aesthetic properties of a product were highlighted. Technical expertise and understanding of how a food product will perform and constructional factors of how it can be made were developed through the focused practical activities.

It was significant that though this was the first time that the primary students had used the model they responded very positively and were able to appreciate its use as a tool for decision making. This was not generally the immediate response with secondary students who took part in the research projects. Students from more traditional food backgrounds who were not used to the term 'designing' were initially resistant to the model, as their understanding of designing was a paper based, drawing activity and not a hands-on experience. Students with food technology as a second focus area and a first specialist area in product design or textiles were quicker to appreciate the use of the model. Unlike their secondary colleagues the primary students in this study had experiences across all specialist areas of D&T, hence it can be argued that they initially were more open to the concept of 'designerly thinking'.

The model for design decisions has only been used in food technology with the primary students at Roehampton and a consideration for the future is the use of the model as an effective means of engaging the students with designing across all areas of D&T. There is a range of modules on the course including ones based on resistant materials, textiles and systems and control. Though, consideration is needed for modifications of the model for each specialist areas.

There is clear evidence that the approach enabled the primary students to increase their own skills and knowledge of working with food. However, the impact on the work on their teaching school placements is as yet unexplored. After discussions by one of the tutors with the students about food technology in the primary school, it was obvious that their range of experience had been very similar and somewhat limited. The main practice in their placement schools seemed to be around a small selection of basic recipes, for example, bread, pizza, sandwiches and fruit salad. Considering that children are in primary school for six years, this is an extremely restricted choice of activity. The students were keen to discuss the possibilities of undertaking various activities, such as the exploratory 'taste tests' they had experienced, prior to the 'cooking' session with children in school. They agreed that this would be more exciting and thought provoking for the children.

Finally, there is the potential for the use of the model with children in primary schools. It is not uncommon for the specialist D&T primary students to find that theiry expertise is in greater in depth and breadth thatn teachers who completed their initial teacher education before the introduction of D&T in the National Curriculum in 1990. The support given to students is very much dependent on the individual teacher's interests and background. On the positive side, primary teachers frequently welcome the D&T students and appreciate their input into the curriculum. Hence, there are opportunities available for students to introduce new ideas on their school placements. A suggestion of a simplified version of the design decisions is the 'star designer' model produced in a secondary partnership school during the second research project (Figure 10). The teachers found it a helpful tool to support the pupils to support them during a designing and making project. It would be interesting if this modified version could be tried with children in the primary phase.

Recommendations

Primary design and technology ITE courses should include a significant experience for the students of designing with food and they should be encouraged to develop these strategies and experiences in their school placements. Modification should be made to the model to cover all specialist areas.

A simplified version of the model for all specialist areas should be developed for use by children in primary lessons.

Organisations, for example the Design and Technology Association, should be approached to explore further methods of disseminating the findings of the project to a wider audience and support future developments.

References

- Barlex D & Rutland M (2004)
  'Developing trainee teacher's ability to teach designing within secondary school design & technology in England'. In PATT14 (Pupils Attitudes Towards Technology) International Conference, Pupils' decision making in Technology Research Curriculum Development and Assessment
  Albuquerque, New Mexico, USA
  www.iteaconnect.org/PATT14/barlex.pdf
- Lewis T (1995)
  'Partnership Schools, Universities and the Shortage of D&T Skills' Design and Technology Teaching, 27, (2), 47-52
- Lewis T (1996)
  'The skills and quantities of students entering design and technology initial teacher education' in International Conference on Design and Technology Educational Research and Curriculum Development IDATER 1996 ed JS Smith
  Loughborough University of Technology, 147-152
  www.lboro.ac.uk/idater/lewis96
- Murphy P, McCormick B, Lunn S, Davidson M & Jones H (2004)
  EiS Final Evaluation Report
  DTI and The Open University
- Office for Standards in Education (2000)
  Ofsted Subject Reports
  Secondary Design and Technology, 1999 – 2000
  The Stationary Office, London, UK
- Ofsted (2002)
  Design and technology in secondary schools
  Ofsted subject reports series 2001/02
  Office for Standards in Education:
  The Stationary Office, London, UK
- Office for Standards in Education (2003)
  Secondary ITT Subject Inspections Conference:
  Design and Technology SSI Review 1999-2002
  The Stationary Office, London, UK
- Rutland M (1996)
  'An analysis of developing partnership between ITE and schools in the training of D&T teachers' The International Conference on Design and Technology Educational Research and Curriculum Development (IDATER 96) Loughborough University of Technology, pp.153 – 160, ISBN 1 899291 10 5,
  www.lboro.ac.uk/idater/rutland96
- Rutland M (1997)
  Partnership in Initial Teacher education and beyond in Primary and Secondary Education
  DATA, Wellesbourne
- Rutland M, Barlex D & Jepson M (2005)
  'Designing in food technology – a curriculum intervention strategy in a one year design & technology postgraduate teacher training course'
  in Inspire and Educate DATA International Research Conference
  Sheffield Hallam University, Sheffield, pp.153 – 160
  ISBN 1 898788 75 8

- Rutland M & Barlex D (2006)
  'Developing a conceptual Framework for Auditing Design Decisions in Food Technology: the potential impact on initial teacher education (ITA) and classroom practice'
  in Designing the future, D&T Association International Research Conference 2006, Wolverhampton University, pp.111 – 120
  ISBN 1 898788 80 4
- Toft P (2007)
  'Design and Technology Ofsted Reports' in D&T News
  The Design and Technology Association
  Wellesbourne, Issue 35, April 2007, p.10
- Tufnell R (1998)
  'University Perspective' in An Invitation Conference on Teacher Supply in Design and Technology: Report and Findings
  DATA Research Paper 9, Wellesbourne

Developing Designerly Thinking in the Foundation Stage – A Case Study

James Dixon Primary School, London
Tara Treleven – E-mail tara@tarat.fsnet.co.uk

Abstract

This is an exploratory case study focused on developing designerly thinking in a nursery setting. Different activities were designed to encourage designerly thinking skills through a problem solving approach that also linked to creative and critical thinking. Findings suggest that young children, through discussion, were well able to evaluate and discuss products critically, suggesting possible users, uses of, and needs for, products, and justified choices that they made.

This paper is a summary of an unpublished MA dissertation and supports the need for more research into designerly thinking with young children. Further detailed information can be obtained from the author.

Introduction

The project was designed to determine how important product evaluation is in setting good foundations for design and technology for young children. It will aim to support the findings of an original project (Benson, 2003), which was to develop and enhance young children's designerly thinking. It will discuss the skills that develop when children are involved in product evaluation activities. It aims to show that when tasks are meaningful to them, children are able to use designerly thinking skills to evaluate different made world products. In order to do this, the study will begin by drawing upon different aspects of children's thinking, with particular reference to creativity, critical thinking and problem solving.

Literature review

The literature review focused on a review and discussion of:

- Documentation (QCA 2000, Bennet and Dunne 1992).
- Schemas (Tassoni and Hucker 2000, Nutbrown 2005, Bruner 1983, Edwards and Knight 1994.
- Creative and critical thinking (Fisher 2005, QCA 1999, Moyles 1989, Spendlove 2005, Guilford 1957 De Bono 1987, Dansky and Silverman 1973, Siraj-Blatchford 2003, Benson 2004a, Conridge 2004.
- Children's ability to evaluate products (Benson 2005,Siraj Blatchford 2003, Rogers 2002.

A full list of references are included at the end of this paper.

Methodology

The current study follows the cycle of action research. Action research is practical, flexible research aimed at improving educational practice (Costello, 2003). The fact that I chose to carry out the research in the setting where I worked, meant that I could use the study to further develop my own practice in this way. Action research is more than just an isolated study. It is cyclical in nature, whereby the individual carrying out the research is systematically reflecting on and changing practice (Dick, 2002). As the research is carried out, there are implications for the researcher to consider their own practice in order to plan changes so that progress is constantly being made (Denscombe 1998). In the current study, I decided to focus on designerly thinking, having already identified it as an area for development in the Nursery. I devised and implemented a series of activities, with the intention that the children involved would develop their skills in this area. The ultimate aim was to improve practice within the area of designerly thinking in the Nursery, and improving practice is a key factor of action research (Cohen and Manion, 2000). Although the study consisted of a small sample of children, the conclusions made will effect how d&t is then developed further in the Nursery. From the findings, I will consider the implications for the planning in the Nursery and make changes accordingly. In keeping with a data-driven approach (Dick, 2000). Although d&t and, in particular designerly thinking, was identified as the initial focus for the research, the nature of the study ensured there was flexibility for other important issues to be considered if they emerged. This was to prevent the study from having too narrow a focus, which may occur with theory driven practice (Costello, 2003). As I am focusing on changing practice within just one setting, this is 'technical research', as identified by Zuber-Skerritt (1996). This process of action research followed an initial cycle of 10 months, with the in-school research being carried out in the second half of the Autumn term 2005.

There is a great deal of research concerned with the effect of questioning on children's performance. It was therefore important to consider some of the factors that may influence the data collected by considering some of this research. Questioning is vital when developing critical thinking. Just as dismissing children's creative ideas may dampen their enthusiasm for creativity, restricting children's responses by asking the wrong questions may limit their ability to think critically (Fisher, 2005). It is vital therefore, to ask questions that stimulate and extend children's thinking. Bloom's taxonomy places importance on asking questions that will elicit synthesis and evaluative responses (Fisher, 1995). Therefore, in order to ensure that I had a range of questions, I divided possible questions into the different levels of thinking. I also considered the 'productive questions' recorded by Benson (2004b) which were directly related to young children involved in an activity based on made world products. These questions related directly to the product, its user and its purpose and had a significant influence on the types of questions I decided to use.

Findings

In order to gain an idea of any general trends in the findings, I carried out a count analysis on the children's responses. This is identified by Gillham (2005) as a useful summative tool. One disadvantage that emerged with this small group research was that absent children meant there were gaps in responses for different children. This meant it was extremely difficult to follow the children's responses individually through each task. Therefore, it was more practical to take the responses to each activity and analyse them as a group. As discussed by Gillham (2000), when carrying out case study research you can begin by having a broad expectation of what may be indicated in the findings. However, as the case study is not restrained by experimental conditions, the findings may not necessarily follow an expected route. When designing the activities to carry out in the study, I focused on developing children's designerly thinking skills. This also involved reference to creativity and critical thinking skills. I based my count analysis on these areas while also including personal experience. As is the nature of data driven action research, any issues that arise during the research need to be considered (Dick, 2002), and personal experience was an issue that although not having been identified as a focus, during an initial read through of the transcripts showed it as a reoccurring theme throughout the responses (for the response recording for each activity. Although the transcriptions are an accurate, reliable method of recording (Hopkins, 1985), it is my own interpretation of responses through my notes and subsequent evaluations that are more subjective, but are on which the following discussion is based. Thus, I categorised the responses into what I considered to be the correct category based on the following assumptions:

- Personal experience – responses that related directly to aspects of the children's lives outside of the Nursery.
- Critical thinking – in order for a response to be considered an example of critical thought, the children's responses would be considered comparison and justification responses when based on the higher order thinking skills identified by Bloom (1956).
- Creative thinking – On reviewing various views about the nature of creativity (De Bono (1987), Moyles (1989), Siraj-Blatchford 2003), I concluded that the definition given by Fisher (1995) relating creativity to the ability to generate new ideas and explore alternatives would be the basis of what I deem to be creativity in the current study. Thus, a response fitted into this category if it was an example of the children using knowledge they already have and applying it to something new.
- Designerly thinking – reflects developing children's awareness of the made world, looking at aspects such as features of a product, purpose and user (Benson 2003). The children's responses were classified in this category if they related to one of those areas. When considering user, there was some overlap with the category personal experience, as the identified users were often related to the children's lives.

Using these four categories when examining the transcripts, I identified the following key findings:

- The children were enthusiastic and interested in the activities they participated in.
- Most of the evidence gathered was verbal but significant non-verbal behaviour was also recorded.
- Personal experience had a significant effect on the responses of the children.
- The activities provided numerous examples of children engaging in critical thinking, including higher order thinking as identified by Bloom (1956).
- The activities provided an ideal starting point for encouraging independent thinking and creative thought.
  - Although the number of designerly thinking responses did not increase with each activity, 44 % of verbal comments related directly to designerly thinking – meaning they referred to a product, a user or the purpose of a product.
- The number of don't know/no responses was high in the first activity, reducing to 0 in the last 3 activities.

Discussion

Children's interest in the activities

The findings of the current study reflect those of the Benson (2003) research in that the children were motivated by the products they were shown. The children were interested and eager to come to the table when I arrived each week. This was reflected in their comments which included 'when are we going to help you today? (Child 1) and 'can we go over there (indicating where we sat last time) now?' (Child 2: both before the start of truck activity). These comments show that the activities stimulated interest and enthusiasm among the group. Using the phrase from Woods (1986) the children's attention was 'captured' as opposed to being recruited. That is, they wanted to be involved in the activity, rather than being told that they must participate in the activity, as often happens once children start KS1 (Edwards and Knight, 1994).

Verbal/non verbal evidence

Children will respond more if an activity is of interest to them (Craft 1997). However, some children choose not to respond in a verbal manner but show interest through their behaviour (Moyles, 1989). Although categorising the verbal responses was a useful starting point for analysing the activities, a disadvantage to audio recording is that it is limited to things that have been said, with no record of what is happening during the 'gaps' in discussion. This is why I also recorded notes as I was going along – to record what was happening if the children were 'doing' rather than talking. In doing so, I highlighted an important finding – although child 5 did not contribute much verbally in both the cup and book activity, his behaviour shows he responded well to the activity, just not in a verbal way.

Personal experience

As discussed by Fleer, Jane & Robbins (2004) the home environment has a big impact on the designerly thinking skills of young children. As they highlight, many young children have a wealth of experience with made world products before they start school and will continue building on this experience within their home environment. These individual, personal experiences will have an effect on how they respond to stimuli once they reach school: Wells (1988) and Roden (1999) both talk of personal experience as being a crucial factor in the way that young children will approach a problem.

The current study supports the view that a child's own experiences will have an effect on how they respond within the classroom. The children referred to family members 'sometimes my mum wears glasses' (child 2 glasses activity) and objects at home 'I have a plastic cup, a fairy cup, it has fairies on' (child 6, cup activity). The children had knowledge about how to behave in certain situations: 'I think you need to wrap it up and give it to him' (child 3, truck activity). Child 3 has clearly had some personal experience of wrapping birthday presents in preparation for giving it to someone else.

It was also not only direct experience that affected decisions made by the children, Child 3 drew on the story of Cinderella as a solution to my 'slipper' problem: 'knock on everyone's door 'is that your slipper' if they say no, then go to the next one, they say yes'. The parallel to the fairy tale is quite clear, thus child 3 has drawn on this aspect of a previously heard story and applied it to the current problem, being able to select a solution that might work. She was clearly using her prior knowledge to help her make sense of the current situation. That she was able to do so quite confidently is reflective of the independent, confident learners that the Foundation Stage framework encourages (QCA, 2000).

Critical thinking

The children were confident at making decisions and were often able to give reasons for their choices. There are clear examples of logical thought, suggesting that even young children can engage in more complex thinking than Piaget suggests. The evidence for schemas is a little disappointing but may be due to incomplete observational evidence of the children over time.

Designerly thinking

With designerly thinking as the focus, the activities were not developed with the aim of actively promoting creativity. However, any creative thinking displayed by the children was encouraged and recorded, and the findings show that in fact, there were a number of examples where the children were able to develop new ideas and alternatives independently. Although the activities were not designed with creativity as a focus, they did in fact provide an opportunity for creative thought. Despite little reference to d&t in publications relating to creativity (Benson, 2004), the current study would support Benson's conclusions that d&t is an ideal subject to provide creative opportunities for young children.

As with the critical thinking responses, it seemed appropriate to sub divide the designerly thinking responses into user, product and purpose, those being the 3 main focuses within the area of product evaluation that reflect the skill of designerly thinking (Benson, 2004).

Nearly half of all the comments made by the children related to designerly thinking, a positive finding that suggests that the activities were appropriate and did in fact encourage the children to think in a 'designerly' way. There was no apparent pattern in whether the children focused more on user, product or purpose. For some activities the comments were evenly spread between the 3 areas, or in the case of the book activity, the designerly comments were exclusively about the product.

Implications

Implications for personal future practice

The implications for my own setting are that the activities need to be planned into the Nursery long term and medium term plans, so that as different groups of children move through the Nursery, all get the chance to participate in designerly thinking activities. For the children who have participated in the current study, I now need to work with the Nursery staff to decide how to move these children on and the best way of doing that. In deciding how the research now fits in with the long term planning in the Nursery, I am developing my role as lead practitioner in the setting. I will need to make decisions with the staff as how best to use the information that has been discussed.

Implications for Foundation stage practitioners

For designerly thinking activities to become a part of everyday teaching in the Foundation Stage, practitioners would need to feel confident in developing designerly thinking skills. This would possibly raise staff training issues regarding how to question and respond to children in the best possible way. It is most likely, based on previous research (Benson 2003, Anning, 2003) that the majority of Foundation Stage practitioners are unaccustomed to this type of activity.

Implications for the Foundation Stage curriculum

The Foundation Stage curriculum aims to be a cross curricular one (QCA, 2000) and in the Foundation Stage the influence of d&t can be found across all areas of the curriculum. Despite this however, the current Foundation Stage curriculum guidance does not place emphasis on how d&t can be carried out in the Foundation Stage (Benson, 2005). Whilst it is explicit in the Early Learning goals, there is little reference to product evaluation skills or designerly thinking in the Guidance materials (QCA/DfES, 2000). For designerly thinking activities to be carried out regularly in all foundation settings, there would need to be recognition of the importance of designerly thinking in the foundation curriculum. These findings support a case that designerly thinking activities should be given such acknowledgement. Some children receive these experiences at home (Fleer, Jane and Robbins (2004) but many rely on what they are provided with at school (Anning, 2003).

References

These include all those in the unpublished MA

- Anning A (1993)
  'Technological capability in primary classrooms'
  in Proceedings of the International Conference on Design and Technology Educational Research and Curriculum Development
  Loughborough: Loughborough University Department of Design and Technology
- Anning A (2003)
  Young children meaning making through drawing and modelling at home and in pre-school settings [online]
  University of Leeds. Available from
  http://www.leeds.ac.uk/family/research
  (accessed 6 October 2003)
- Baynes K (1994)
  Designerly Play, Loughborough University of Technology
  Department of design and technology, Loughborough
- Bennett & Dunn (1992)
  in Edwards A & Knight P (1994)
  Effective Early Years Education: Teaching Young Children
  Great Britain: Open University Press
- Benson C (2003)
  Developing 'Designerly' Thinking in the Foundation Stage
  Fourth International Primary Design and Technology Conference: designing the future, England
  Centre for Research in Primary Technology (CRIPT)
- Benson C (2004 a)
  The Surprise Box in De Boo (2004)
  The Early Years Handbook, Sheffield
  The Geographical Association
- Benson C (2004 b)
  Professor John Eggleston Memorial Lecture 2004
  Creativity: Caught or taught?
  The Journal of Design and Technology Education
  Volume 9, Number 3, pp.138 – 144
- Benson C (2005)
  Developing Designerly Thinking in the foundation stage –
  Perceived impact on Teachers' Practice and Children's learning
  Fifth International Primary Design and Technology Conference
  Designing the Future, England
  Centre for Research in Primary Technology (CRIPT).
- Bentley M and Campbell J (1990)
  Primary Design and Technology. An introduction
  In Bentley M, Campbell J, Lewis A & Sullivan M (eds)
  Primary design and technology in practice
  U.K: Longmans
- Betts-Davies G (2005)
  Teacher to Teacher: Primary and Pre-School
  Autumn 2005 edition.
- Bloom B S (1956)
  Taxonomy of educational objectives, vol 1
  The cognitive domain
  New York: McKay
- Bruner (1983)
  in Edwards A & Knight P (1994)
  Effective Early Years Education: Teaching Young Children
  Maidenhead: Open University Press
- Child Education (April 2003 edition)
- Cohen L, Manion L & Morrison K (2000)
  Research Methods in Education (5th ed)
  London: Routledge Falmer Press
- Conridge (2004)
  Do I have to wear my coat?
  in De Boo (2004) The Early Years Handbook
  Sheffield : The Geographical Association
- Costello P J M (2003)
  Action Research
  London: Continuum
- Craft (1997)
  in Siraj-Blatchford J & MacLeod-Brudenell I (2003)
  Supporting Science, Design and Technology in the Early Years
  Maidenhead: Open University Press
- Dansky and Silverman (1973)
  in Siraj-Blatchford J & MacLeod-Brudenell I (2003)
  Supporting Science, Design and Technology in the Early Years
  Maidenhead: Open University Press
- Data (1998)
  The Design and Technology Handbook for Pre-school Provider
  Wellesbourne: DATA
- De Bono E (1987)
  in Fisher R (1995) Teaching children to learn
  Cheltenham: Nelson Thorne
- Denscombe M (1998)
  The good research guide
  Buckingham: Open University Press
- Dick (2000)
  in Costello P J M (2003)
  Action Research
  London: Continuum
- Dick (2002)
  Action Research: action and research (online)
  Available from www.scu.edu.au/schools/gcm/ar/arp/aandr.html
  (accessed 22.6.06)
- Donaldson M (1981)
  Children's minds
  Great Britain: Fontana Press
- Edwards A & Knight P (1994)
  Effective Early Years Education
  Teaching Young Children
  Maidenhead: Open University Press
- Fisher R (1995)
  Teaching children to learn
  Cheltenham: Nelson Thorne
- Fisher R (2005)
  Teaching children to think
  Cheltenham: Nelson Thorne

- Fleer M, Jane B & Robbins J (2004)
  Designerly thinking:
  Locating technology education within the early years curriculum
  Early Childhood Folio, Number 8, pp.29 – 33
- Gillham B (2000)
  Case study Research Methods
  London: Continuum
- Guilford (1957)
  in Moyles J (1989) Just playing? The role and status of play in early childhood education
  Maidenhead: Open University Press
- Hissey J (1998)
  Little Bear's Trousers
  Great Britain: Random House
- Holt (1991)
  Learning all the time
  Nottingham: Education Now
- Hopkins D (2002)
  A Teacher's Guide to Classroom Research
  Great Britain: Open University Press
- Hopkins D (1985)
  A teachers guide to classroom research
  Milton Keynes: Open University Press
- Hughes (1975) in Donaldson M (1981)
  Children's minds
  Great Britain: Fontana Press
- Keirl S (2004)
  Creativity, Innovation and Life in the Lily-Pond
  Nurturing the design and technology family while keeping the alligators fed
  The Journal of Design and Technology Education
  Volume 9, Number 3, pp.145 – 160
- Lincoln Y S & Guba E G (1985)
  Naturalistic Inquiry
  Newbury Park and London: Sage
- McGarrigle (1974)
  in Donaldson M (1981)
  Children's minds
  Great Britain: Fontana Press
- Moyles J (1989)
  Just playing?
  The role and status of play in early childhood education
  Maidenhead: Open University Press
- Munday J (2001)
  Applying Bloom's Taxonomy to teaching and testing (online)
  Available from
  http://www.hishelpinschool.com/learning/Bloom.html
  (accessed on 29/08/05(
- Munn (1992)
  in Edwards A & Knight P (1994)
  Effective Early Years Education:
  Teaching Young Children
  Maidenhead: Open University Press
- Nutbrown C (2005)
  Threads of thinking
  Great Britain: Paul Chapman Publishing Ltd
- Parker-Rees R (1997)
  Making Sense and Made Sense:
  Design and Technology and the Playful Construction of Meaning in the Early Years
  Early Years, Volume 18, Number 1 pp.5 – 8
- Piaget (1896-1980)
  in Tassoni P & Hucker K (2000) Planning play and the early years
  Oxford: Heinemann
- Practical Parenting (2001)
  September issue, p.108
- QCA/DFES (1998)
  Design and Technology:
  A scheme of work for Key Stages 1 and 2
  London: QCA.
- QCA/DfES (1999)
  Early Learning Goals, QCA
- QCA/DfES (1999)
  The National Curriculum
  Handbook for primary teachers in England, QCA
- QCA/DfES (2000)
  Curriculum guidance for the Foundation Stage, QCA
- Robson C (1993)
  Real World Research
  Oxford: Blackwell
- Roden (1999)
  in Davies D and Howe A (2003)
  Teaching science and design and technology in the Early Years
  London: David Fulton Publishers
- Rogers C (1961)
  in Fisher R (2005) Teaching children to think
  Cheltenham: Nelson Thorne
- SCAA (1996)
  Desirable outcomes for children's learning on entering compulsory education, SCAA
- Sensi P (1998)
  'Technological knowledge, concepts and attitudes in nursery school'
  in Proceedings of the International Conference on Design and Technology Educational Research and Curriculum Development
  Loughborough: Loughborough University Department of Design and Technology
- Shallcross P (2006)
  The Early Learning Goals and Design Technology's Contribution (online). Available from www.kented.org.uk (accessed 26/04/06)
- Shayer M & Adey P (1981)
  in Edwards A & Knight P (1994)
  Effective Early Years Education: Teaching Young Children
  Maidenhead: Open University Press
- Siraj-Blatchford J & MacLeod-Brudenell I (2003)
  Supporting Science, Design and Technology in the Early Years
  Maidenhead: Open University Press

- Smith (1994)
  Play and the uses of play in Moyles (ed.)
  The excellence of play
  Buckingham: Open University Press
- Tassoni P and Hucker K (2000)
  Planning play and the early years
  London: David Fulton Publishers
- Taylor R (2005)
  The 'designerly thinking project'
  The beginning of a pedagogical journey
  Fifth International Primary Design and Technology conference:
  Designing the Future, England
  Centre for Tesearch in Primary Technology (CRIPT)
- Treleven (2004)
  Investigating the provision of design and technology in selected
  early Years settings. Unpublished research project
  University of Central England in Birmingham
- TTS (2005)
  TTS Home page (Online)
  Available from www.tts-group.co.uk (accessed 20/1/06)
- Walsh (2005)
  in Yelland N (2005) Critical Issues in Early Childhood education
  Buckingham: Open University Press
- Wells (1988)
  in Moyles J (1989) Just playing? The role and status of play in
  early childhood education
  Maidenhead: Open University Press
- Woods (1986)
  in Edwards A & Knight P (1994)
  Effective Early Years Education: Teaching Young Children
  Great Britain: Open University Press
- www.naaidt.org.uk/news/docs/conf/Benson2
  (accessed 1/2/06)
- www.schoolsnetwork.org.uk
  (accessed 1/2/06)
- www.tlfe.org.uk/courses/designerleythinking
  (accessed 1/2/06)
- Zuber-Skerritt (1996)
  cited in Denscombe M (1998)
  The good research guide
  Buckingham: Open University Press

Cutlery for the Future

Bredasdorp Primary School, Bredasdorp, South Africa
Anne Barnard – E-mail annie@bredasdorpps.wcape.school.za

Background

Bredasdorp Primary School is situated in the Western Cape and in the Overberg region. There are approximately 620 children on enrolled including the nursery classes. There are 283 children in the Foundation Phase (Gr. R –3) and 337 children in the Intermediate Phase (Gr. 4-7). The Foundation Phase teachers teach technology in their own classes and the Intermediate Phase have two teachers, as well as a special class for technology.

Introduction

We received the challenge from Conran to design cutlery for the future. The classes were introduced to the challenge and they were very excited about it. At first some of them said that the task was too difficult and some immediately started giving ideas of what can be produced. Ten juniors and ten of year 7 – 11 were chosen for the challenge. The ideas that take hold in our minds will shape the world of tomorrow. Will we shape the future or will the future shape us?. Cutlery has stayed the same over quite some time and the children said it is time to change that.

Investigate and Evaluate

The children were asked to bring any old or new cutlery that they had at home. The teacher went to an antique shop to find some old cutlery from the early 1900 s. Then they discussed the old and the new ones. Not much change was discovered over the years. The following questions came to mind:

- What materials to be used?
- Can it be washed?
- Who is going to use it?
- How to decorate the cutlery?
- Will this be used in the future or is the idea too far-fetched?

When they started to draw, it showed that they carefully thought about it.

Thinking on paper

At first they discussed their ideas with each other. They sketched several design proposals and then chose the most promising one. While enthusiastically designing, they talked about the fact that cutlery used all over the world and that some cutlery, like knives, was changed in the earlier days. This was because people fought at the dinner table and that's why they changed it into round knives. Learning takes place through socializing. All drawings were done on blank paper. The young children battled to stay with the design on paper. In other words, their design will be one thing, but the end result something else.

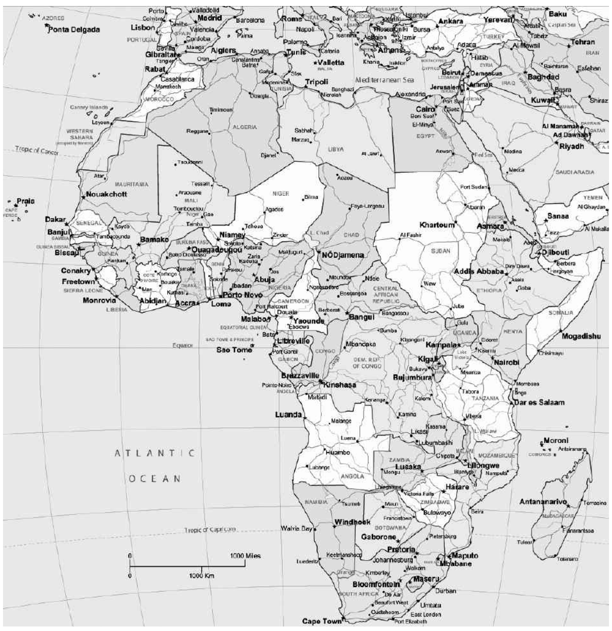
Design as defined by problem solving, applying skills, decision making, being innovative and inventive.

Activity

Week by week summary of activities

- Week 1 – Introduction (as above).
- Week 2 – Design (as above).
- Week 3 – Begin constructing cutlery.

The teacher provided pupils with materials and tools such as cartons, scissors, flexible thin wire, spray paint, thongs, hammers



and safety equipments for the tables. The teacher demonstrated the technical operations, if required. They worked under careful supervision of the teacher. Everything was discussed about the safety rules with the children while working on the project. After each work session everything was carefully stored away for the next session.

- Week 4 – Complete and evaluate

Foundation Phase: (KS 1 – 3)

- Learner 1 – Singing spoon.
- Learner 2 – Germ detector / Nano knife.
- Learner 3 – Camp cutlery.
- Learner 4 – Baby chair cutlery.
- Learner 5 – Granny fork.
- Learner 6 – Salt and Pepper cutlery.
- Learner 7 – Edible cutlery.
- Learner 8 – Space tube.
- Learner 9 – Pasta fork.

Evaluation of the project

The children were proud of their achievements. The project had generated much enthusiasm. The key element of the project was careful planning. The learning objectives had been achieved. The project concluded with an evaluation sheet. Digital photos were taken of the cutlery and the children used self – assessment to evaluate them. New words were used like well done, not so well done and what advice they would give to others or to themselves. They had to use constructive criticism. The most comments were if they enjoyed the project and if they enjoyed making their own decision with their choices.

Re-Think Your Design and Technology Teaching: Linking Sustainability with D&T

Earls Barton Junior School, Broad Street, Earls Barton, Northants, NN6 OND
Suzanne Coles – E-mail suzannec6@EBJS.northants.sch.uk

Abstract

This paper is the result of an area based initiative in Northamptonshire linking the teaching of design and technology with sustainability. Although the National Curriculum is clear about the need to promote awareness about sustainable development many teachers are unaware of the possibilities that are available to us. Many schools follow closely the QCA units of work in D&T as they do not have the confidence or knowledge to widen their experiences. In the Northamptonshire initiative, Aileen Dunkley, adviser for design and technology, developed units of work that highlight the possibilities for primary teachers to develop sustainability through design and technology. In this paper I report on a trial of two of these units of work, one focusing on desk tidies with a Year 3 class (children aged 7 – 8) and the other focusing on textile containers with a Year 4 class (children aged 8 – 9).

Introduction

As an art specialist in a primary school I was given the role as the art coordinator and (as in many schools) the role of Design and technology coordinator was incorporated into my position. As my subject knowledge in D&T is limited I am always looking to improve my professional development in this area.

The new units of work I have trialled have been written in a similar format to, and are interchangeable with, the QCA units of work. Therefore these are easily accessible to teachers with little or no experience of teaching D&T. The two units that I chose to trial were 'Reorganise your desk' and 'Re-home your pencils'. During the training sessions I had found these units the most enjoyable and felt that managing the required resources would be easy. Both units involve practical work with reclaimed materials and include learning about sustainability. I chose to adapt both of the units slightly, giving the children a purpose for their individual projects.

'Reorganise your desk'

'Reorganise you desk' – Desk tidies is a suggested alternative to Unit 3A 'Packaging' or 3D 'Photo frames'. For this unit I worked with my own Year 3 class (25 children). Although not ideal, due to time constraints the unit had to be completed over a period of 4 weeks.

Initially children investigated free standing structures and also evaluated commercial desk tidies. This enabled the children to look at how different products are designed and also to recognise the importance of stability in this type of product. Providing the children with the opportunity to discuss the component parts and their purposes would hopefully inspire the children's final designs. Subsequent sessions focused on the children experimenting with different methods of joining, stiffening and reinforcing structures.

As there was a limited time for this project the children worked in small groups to design and produce the final product. Although this proved difficult at the designing stage it was productive at the making stage as the final designs were larger than expected.

Each group of children was given a written scenario and a photograph giving them a real purpose for their designs. These included desk tidies for the head teacher, a class teacher, caretaker and the staffroom, also a kitchen tidy (for recyclable waste) for me. Each project required the children to explore an issue related to sustainability and incorporate a message communicating this.

When designing their product the children had to ensure that their message (and an appropriate component part) was included in their design criteria. Some children chose to provide a slogan on their product reiterating the purpose of reusing, recycling or reducing waste. These included 'Am I ready to be recycled?', 'Have you used both sides of me? and 'Am I aluminium?' (with a magnet for testing),the latter relying on prior knowledge gained in a previous science unit. One group also included a food chain showing the importance of recycling food waste for compost.

By only allowing the children to use reclaimed materials from home this gave them the opportunity to collect their own materials. They experienced first hand how we can reuse readily available reclaimed supplies to make useful items.

The final products were evaluated according to their design criteria and judged on how they had met the needs of the user. The children also made suggestions as to how they could improve their products.

'Rehome your pencils'

For this unit of work I was fortunate to work in another year group, this time a year 4 class (24 children). Again the time constraints were there but the children had already completed a unit on designing and making purses so they were familiar with some joining techniques associated with textiles work.

The first session of this unit concentrated on examining commercially available textile containers. These were evaluated by the children who considered their purpose, their suitability, their fastenings, the materials used and any special features. This was completed as a speaking and listening activity enabling all children to be involved in feedback to the class.

At this point a request was sent home to all parents in the school for any unwanted jumpers or any other woollen items. Although the response was fairly poor I feel if this was an on going appeal, it would prove more successful.

The next lesson focused on joining techniques (using various stitches) enabling the pupils to understand the importance of making strong and secure seams. During this session the children were also introduced to the sustainability aspect of the project. They were shown how to felt woollen knitwear and the difference in the 'before and after' properties of the fabric. This was compared with fleece fabric and an explanation was given of how this is made from recycled plastic.

Future sessions were spent considering what the children were going to make deciding who it was for, its purpose and what reclaimed materials were available. When the children had chosen their fabrics they examined them to assess their potential identifying any features, e.g. a ribbed cuff, a sleeve shaping, a zip, button or other fastening or a pocket, that could be incorporated into their design. The children decided on their design specification considering the intended user, made initial sketches and then completed a detailed drawing of their design. Each child made a mock up of their designs using j-cloths (an inexpensive and reusable material) which were then dismantled to provide a pattern for their product. As the children began the making process they were encouraged to review their progress and explain any changes they had made.

At the end of the project the children made their evaluations carefully considering their original design specification and justifying any changes that had been made. Discussions were also made as to how this project had differed from the last 'purses' project they had completed, exchanging views on how they had used reclaimed rather than new resources and how they had reused materials that would otherwise have been discarded.

Reflection

Although I had a limited time to implement these schemes of work I feel that I (and hopefully the children) have learned more about the importance of sustainability. In the future I would like to spend more time on the evaluation stage of the projects. Enabling the students to test their products over a prolonged period of time would give them a better picture of the effectiveness of their designs. These projects have shown me that it is easy for children to design and make extremely high quality finished products at relatively no cost at all. This is an excellent way forward in the teaching of design and technology as this subject can been seen by some teachers, as involving an expensive outlay for materials for very little gain or learning.

The children reacted very well to the practical elements of this work. Creating final products that would have a direct impact on their school environment challenged them to consider the wider issue of sustainability. The use of reclaimed materials from home also extended their (and their families) awareness of recycling. By adding this extra dimension to the teaching of D&T the children were challenged to take responsibility for reducing their own carbon footprint. When approaching such a task, the children now consider not just whether a material is functional, but how damaging it may be to the environment.

As a result of piloting these units it is now possible to include the criterion of sustainability when planning across the year groups. This will reduce the use of new (bought in) resources, allowing us to target our budget more effectively and produce less waste.

Both of these units of work have enabled me not only to update the design and technology curriculum but also to rethink the way we work as a school. The experience has encouraged me, and also the rest of the staff, to think about sustainability within the context of the whole school and the wider community. We are in the process of applying to be an eco-school (which includes setting up an eco–council), we have implemented paper recycling bins (as well as using both sides!), we are creating a school garden (complete with compost bin for all fruit and vegetable waste) and of course are thinking about sustainable development across the curriculum.

As schools are responsible for approximately 15 per cent of public sector greenhouse gas emissions and two per cent of the UK total we must as teachers begin to educate our children for the future. The challenges of our changing environment are a growing problem and as educators I believe it is our task to adapt the behaviour of the younger generation so they can build on the good work we have started.

Teaching Overseas: Extending Trainees Perspectives

Faculty of Education, University of Central England, Perry Barr, B42 2SU, EnglandUK
Specialist and Non Specialist Design & Technology Trainees.
Leanne Cahill – E-mail cahill_leanne@hotmail.com Laura Green – E-mail laura_green86@hotmail.com
Caroline Gilbert – E-mail E03125190@student.uce.ac.uk Terri Hitchcox – E-mail E03257680@student.uce.ac.uk
Charlotte Maddocks – E-mail E03042840@student.uce.ac.uk Laura Marshall – E-mail laukmarshall@yahoo.co.uk
Laura Shortland – E-mail laurabeth83@btinternet.com Vikki Pearce – E-mail vikki@pearce.wanadoo.co.uk

We would like to thank Clare Benson, Anne Barnard, Johann Burger, Thembisa Stevens; everybody at Ikhwezilesizwe Primary School and Bredasdorps Primary School and finally Penny Bailey and Dave Tortise. Without any of these people this fantastic experience would not have been able to go ahead.

Introduction

In November 2005, BA QTS students at University of Central England, (UCE), were offered the opportunity to experience teaching miles away in South Africa. Seven months later in July and after an immense amount of planning and organising we were on our way. We were to experience school life in two schools in contrasting locations. The majority of our time would be spent in Bredasdorps Primary School situated two hours south of Cape Town. During our time here we would teach design and technology to 6 – 14 year olds. Although we had a theme for our lessons we had to wait until we were in the classroom to understand the most effective way of delivering the lesson forto the children.

A day would also be spent in Ikhwezilesizwe Primary School, in Khayletisha, a township school located just south of Cape Town. Here we would be able to observe several lessons, and gain an insight into the daily life of the school. Although we were spending such a short time in Khayletisha the time spent here would not be overlooked and our experiences would be just as valuable, greatly affecting our teaching.

Planning

We intended to plan and teach within the lines of the English National Curriculum for design & technology as we felt it was important to model how we teach the subject in England. This would allow us to give the pupils an understanding of why it is important to have a user and a purpose, when designing and making. Prior to departure we knew that the Head Teacher was enthusiastic that we taught all pupils in the school and that we would only have one fifty minute lesson with each class, with class sizes of 30 to 50 pupils. After much deliberation we decided that we needed to provide a tight framework, by giving each class a design brief to work to, varying it slightly for the different age groups. The brief asked pupils to design and make a mask that could be sold or displayed to tourists to promote South Africa and to feature the native animals. Due to the short amount of contact time with each class, we also decided to give a specification outlining four criteria. As we were unsure of the resources that would be available to us at the school, we also took thirty two kilos of resources with us, ranging from card, paper drills, glue sticks to scissors! As trainees, we are used to designing design and technology units of work that have investigative and evaluative activities, as well as focused practical tasks, that prepare pupils to produce individual responses in a design and make assignment, so designing a design and technology experience that was quite restrictive was difficult for us. However we felt that the time constraints forced us to do so.

Bredasdorps Primary School

It was with great apprehension that we arrived at the school in Bredasdorps after a two and a half hour journey from Cape Town. We had watched with curiosity the changing landscapes and tried to guess what the small town would be like and what the capabilities and experiences of the children would be. Our concerns were that the children would show no interest in making our masks, be unable to understand us or our instructions, the complexity of the older children's designs, the flexibility of our plans to adapt to the abilities of the children and whether we had brought enough resources to teach 550 children. Due to this lack of knowledge and a wealth of experience in different schools situated throughout Birmingham we expected children's attitudes towards school as well as design and technology to be similar to those of the children we have already encountered. However this assumption proved to be unfounded, as we were welcomed with enthusiastic and attentive children valuing every opportunity that is available in their education.

On arrival at the school we were shown into the staffroom full of teachers who were eager to be introduced to the English student teachers. Their enthusiasm and warmth quickly put our fears aside and made us feel that our contribution to the school, however small, would indeed be of value. As we were shown around the school we were struck by how the children's personal and social welfare were of paramount importance to the staff and how they celebrated whatever achievements the children made. This contrasted with our own experiences where the achievements celebrated were usually limited to subjects in the National Curriculum.

On our first full day we were introduced through a whole school assembly where we were presented with a few mementos which will act as a reminder of this wonderful experience. This gave us the opportunity to introduce ourselves to the school and for us to try our hand at the Afrikaans that we had been taught on our journey down. This will definitely be something the school will remember about us but we will always remember the children's welcome through song and their positive attitude.

Teaching the first class was a daunting experience as we were unsure of how many of the children would understand us due to the different languages. However this was quickly dispelled through the wonderful multilingual abilities of the children. We were encouraged to talk to the children and to share our experiences. The children were equally encouraged to speak their minds and to back up their opinions and we were impressed with their positive attitudes to us and their desire to discuss their ideas and thoughts. The older children in particular were keen to discuss the merits of different cultures and the importance of sport and which teams from our country they had beaten! This simply made our teaching experience more enjoyable and enhanced our understanding of the children.

Teaching at Bredasdorps Primary School

As we were a mixture of year 2, 3 and 4 design and technology specialist and non specialist trainees, we decided to teach in two groups, with the more experienced design and technology trainees leading the teaching to begin with and the other trainees acting as support teachers.

The sessions started with a discussion about the brief we had set the pupils and the content context in which it was placed. The pupils were encouraged to talk about the native South African animals and the characteristics peculiar to each animal. We also showed them possible outcomes; we were aware that this could influence their designs but felt that within the time frame, the pupils needed some direction. They were encouraged to experiment with the materials and tools we had brought along to produce different outcomes. The older pupils were encouraged to introduce mechanisms and; one boy even used his bicycle lights to bestow his mask with glowing red eyes. The older pupils were also encouraged to make their masks three- dimensional. Mini focused practical tasks included use of the tools and how to construct various components. Through discussion, the pupils were also encouraged to think about the order in which they needed to make up their designs. At the end of each session, an evaluation was carried out orally and pupils were encouraged to think about possible improvements to their masks. All of us felt that it was extremely important that every child should take home a completed mask. On leaving the sessions most pupils insisted on wearing their masks in the playground and on their way home. Bredasdorps was certainly full of animals at lunchtime that week! Having four adults plus the class teacher certainly allowed the pupils to complete the work within the fifty minutes. Halfway through the visit there was a role reversal and the less experienced and non- specialist trainees led the sessions. We were all nervous at teaching without detailed lesson plans, but after the first lesson, our confidence grew and we felt upon reflection that this impacted our teaching in a positive way. All students felt this was extremely beneficial as we could adapt each lesson to suit the varied needs of each class, and it allowed us to use our initiative.

One of the biggest differences we found in South Africa was the variation in class sizes as the government ratio of teacher to children is 1:50. However, the school in Bredasdorps saw it as fundamental that to enhance the children's education it was paramount to reduce the class sizes. This resulted in most classes being similar to our own experiences in the UK. However, further up the school the class sizes were larger and this made discipline key. In South Africa the discipline in school is very strict. Nevertheless, the school in Bredasdorps was keen to ensure that this discipline did not stifle the children and encouraged the children to share their ideas, thoughts and talents.

The biggest difference between South Africa and the UK was that the schools started at 7.30am and finished at about 1.30pm in time for lunch. This enabled the school to have a strong focus on extra curricular activities and we were particularly impressed by the attitude towards sport. However the school also encouraged the teachers to take the children to the beach, nature reserves and camping as this was essential in providing the children with a more rounded education. This contrasts with the UK where the threat of paperwork and risk assessments positively hinders teachers trying to look at alternative ways to educate children and provide a more rounded education.

Reflections on teaching in South Africa

We feel privileged to have been given the opportunity to visit a school in another country and experience a different culture of teaching and learning than that which we are familiar with. It was apparent that we, as a group, visited South Africa with the intention of broadening our acknowledgement of children's education within another country. However the welcome we received was enough to show us how important our presence was to both teachers and children at Bredasdorps Primary School. Not only was it a learning journey for us personally but also for the whole school community, also which gave us a feeling of pride at being able to share our knowledge and experience with others.

Teaching design and technology in one short session was extremely challenging for us. All the trainees tried hard to emphasise the English version of the design and technology process during the lessons and it was a real difference for us to focus on oral work, in spite of the language differences. This whole experience gave us an insight into international schooling and what we believed appeared to be a more flexible and personal approach to teaching with emphasis on the children and the experiences that they bring into the classroom.

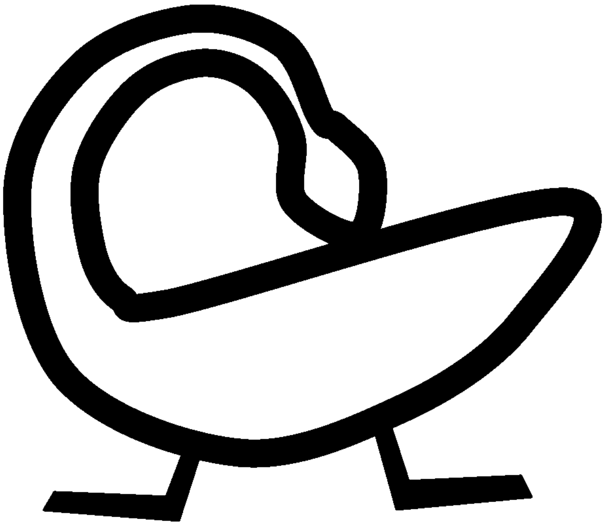
To witness children and adults that are so proud of their country's past and present was an experience in itself. Listening to a whole school sing their national anthem with such prowess was enlightening, considering the current UK culture does not encourage children to have knowledge of their own heritage. Evidence of this showed within ourselvesus not knowing our own national anthem. From this experience we feel that it is fundamental for children to have knowledge of the country they live in. This needs to be included throughout a child's education.

The contrast between children's value of education in the UK and South Africa was astonishing. Children understood the importance of education and valued the opportunity that they were being given. Within the UK, schools are striving to keep children interested in their own education, taking on a role within their own learning. As we all know from experience, it is a constant battle to maintain motivation and attendance in a school. We began to question how we can change children's perceptions of education within our own country.

This trip has enabled us to see the importance of many issues that we do not necessarily highlight in UK education. We had an amazing trip to South Africa. It was a fabulous experience, and for many of us a once in a life time opportunity. It has shown the necessity of international communication between schools and how this communication can enhance both teaching and learning across the curriculum within different cultures.

Sankofa: Aspirational Learning about Identity and Values

Kennet School, Stoney Lane, Thatcham, RG19 4LL
Cathy Growney – E-mail cgrowney@westberks.org
Reading International Solidarity Centre (RISC), 35-39 London Street, Reading, RG1 4PS
Barbara Lowe – E-mail Barbara@risc.org



'Sankofa' – A symbol of education and heritage.'Sanko' meaning go back, 'Fa' meaning take.

"The symbol represents the wisdom of learning from the past, to help build the future. It is sometimes depicted as a bird, which flies forwards whilst looking backwards. It reminds us to value our culture and history."

Abstract

This paper describes the development of a Technology Education project using Adinkra cloth from Ghana to explore pupils' identities and values. The Sankofa symbol shown is one of hundreds of Adinkra symbols. The symbols represent aspects of knowledge, history, beliefs and values.

The project aims were to raise pupils' awareness of the diversity of cultures within Africa; to promote understanding of our interdependence and shared history with Ghana; to consider pupils' own values and identities, and respect those of others. Simultaneous to these aims were curricular aspects of design and technology, art & and design, geography and citizenship / personal, social and health education (PSHE).

The methodology described used artefacts as a starting point. Rather than exhibiting these artefacts as interesting primitive/exotic decoration, they were handled and investigated thoroughly thus increasing understanding of Global Citizenship and bringing a meaningful aspect of Ghana into the classroom.

The paper explains how the projects took place in twelve schools in England, the differences between the projects and the impacts. The analysis of the projects (predominantly with year Year 5 classes but also with pupils in other year groups from Nursery to year Year 6) led to the development of an educational resource.

Introduction

In 2000, Cathy Growney, Technology Education teacher, Cathy Growney carried out a research project in Ghana on schoolchildren's toy-making. While there she made a collection of artefacts which were donated to Reading International Solidarity Centre's (RISC's) newly established handling collection. The handling collection (known as "The World in Their Hands") is now well established. It includes 1000s thousands of artefacts from many countries. Barbara Lowe and the education team at RISC have been developing methodologies which enable the school educators loaning the artefacts to use them to increase understanding of Global Citizenship, rather than as decoration. Often the artefacts are used as a starting point for cross-curricular work.

Adinkra cloth, a textile from the Ashanti Region in Ghana, is the vehicle in this case study for bringing the Global Dimension of Ghana to the classroom. The cloth is hand-printed with repeating symbols that represent aspects of Ashanti knowledge and history, proverbs, beliefs and values. Adinkra has been made in the town of Ntonso (in the Central Region of Ghana) for hundreds of years. Adinkra means "goodbye"; traditionally Adinkra cloth was created to be worn toga-style at funerals. The cloth was printed with symbols chosen to represent the values of the person who had died. Today, Adinkra cloths are for everyday use, for celebrations, as well as for funerals. Adinkra symbols are now strongly associated with all aspects of Ghanaian identity. They are seen on buildings, banknotes, jewellery and business cards.

The authors designed a cross-curricular project called "Remember Me" aimed at developing primary school pupils' identity and values through the inspiration of Adinkra. The project aims for Global Citizenship and Technology Education were:

- To challenge pupils' negative stereotypes of Africa.
- To raise awareness of the diversity of cultures within Africa.
- To focus on the similarities between Ghana and Britain, rather than differences.
- To promote understanding of our interdependence and shared history.
- To consider pupils' own values and identity, and to respect those of others.
- To provide pupils with opportunities for decision making.
- To enable all pupils to participate in a collaborative activity and negotiate outcomes.
- To enable pupils to express their creativity.
- To enable pupils to follow the design process.
- To enable pupils to learn about printing processes and CADCAM (where possible).
- To enable pupils to develop their printing skills.
- To enable pupils to apply pattern and decoration to textiles.

Methodology

The project team was made up of the authors and where designing was carried out using computers there was an ICT assistant. The plan for the project was to approach schools in which the trialling would take place. The authors believed that it was important to establish partnerships between themselves, as the researchers, and teachers in the schools. It was important to plan the projects with the schoolteachers so that they could consider how the project could be adapted to their unique situations and be integrated into the primary curriculum for the chosen year group.

In the project's most basic form the pupils design and make a whole class collaborative banner inspired by the Adinkra tradition. The purpose of the banner was to represent the values of each pupil in the class and to enable each of the pupils to be remembered and recognised for their chosen personal value. The Adinkra tradition was introduced to the pupils by showing the pupils samples of the cloth and printing blocks. The pupils were able to investigate the artefacts and develop questions they had of the artefacts. Many of these were answered using photographs of Adinkra cloth and block production, world maps and globes, charts and websites explaining the symbolism and the children's fiction

The pupils then thought about their own values and identities; they analysed a range of symbols and pictograms and then designed symbols to represent their own values. In many cases, particularly with the older pupils, this designing was done using CAD software, e.g. Dr Engrave™.

The next stage was to make the printing blocks. Again this was to be done in a variety of ways according to the different age groups of pupils and the resources available. Some of the schools were feeder schools to the Specialist Technology College in which Cathy Growney taught; in these schools the CADCAM engraving machine was borrowed from the secondary school so the designs were engraved onto neoprene and then glued on to wooden blocks. In some of the schools pupils made printing blocks from expanded polystyrene and in others pupils used string glued onto wooden blocks. Once the blocks were made the pupils printed their designs on to the collaborative banners and embellished them in the style of Adinkra cloths.

The project had the scope to go beyond the basic level in that the teachers were able to extend the project into other curriculum areas. For example mathematical activities could take place on repeating patterns, tessellations and symmetry; proverbs and poetry inspired by the Adinkra tradition could be developed in English activities; arts activities could be developed e.g. inspired by artist Owusu-Ankomah; country profiles could be investigated e.g. chocolate and Fair Trade cocoa production from Ghana, the slave trade or the Ghanaian world-cup football team, tourism in Ghana; Ghanaian language activities; SEAL[1]; assemblies.

Implementation

The implementation of the project in each school varied considerably. This was primarily due to the nature of the partnerships between the school staff and the authors and the time the school were able to devote to the project. Other factors included variation in the numbers of classes simultaneously carrying out the project, curriculum timetabling, classroom accommodation, resources available and age ranges. Some schools looked to the authors to lead the project, whereas other schools allowed considerable time for planning, thinking through the implications for the whole curriculum and including all teaching staff and assistants in the process. Teachers in these schools took ownership of the project by contributing their own ideas e.g. planning assemblies after the completion of the project so that the whole school could benefit.

The project was tried and tested in 12 different primary schools predominantly with year 5 classes (9 – 10 year olds) but also with pupils in all other year groups from Nursery to year 6. In some schools the pupils were taught in vertically organised groups, so differentiating the tasks to suit the whole age range was a challenge. This was especially acute in one very small school that included all Key Stage 2 (7 – 11 year olds) in a single class. In some schools the project took place over the course of an intensive day, in others it was over the course of a week (either full days or afternoons), and in some schools the project took place over a few weeks.

In the larger schools, where there was more than one class carrying out the project, the first introductory stage was carried out with the whole cohort as an interactive assembly. The 'values' workshops were carried out with the whole class, the class teachers and the project team; or in some situations the classes carried out the 'values' workshops under the direction of the class teacher without the project team and then the designing and making stages of the project were conducted once the project team had arrived. The staff from two schools decided that they wanted small groups of the pupils to carry out the project with the project team in a space separate from the classroom, while the remaining cohort did other activities with their class teacher.

Outcomes

The projects were successful in each of the schools. The pupils thoroughly enjoyed themselves; each pupil designed and made a printing block depicting a personal symbol. In all but the schools where only nursery or reception age pupils carried out the project, the pupils produced collaborative banners in which each individual was represented. In the schools where only nursery or reception age pupils carried out the project, and also many of the other schools, the pupils used their printing blocks to print on to individual cloth or card products.

The successes were revealed in the final products that in all cases were proudly displayed in public areas of the schools; as well as in the pupils' evaluations. The pupils demonstrated how much they had learned about Ghana and they appreciated the wealth of the Adinkra tradition. They also revealed their learning about the design process and their knowledge and understanding of processes, materials and techniques. They learned to design communicative symbols (by hand or using CAD); printing, pattern making and embellishing techniques on calico; and in ten out of the twelve schools, manufacturing processes using CADCAM. The pupils were particularly fascinated to see their designs being engraved on the neoprene.

In most schools the pupils carried out whole-school assemblies showcasing their work, its background and what they had learned. A few schools developed the project further so pupils wrote newspaper articles about Adinkra or other aspects of Ghana e.g. Tourism, Cocoa production, Fair Trade, Britain's history with Ghana's and the slave trade; or Ghana's inclusion for the first time in the World Cup finals 2006.

The most successful aspects of Global Citizenship took place where the teachers were already doing values based education through PSHE and Citizenship or where the project had been linked to SEAL. The pupils in these schools gained understanding of Britain's links with Ghana; and an awareness of the diversity of Ghanaian people's lives. In the schools where staff were keen to develop the 'values' aspects, the introduction was followed by values workshops in which pupils explored the values depicted through Adinkra symbols and then they carried out exercises (usually in pairs) where they discussed their own identity, beliefs and values.

In the other schools the project focus was on the making and the outcome. In these schools the values elements and the wealth of the Ghanaian tradition received inadequate emphasis. Some pupils had such little time to explore values that they designed symbols of 'what has value?' rather than their personal values and ethical codes. Many of these pupils designed symbols representing their pocket money, PlayStations™ or fast cars as opposed to the symbols designed by pupils who had explored values more thoroughly and designed symbols representing for example security, wisdom and justice.

In those schools where pupils used DrEngrave™ software, some pupils discovered the text function and the template designs embedded in the programmes. They preferred using these to designing their own unique symbols. These pupils lacked creative thinking in their designs. Popular images included pupils' initials, love hearts and, on occasion, aircraft. The templates became a diversion from the values themselves since some of the images were selected because it was easier than designing pupils' own images.

In the evaluative discussions with the teachers, the authors found that they too had found the project exciting, celebratory and a valuable learning experience, but there were also concerns. The most significant concern was the teachers' feelings of their inadequate expertise to implement the project unsupported. They described insecurities in:

- Developing cross-curricular projects.
- Ensuring there was an adequate emphasis on each stage of the project to maximise its meaningful impact.
- Knowing how to help pupils identify their beliefs and values (especially under the finite boundaries of the Design and Technology curriculum area).
- Their own knowledge and understanding of the Adinkra tradition.
- Using the Adinkra inspiration without access to hands-on artefacts.

Acknowledging these concerns, the authors initiated the development of a meaningful cross-curricular teaching resource that would enable unsupported teachers to repeat the project regardless of their subject specialism. The plan for the resource was that it would provide a background of the Adinkra tradition and it would demonstrate how the tradition could be used to carry out a values-based project inspired by Adinkra that also helps teachers readdress pupils' negative stereotypes of African people. The resource would be designed such that it would cover the whole of the design process in progressive steps.

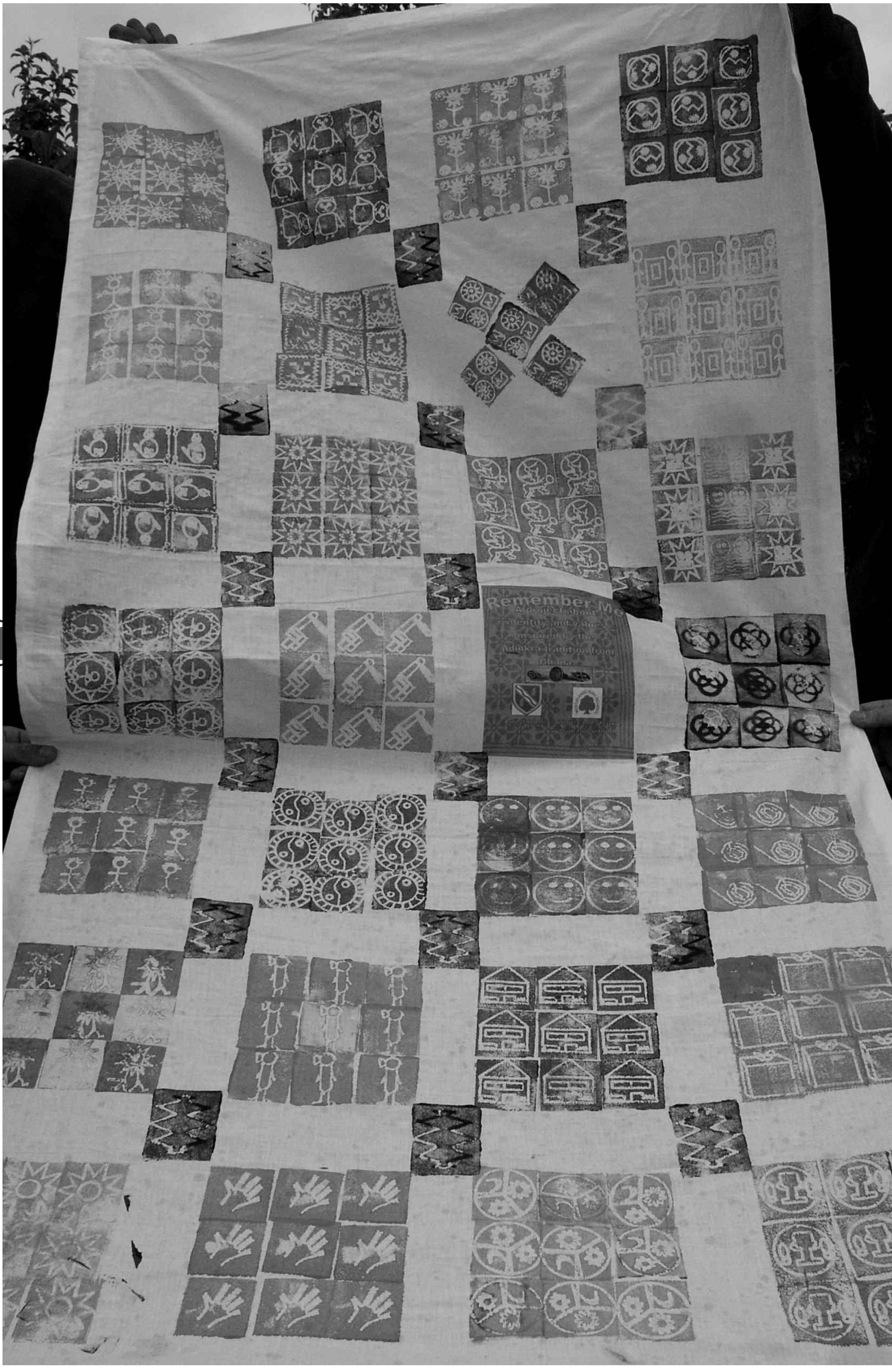
The writing of this resource started in July 2006 and in September the draft resource was sent to numerous teachers and other colleagues in education for testing and comment. During the course of trialling the resource, colleagues made suggestions, many of these which have been added into the resource, for example, alternative methods of printing on to textiles using calico impregnated with diluted PVA and an inkjet printer. The authors made several revisions based on the draft feedback and finally the resource was published in February this year (Growney and Lowe, 2007 {Growney, 2007 #208}). It is accompanied by a website[2] that indicates where teachers can access artefacts and provides photographs and weblinks for teachers who are still unable to access artefacts.

Resources

- Growney C & B Lowe (2007)
  Adinkra: a primary cross-curricular project,
  using a textile tradition from Ghana, to explore children's values and identity
  Reading, RISC/Growney and Lowe
- Mitchell R (1997)
  Talking Cloth
  New York, Orchard Books

Notes

1) Social and Emotional Aspects of Learning
2) www.risc.org.uk/adinkra/


Remember Me
Ghana


Earls Barton Junior

The Use of Resistant Materials in Primary Schools

Grestone Primary School, Handsworth Wood, Birmingham
Chris Perry – E-mail chrisperry@cwperry.freeserve.co.uk

Resistant materials fall into three main categories – woods, metals and plastics. The properties of the materials form the chief consideration of which one to use when making a product.

At Key Stage 3 and Key Stage 4 the following criteria would be applied when deciding which material to choose:

- Tensile, Bending, Compressive, Torsional & Shear Strengths.
- Elasticity, Plasticity, Ductility & Malleability.
- Hardness, Fatigue, Toughness, Brittleness, Durability and Stability.

Now analysing some of these properties are not necessary at Key Stages 1 and 2, but surely, issues like toughness, durability, stability and malleability are evident even in Foundation classes when children use building blocks to create towers? For too long primary school teachers have failed to recognise the value of looking closer at resistant materials. Indeed, the teaching materials I use have for some years included sections to complete on testing products using these criteria.

At Key Stage 2, the schemes of work provided by QCA, and therefore the most common in schools, provide direction on how, when and why to teach a design and technology (D&T) Unit, but rarely make judgements about the type of materials suitable for the task. Take the example below from Unit 6c Fairground Rides:

Children should learn:

- That there are a variety of products which incorporate a pulley and a drive belt and are driven by a motor or a computer
- How control systems are used in everyday life
- The appropriate vocabulary related to control systems

There is no mention of the materials used to create the 'variety of products' that the children will be examining. Now common sense prevails that children, upon examining a pulley system, often notice that the housing is made from plastic or metal, but teachers often fail to realise that when they come to make their own design & make assignments (DMA) that they can also use plastic or metal.

This is perhaps due to many factors:

- Lack of teacher awareness that resistant materials are now available to buy for primary schools.
- Teacher ignorance as to how to make DMA products, believing that cardboard and masking tape is always the easiest way to make something.
- Lack of time in the curriculum to explore options as to what materials are available for the task.
- Lack of teaching confidence believing that they have no idea how to use a saw or wire a circuit, so why should the children be any better at the task?
- There is a long-held and widespread misperception within primary teachers that what they do stands alone from Key Stage 3/4 and anything 'too complex' should be left to secondary school teachers.

Of course this is indeed a misperception, because teachers at Lodge Primary School and now Grestone Primary School, Handsworth Wood, Birmingham are now proving that resistant materials can be used safely, quickly and effectively to improve DMA tasks at Key Stage 1/2. Furthermore, QCA Units of Work can be dropped completely and other units implemented that strengthen the role of resistant materials in teaching practices, whilst also building transition links into Year 7.

To begin with, the school has accessed resources from education suppliers, TTS and TEP, to purchase wooden wheels, wooden cams, plastic battery holders, plastic motor holders, wire, precious stones, spray paint and lots of balsa wood. These materials have been used to give children choices.

Year 1 make fridge magnets using balsa wood – it is soft enough to cut with scissors, but tougher than card and paints better. The magnet is attached using a glue gun, supervised by an adult. Year 2 use the wood for wheels and axles.

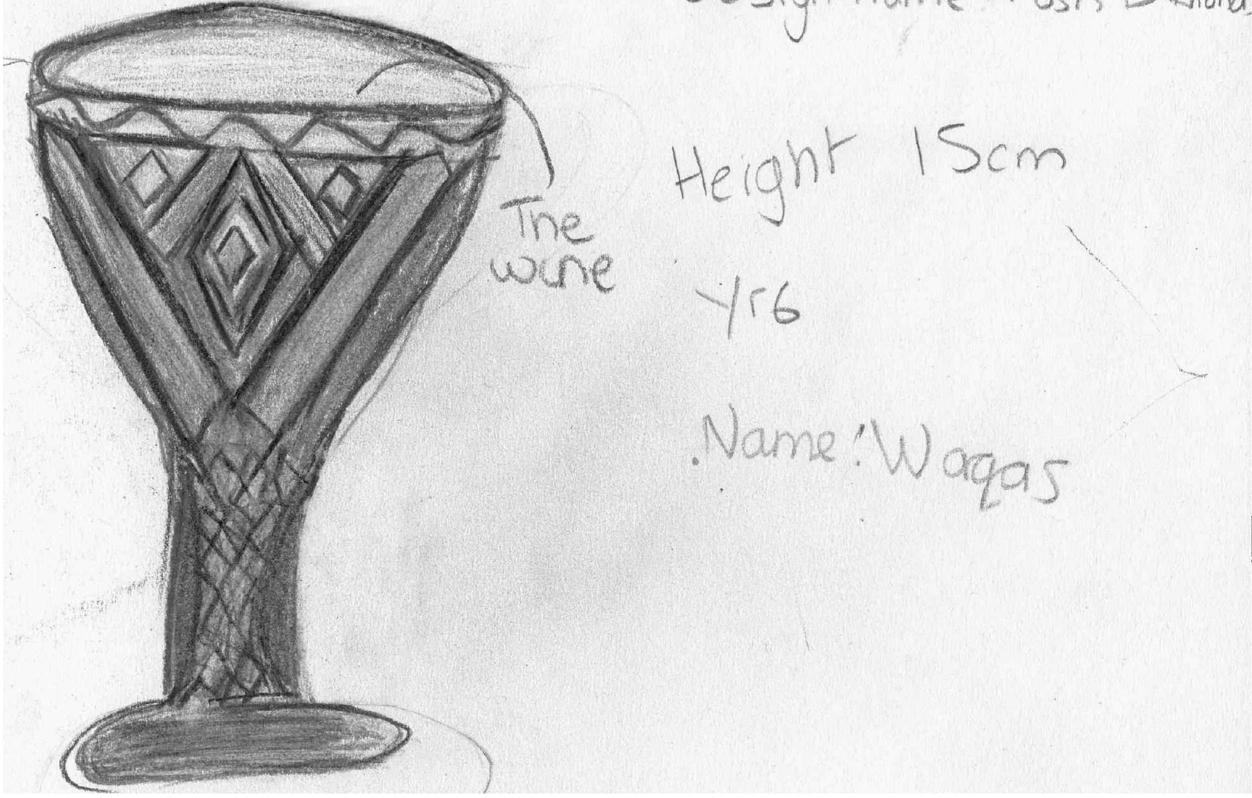
Key Stage 2 uses wood to construct mechanical toys, fairground rides and moving monsters. The latter product also uses plastic tubing and plastic boxes. Teachers give the children the freedom of choice to use cardboard or resistant materials. The children invariably choose the resistant materials, because of the durability and strength of the materials. This also leads to a wider debate about suitable adhesives which further strengthens their knowledge ready for Key Stage 3.

Probably Lodge Primary School's most notable success in this field has been the Key Stage 2 to 3 transition project: 'Jewellery of the Future'. The premise of the scheme was simple:

All humans love jewellery. Men and women have worn it since ancient times, so now it is time for our children to look to the future and design jewellery for adults in the 21st Century.

In July 2005 and 2006, Year 6 children from Lodge Primary School, Newtown Primary School and Oakham Primary School came together at Tipton Sports Academy to perform a Fashion Show. They were exhibiting jewellery they had designed and made, which showed their vision of the future.

The project had begun with me by training teachers from all three schools to look at existing types of jewellery. Chris showed the teachers how to make jewellery using gold, silver, wire and precious stones, as well as beads and string. The Year 6 teachers carried on the design process and two Secondary



Schools – George Salter High School and St Michael's High School – sent teachers to finish the making process. The secondary school teachers that were sent brought with them fascinating skills in CAD/CAM and wirework that the Year 6 children found invaluable.

One of the inherent beauties of the scheme of work is that each primary school can work on their section of the process in isolation before coming together at the end of the unit to display their results. It proves to be a perfect ending for Year 6 pupils, whom after SATS were looking to spending more time with their Year 7 teachers, whilst also providing meaningful and purposeful activity that has a clear outcome – the Fashion Show.

Indeed, having a clear outcome to a project is desirable at all times, but basing that outcome firmly in the real world is vital. The jewellery that is produced by the children is strong enough and uses enough real techniques employed by jewellers to provide the children with their first real taste of economic life in the big world. The Government's 'Every Child Matters'[1] agenda has always stressed the need for a school's curriculum to be based in the real world of business, but that is a complex issue to implement in primary schools which are Utopian paradises not associated with Alan Sugar or 'The Apprentice'.

Children in my Year 5 class that made bread have found over the years that I have added on sections of new work in their project, including a look at the process of milling flour and the need to create a bakery to sell their bread that runs along commercial lines.

It seems a natural step onwards therefore for me to create a partnership between a local economic interest and the children in my Friday afternoon D&T Club. The area of West Bromwich has long been associated with the industry of glassblowing. The technology of glass making for artistic purposes has remained largely unchanged since the 17th Century, with large factories like the Chance Brothers using the same techniques as modern studio artists. Typically, small teams of workers using a 'Chair' to sit in whilst they make a variety of glassware using pads of wet newspaper and metal sheers. Seriously, the technology is that primitive. Children find glassmaking fascinating: it is brilliant for science work, because they believe the molten fluidity of glass is impossible they believe, so it teaches principles of reversible materials and freezing/melting that applies to more than just water and ice.

However, with so many small glassblowers keen to promote educational links and short of economic work, it seemed a natural partnership for our children to design glassware that could then be made by experienced craftsmen. Over ninety children produced designs of stunning variety, and ten were chosen and made. The glassblower being was paid from my own pocket. Where a design proved too complex, the children used enamel paints to finish the vase. Why enamel paints? So they could resist usage afterwards.

The hope is that the ideas contained in this case-study will engender some serious debate amongst primary teachers about the role of resistant materials in their classroom. It seems a natural step onward, if we accept the need for a sustainable curriculum, that we should teach children that what they make can be kept for ever and must not be wasted. I still have the metal sculpture I made in Year 8 at secondary school in 1984, but none of my card efforts have survived. Perhaps in twenty years time my Year 1 children will still have the fridge magnets that I made with them.

Notes

1) Every Child Matters: Change for Children is a new approach to the well-being of children and young people from birth to age 19. The Government's aim is for every child, whatever their background or their circumstances, to have the support they need to:
   - Be healthy
   - Stay safe
   - Enjoy and achieve
   - Make a positive contribution
   - Achieve economic well-being

Thinking Globally whilst Designing Locally

University of KwaZuluNatal, Technology for All, Box 735, Kloof 3640, South Africa
Kate Ter-Morshuizen – E-mail kimali@mweb.co.za Telephone + 27 2603593

Abstract

This paper examines the application of the design process within a local context. We need to develop our pupils to engage with changing times as active, thoughtful and reflective local and global citizens. When investigating a problem, need or product, global trends or comparative examples are studied / investigated. Once the product, has been evaluated, a local solution is compared. Learners then design and make their own products. An important part of technological literacy is looking at values within products and processes and reflecting on the effect that products will have on society and how they are valued (Martin 1996 p4).

Technology can help to meet the massive disparities that exist between the different worlds – between the North and the South; between the industrialised West and the rest of us; between the first and second economies. But most importantly, technology is used to meet our local problems and needs by investigating and applying appropriate, meaningful solutions to these problems within a local context. This can contribute to a better understanding of the human dimension of technological literacy.

Case Studies of work carried out in classrooms are used as examples of 'thinking globally whilst designing locally,' using the core content areas of the curriculum. The examples are not dependent on special equipment nor expensive resources and have been taught in classrooms which in some instances are still traditionally under-resourced and overcrowded.

Background

In June 1996, South Africa launched a New National Curriculum for all learners in General Education and Training (GET) i.e. Grades 1 – 9. Technology is one of eight Learning Areas and in order to support the implementation of the new curriculum, the Technology 2005 initiative was developed.

Phase 1 developed, trialled and contextualised a South African relevant curriculum and accompanying educational materials in pilot projects.

Phase 2 offered provincial support in the systematic provision of training to a growing pool of lead teachers. This included retraining of college lecturers and extended training to other teachers.

The project was concluded in March 2000 and three of the four team members formed 'Technology for All' in order to continue the challenge of training more teachers as the systematic and rapid roll out of curriculum implementation takes place. The University of KwaZuluNatal has contracted Technology for All to teach the Advanced Certificate in Technology Education and the B.Ed. Hons. in Technology Education. This takes place in KZN, and other provinces such as Mpumalanga and Free State.

Introduction

Many people perceive technology in terms of its artefacts. When asked what I teach and I reply 'training teachers in Technology,' I invariable get the response – 'Oh, computers.' Many see technology in terms of the products created for a modern and increasingly complex and fast-paced world. They are frequently unreflective and simply see technology as increasingly complex products, designed and made to meet our needs and solve our problems. Dakers (2005) argues that ' it is this unreflectivity, this lack of discourse, this missing literacy that essentially reduces the concept of technology to that of raw materials.' Borgman (1984) goes further and suggests that the very nature of modern technology tends to separate us from truly engaging and interacting with the world and with each other.

Bearing in mind that design takes place in a social and environmental context, and that design reflects our culture, our course material is embedded in relevant problem contexts. This paper attempts to show how we help the students to think globally whilst designing locally. Local solutions to problem help develop a sense of personal and group identity. Our interdependence develops understanding between local and global communities. We need to develop the capacity to consider and respond to the needs of diverse cultures. The practical portfolios that are developed for teaching practice challenge the students to be rooted in relevant contexts using the community and business resources.

Thus in first year the students' prepare a portfolio on Indigenous Technology. This encompasses a Case Study consisting of a visit to an elder, African Art Centre or demonstration of a process; several Resource Tasks focussing on Knowledge and Skills needed (Focussed Practical Tasks) and a Capability Task (Design and Make).

Building on this is in second year, the students go back to their classrooms to prepare three Schemes of Work covering the three areas of Technological Knowledge and Skills i.e. Structures, Processing and Systems and Control.

A rationale for thinking globally whilst designing locally

Papanek (1994, p.154) states that 'although the ability to solve problems has been an inherent and desirable trait throughout human history, mass production, mass advertising, media manipulation and automation are four contemporary trends that have emphasised conformity and made creativity a harder ideal to attain.'

When one identifies and examines indigenous solutions to real problems, the old saying that 'Necessity is the mother of invention' becomes very true. Many of our communities reveal innovation and design that reflects a creative mind as a powerful mind.

Technological Literacy

How can we create a balance between living in a fast paced technological world with the tendency to progress towards modernity as we regress towards instrumentality (Inde 1990) and on the other hand to remind ourselves that technology is essentially a human response to a human need.

Technological literacy implies that our projects must be real and relevant. Every effort must be made to develop socially-sensitive teachers, able to teach learners to become technologically literate. An important part of technological literacy is looking at values within products (and processes) and reflecting on the effect that products (and processes) have on people and society and how they are valued. (Martin 1996 p4).

We are all part of the global village. The countries of the North are regarded as key players and those of the South as secondary players. This presents a challenge to create a balance between unreflective instrumentality and the development of high-tech products and technological sensitivity; between thinking globally and designing locally. There is a global shortage of creative ideas. From the conceptualization of the idea to the solution we need both logic and 'magic'. We need to bring a fresh local perspective to a global need or problem. This will be illustrated in the following Case Studies.

Case studies

Working within the curriculum framework, students are required to develop a portfolio of work. In each of the following Case Studies, a different Core Content Area of Technological Knowledge and Skills (Learning Outcome 2) was chosen as a series of lessons in different grades i.e. Year 2 Structures that Protect (Slip-on Shoes), Year 6 Processing (Recycling Paper) and Year 9 Mechanical Systems (Wire and Metal Cars). In addition, aspects of Learning Outcome 3 on The Relationship between Technology, Society and the Environment needs to be evident. This technological literacy covers three focus areas, namely:

- Indigenous Knowledge (different people, different places, different times).
- The positive and negative impact of technology on people and the environment.
- Bias – awareness and prevention of any form of bias i.e. cultural, gender, age, disability (differently–able) and access bias.

Case study 1 – Structures that protect – Slip on Shoes – Year 2

The topic covered a series of seven lessons.

Problem Context

A company has asked your class to design and make a model of the kind of slip on shoe that they would like to wear.

Investigative tasks

- Teacher brought a range of slip on shoes to class. Discussed why we wear shoes (to protect our feet and as a fashion statement). Discussion on function of structure (to protect) and kind of structure (shell). Discussed the different parts of a shoe and showed a range of footwear from different factories. Some included Italian shoes with discussion on imports and exports. Children felt real and simulated leather and the difference was discussed.
- A range of locally produced footwear was shown to the children. These slip on shoes were made by people in their communities to inspire them to show what can be produced locally to meet immediate needs. What came across clearly was the high level of creativity in the community, where necessity is the mother of invention.
- Children were then asked to find examples of shoes from magazines, cut them out and then stick them into their notes in the spaces provided.

Focussed Practical tasks

- Children took off one of their own shoes, put it at eye level. They drew a side view of it, identifying and labelling any distinguishing parts of details. Then they put it on the floor next to them and had to draw a top view.
- Children then put the shoe on a piece of paper and traced around the sole. This then became the template which was used to make a cardboard sole.
- The use of the stapler was taught to the children so that they could staple the upper to the sole neatly and safely.

Design and Make

- Children had to begin their designs using colour and labels.
- Each child was given an oblong of black synthetic leather which had come from a factory off-cut. Each measured their foot and cut the upper accordingly.
- They decorated their slip on shoe by gluing on any scraps which they had brought from home. Their designs were highly decorated and quite exotic.
- They stapled the upper to the sole.
- They designed and made a personalised label for their shoe.
- They evaluated their shoes by choosing three as possibilities for the export market. Once all the votes were counted, the top three were then given a possible price. Children learned that a product is really only worth what someone is prepared to pay for it.

Case study 2 – Processing of Paper by Recycling – Year 6

This topic covers a series of six to seven lessons
This topic has two areas of focus – paper making and Appropriate Paper Technology (APT) which is used in Zimbabwe and in some South African communities as an adaptation of papier mâchè, using the strip method.

Problem Context
As a fund raiser for your school Technology classroom, your class has been asked to make products from recycled paper. Hand made paper and APU products have been identified as suitable.

Paper making

Investigative tasks
- Explore a range of paper. Discuss why some needs to be absorbent (kitchen paper towels, toilet paper) and other paper non-absorbent (glossy magazine paper, wax proof paper).
  - Examine a range of note paper – size, design, texture, colour.
  - Note ways in which it is packaged.

Focussed practical tasks
- Prepare the pulp – tear up into postage stamp size computer paper, old exercise paper, used envelopes. Shredded paper is also useful. Cover with water and soak overnight. Can be mixed with a hand beater or blender.
- Texture – experiment with adding bagasse (shredded waste from sugar cane mill) grass seeds or dried dung. Elephant dung is excellent but difficult to obtain, but dried cow dung as an alternative, also makes excellent texture as the fibres have been broken down and float to the top when water is added. Maize silks, fibres from onion skins, celery or banana leaves can be used. Threads of cotton, especially silver or gold thread is effective.
- Colour – Boil and liquidize citrus leaves or grass clippings for a lovely green. Onion skins make a pleasant yellow shade. Tea or coffee can be used to good effect. Or tear up a coloured paper napkin and add to the pulp.

Design and make
- Either make a mould and deckle or improvise by taking a wire coat hanger and reshaping it to form a rectangle or square. Pull a stocking taut over this shape and knot.
- Use a baby bath as a vat and place about 2 litres of pulp.
- Dip the mould into the pulp at an angle and lift it up, gently moving it from side to side to distribute the pulp evenly.
- Place mould onto couch of kitchen swipes or an old towel and use a sponge to mop the back of the mould. Squeeze out water.
- Use gelatine, starch or wall paper glue to size the paper.

Industrial Visit
A follow up visit to a paper manufacturing mill completed the task.

Appropriate Paper Technology (APT)
Disadvantaged people in rural communities are often lacking in basic household objects such as stools, trays and bowls.
In addition they need to become self-employed in entrepreneurial activities as unemployment is very high.

Case Study – Visit Training and Resources for Early Education (TREE)
Here the local community which consists largely of informal settlements and squatters, apply APT and make preschool furniture such as chairs, stools, tables, dolls' furniture etc. The ideas are imaginative and colourful and the chairs can support the weight of an adult.

Investigative Tasks
- Examine a range of bowls, plates and trays. Choose one suitable for a mould. If a bowl is chosen, the rim must be the widest part or the product can not be removed from the mould.

Focussed Practical Tasks
- Legs and bases of bowl – use a card circle cut from a toilet roll or an empty scellotape roll. Cover with two layers of strips.
- Rims – coat small strips of paper with wallpaper glue and roll into sausage shape. This will be place around the bowl and held in place with thin strips.

Design and Make
- Choose a mould and cover it with petroleum jelly or a layer of clingwrap.
- Use five double sheets of newspaper. Using the flat of both hands, smear a glob of glue over the first sheet and place the second sheet on top. Do the same and continue until l all sheets are sandwiched together.
- Tear into long strips and place close together over the mould.
- Place another layer of strips at right angles to the first.
- When dry, rub smooth with sandpaper.
- Cover with an undercoat of white paint.
- Paint and decorate as desired.
- Seal with a thin coat of varnish.

Case Study 3 – Mechanical Systems – Year 9 (Summary)

Investigative task
Pupils were taken to the Toyota factory near Durban.

Focussed Practical Tasks
- Making of cranks.
- Making belt drives.
- Using a jig to bend wire.
- Using old cans for recycling – flatten, shape, use tin snips.

Design and Make
Some of the products showed a high level of ingenuity, innovation and improvisation!

Conclusion

Teachers were amazed at the raw talent available in their classrooms. When children are allowed to run with an idea, when we remove unnecessary restrictions, when we stimulate children by showing what is available globally and then challenging them to think creatively using local resources and their own ideas, when we believe in their ability to think 'out of the box', then the results are fresh, innovative and exciting. Thinking globally and designing locally, has produced some wonderful results that exceeded expectations.

References

- Borgmann A (1984)
  Technology and the Character of Contemporary Life:
  A Philosophical enquiry
  University of Chicago Press. Chicago
- Dakers J (2005)
  Arguing for the Development of Technological Literacy,
  Centre for Research In Primary Technology (In CRIPT)
  at UCE Birmingham Conference proceedings 2005
- Ihde D (1990)
  Technology and the Lifeworld: From Garden to Earth
  Indiana University Press. Bloomington
- Martin M (1996)
  Valuing products and applications
  In IDATER 1996 International Design and Technology Education Research Conference (IDATER) proceedings1996
- Papanek V (1991)
  Design for the Real World
  Thames and Hudson. London

Thank you

My thanks to past students for their classroom application:

- Liz Gormley – Year 2 – Structures: Making Slip on Shoes
- Nerishnee Naidoo – Year 6 – Processing Paper by recycling
- Mmele Nyathi – Year 9 – Mechanical Systems using Wire and Metal

From Birmingham to Jyvsäkylä

UCE Birmingham, Attwood Building, Perry Barr, Birmingham, B42 2SU, England
Wesley Till – E-mail wesley.till@uce.ac.uk   Telephone +44 (0)1889 882960

Abstract

This paper outlines a teaching exchange between the University of Central England, Birmingham, England and The University of Jyvsäkylä in central Finland. The exchange was funded as part of the Erasmus programme. The point of contact at Jyvsäkylä was Professor Aki Rassinen who is well known amongst international Technology Education circles.

The exchange has been two way. As well as UCE tutors visiting Finland on three separate occasions between February 2005 and April to Jyvsäkylä 2007, their Finish counterparts also visited UCE in the summer of 2005. Another visit is planned by two Jyvsäkylä tutors for the autumn of 2007. I shall also discuss some of the effects that the exchange has had on my teaching when back in Birmingham.

On my first visit to The University of Jyvsäkylä in February 2005, I led several inputs with the same undergraduate group. The first input was to explain the English education system, including a discussion about the different aspects such as Key Stages; assessment; the National Curriculum; the Literacy and Numeracy Strategies; together with an explanation about some of the publications from the Qualifications and Curriculum Authority (QCA).

I then focused on the background to the subject of Design and Technology (D&T), and tracked the development of D&T in the English National Curriculum from the original 1990 D&T orders, through to the revised documents of 1995 and 1999 (the latter of which was implemented in 2000). I also explained about the QCA Scheme of Work for D&T, together with the work of The Design and Technology Association (DATA) and their supporting publications to support the QCA scheme of work.

The focus of the practical work later in the week was based around researching, designing and making working models from the BBC 'Bob the Builder' television series. One of the areas which this activity relates to is the use of recycled materials, and this links well with the theme of sustainability, an area which the Scandinavian countries appear to be well ahead of the UK. It was a pleasant surprise to see a well organised display of the 'Bob the Builder' work in the department when I went over this year. The students involved had written about the project; what they had done; together with descriptions of their various character vehicles produced. Two years later the display brought back some good memories.

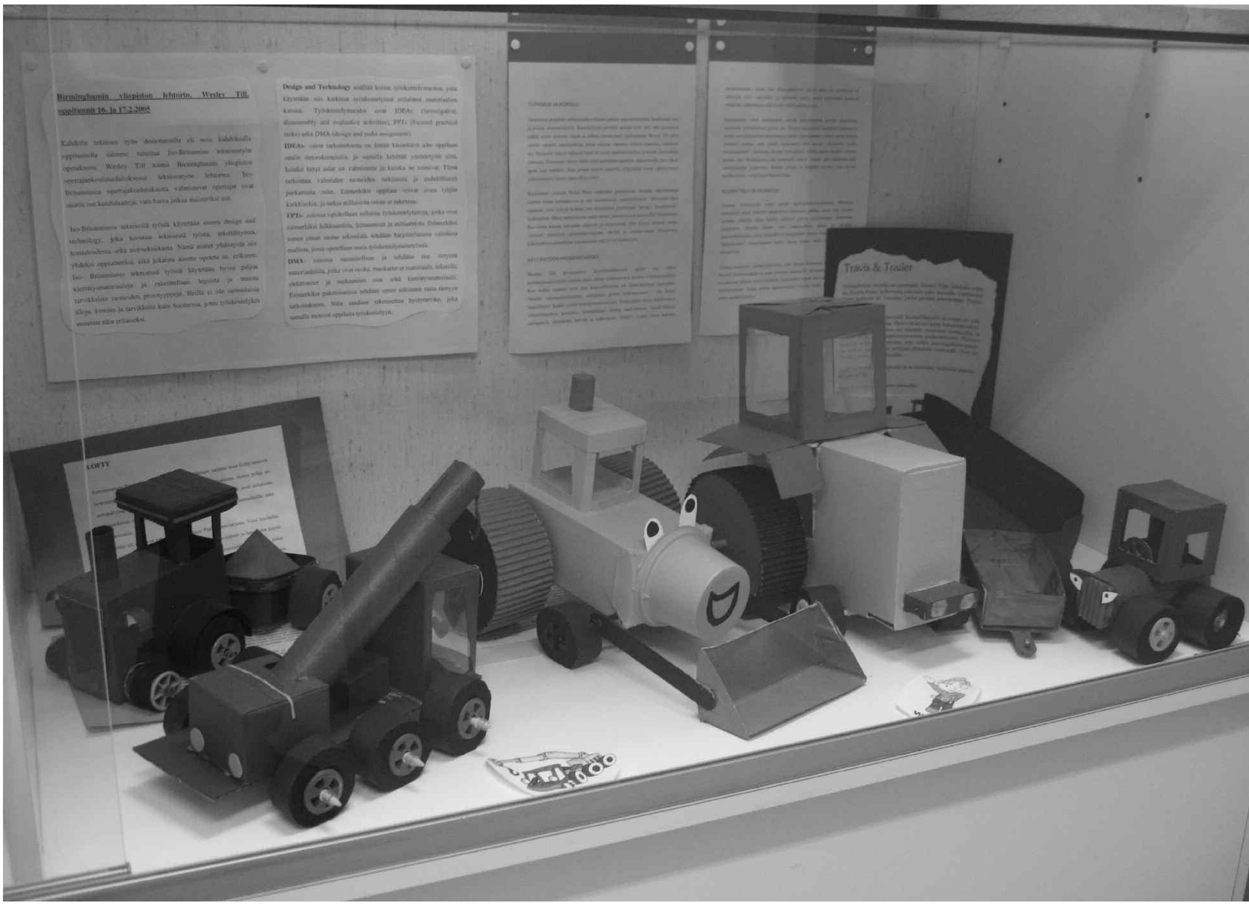


Image 1. Bob the Builder display in the Technology Department at Jyvsäkylä

12 months later in the spring of 2006, my colleague Penny Bailey then went to Jyvsäkylä for 4 days. Penny's focus was with the area of electronics, and the students involved with her each produced a battery tester. This was a well received project.

In April 2007 I made a second visit, during which I had the opportunity to work with three different groups. I was requested to work with the first group on an input about evaluation and assessment within Design and Technology. Within the evaluation aspect of my presentation I also drew the group's attention to the well considered pupils' D&T recording booklets illustrated on the Kent NGfL website (www.kented.org.uk/ngfl/). One of the features of this material is that children are directed to consider design criteria when designing products. The subsequent evaluation sheets then relate to children actually evaluating against this criteria, rather than the 'what I thought of my work' approach frequently used.

To quote the words from a famous song 'A picture speaks a thousand songs… I was anxious to put together a presentation showing good practice in D&T and to show images of quality examples of children's work. Although I have slowly built up a library of suitable D&T images, I was anxious to also expand this to include examples from all QCA units of work. I consequently used the National Curriculum in Action website (www.ncaction.org.uk) which was particularly useful as the students could access this afterwards.

The focus for the practical work for my 2007 visit focused on the QCA scheme of work unit on Packaging. I chose this as it is a unit that has very strong curriculum links, and I could use it to demonstrate the value of cross curricular work where D&T could both enhance and provide opportunities for links with several other subject areas.

Image 2. The Juliet group at Jyvsäkylä who participated in the 2007 Packaging activity

During my visit this year I also witnessed a session of 'cycle maintenance'. This was certainly very different to the UK, although in contrast to the UK many children travel to school on a daily basis by cycle (and certainly in Jyvsäkylä most students travel around by cycle).

Image 3: The cycle maintenance session at Jyvsäkylä

Two members of staff from Jyvsäkylä also visited UCE in the Autumn of 2005. During their visit they supported the work of The Faculty of Education, as well as visiting local primary schools that have a high reputation for their design and technology work. The staff from Jyvsäkylä also visited The Technology Centre at Frankley City Technology College in Birmingham, where they saw CAD/CAM in action. Their next visit is due to be in November 2007, when two staff members are planning to come over to coincide with the annual D&T Education Show at the NEC.

The main aim of the project has been to support staff in gaining an understanding of the nature of the subject in both countries, the way in which technology education has been developed, and how technology education is implemented in both teacher education and in the mainstream school environment.

In England the main features of the nature of Design and Technology are around the importance of designing and making a product with a purpose and for an intended user. However in Finland the perception I gained was more about teaching high quality skills, particularly in the resistant materials areas of wood, metal and plastics.

The implementation of Technology education in Finland differs in a variety of ways, not least in that the material areas involved are not so comprehensive as in England. Textiles, for example, is not part of the Finnish subject area of technology, although it is taught in school, and The University of Jyvsäkylä has a well equipped textiles department. The quality of work that I saw in the technology department at Jyvsäkylä was of a very high standard.

When visiting the local teaching practice school I observed the superb facilities available for technology. The workshop at the school was extremely very well equipped and made me very envious when compared to our limited facilities at UCE. The work I observed was very skills orientated and reminded me of the range of work that was prevalent in English middle schools in the 1980's. Interestingly, one aspect of our D&T National Curriculum which does not appear to be covered in the same depth is that of investigating products. One of the activities which I got the students to do this year was to investigate a range of everyday items, and to discuss the type of questioning that could be used to encourage children to evaluate the products.

What have been the main effects back with my day to day teaching at UCE? My main teaching commitments are with the BA and PGCE generalist courses in which all students cover all of the English National Curriculum subjects together with RE. Since returning from Finland each time, I have been able to add an 'international' element into my inputs where I have been able to compare the English D&T curriculum with at least one other overseas country. This, together with my involvement with CRIPT for the past 10 years, has given me a better insight into the many and varied approaches to technology education throughout the world.

Another useful side effect is that I have updated my own course PowerPoint® presentations using much of the material that I generated for the exchange!

References

- DfEE (1999)
  The National Curriculum for England
- QCA (1998)
  Scheme of Work for Design and Technology
  DfEE, London
- DATA (1999)
  Help sheets to support the DfEE/SEU/QCA
  Scheme of Work for Design and Technology
- DATA (2000)
  Lesson Plans to support the DfEE/SEU/QCA
  Scheme of Work for Design and Technology
- http://www.ncaction.org.uk/
  [National Curriculum in Action website]
- http://www.kented.org.uk/ngfl/
  [Kent National Grid for Learning website]

The ONTDEKPLEK: Going Dutch

School of Education, Inholland Alkmaar, Stichting Ontdekplek, BS De Dolfijn Haarlem
Harry Valkenier – E-mail harry.valkenier@ontdekplek.nl Telephone +31 23 5246267

Abstract

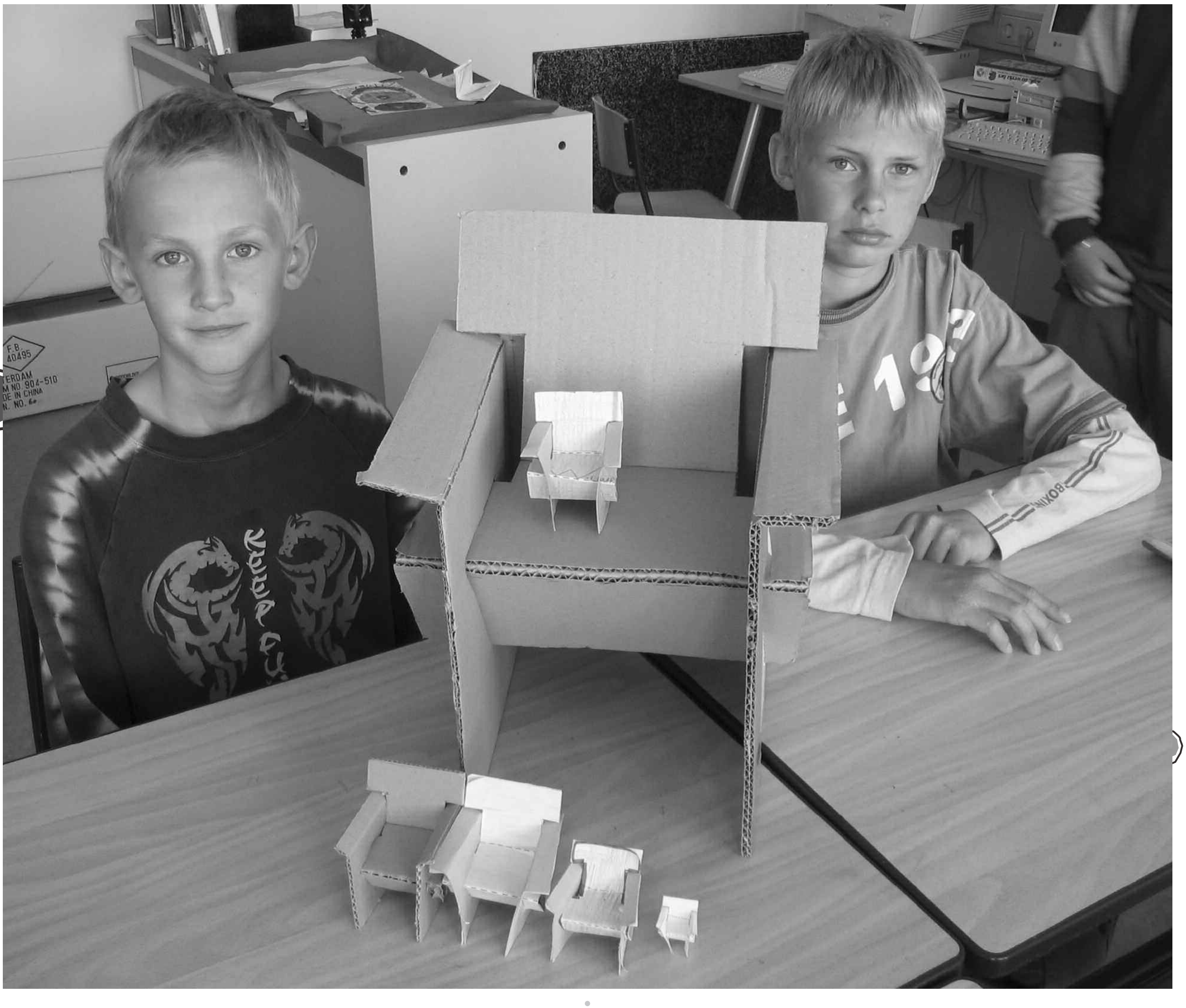
This paper outlines the work of Ontdekplek, a very successful organisation, based in the Netherlands that supports the development of primary technology education. It started by providing after school opportunities for children, and now works with children, teachers and Initial teacher education students. It is based on the principles of making learning fun, accessible, relevant and appropriate. Children are given starting points and it is up to them where their learning goes.

Introduction

The Ontdekplek (discovery place) has developed a successful approach to stimulate children in technological activities. These activities take place in a school or an afterschool situation. The purpose is to keep the threshold as low as possible, so that everybody who works with children can offer these activities.

Naturally, the Ontdekplek is aware, on account of its own experience, that there is always a lack of funding. That is why worksheets are offered free of charge on a very popular website: www.ontdekplek.nlwww.ontdekplek.nl, click on 'werkbladen'. It has a thousand visitors a day in a country that has 6,000 primary schools.

We are also proud to have a unique system on our website, the EncyclopeDoe. Hence the name. This is an encyclopedia of technological hands-on activities collected from all over the world. The activities are selected for being useful in primary education and each one is described in two short sentences to make things easy. From the activity description you click straight on to the associated worksheet. So that means no more Googling, on, for example, 'magnetism', and having to select from selecting out of 170,000 possibilities and drowning in the information. Here there are, just some 15-20 useful activities selected by our volunteer Jan van den Berg. The ICT part is done by Sitan van Sluis, who came to the Ontdekplek as a little



boy some 15 years ago and he now has his own flourishing ICT-company now, but the Ontdekplek was his first client.

The Ontdekplek approach

- All children choose the activity for themselves. They are not obliged to do a special particular activity and if they are in the mood for bricklaying week after week, it is no problem.
- All children should have a successful experience, from there on they can improve and evaluate their design.
- All children make something that really works, for example a simple sailing car with a sail. Even 4 year old children can make a simple car out of cardboard, a hole-punch and cardboard wheels. The technology is in the development of the sail system. Which car sails best and how to improve the design? These are problems for the children to solve. It is still a very popular activity at the EXPO-2000 project in Wilhelmshaven Germany.
- See Zeilwagen on werkbladen www.ontdekplek.nl.
- Children are working with bulk materials. So it is not a problem when a cardboard-wheel or Art straw is missing or damaged. They can take their own materials out of a drawer in several cupboards. When we are clearing up afterwards, we take the useful pieces out of the debris and use them again.
- Materials are inexpensive and easy to order. The children can take some spare parts home and continue the research and development.
- The activities are simple, for teacher and children, and can be made using the worksheets, although some practising in advance by the teachers could be useful.
- The activities are open-ended. Starting is simple, but there is no end to the possibilities for improvement. This offers a challenge to all kinds and levels of intelligence.
- The children can work on their own using the worksheets, although an introduction by the teacher could be useful. As soon as the children know what to do, they work 'on task' nice and quietly, especially those who are normally 'trouble-makers'.
- Activities can be done language-free, because the worksheets are made up with simple drawings with a clear line. On the other hand they can also be used to stimulate language skills. This also offers opportunities for children not originally from the Netherlands to stimulate their self-esteem.

This approach has been tested for over twenty years in Haarlem and several other places in the world, like Germany, Sweden and South Africa in the townships of Cape Town and in Bredasdorp). China has also shown an interest.

What has the Ontdekplek to offer you?

The Ontdekplek is an organisation that helps everyone who wants to organise technological activities for children between 4 and 12.

Activities

Apart from the worksheets and EncyclopeDoe, the Ontdekplek has published a whole range of very small booklets and a teaching guide. For example, we also publish inexpensive booklets, like '50 things you can do with Artstraws' and 'Cardboard wheels in technology', a workbook for very intelligent children titled 'Technobrains', and a hands-on book on electricity. All our books are richly illustrated with many drawings.

In the Dutch educational system, schools base their education on what we call methods. This is a whole series of books on language, mathematics, etc. from Y1 – Y8. Most schools also work with a method on science/technology. Each book contains 24 lessons/subjects for a whole year, and most methods also do have worksheets. In Leefwereld (Living world) a science method, has at least four different technology – activities in a year, mostly based on the Ontdekplek approach, in a year. This is the most popular method, so we reach a lot of Dutch children and teachers. Recently 72 extra photocopiable worksheets have been added to the teaching materials.

At the moment we are working hard to make a lot of technology teaching equipment fit for the Dutch schools, for example, the Bee-Bot, KNEX-educational sets on levers, gears, bridges and electricity kits like Brainbox, etc. but everything has been thoroughly tested by the Ontdekplek-children in advance.

Materials

The Ontdekplek has also started cooperating with a big school supply company, to supply all the materials for the worksheets on the website as a set of bulk materials. What has really helped is that the Dutch government and metal-industry started a technology promotion project for primary education called VTB. The main part of the programme is to sponsor half of the all Dutch primary schools with 12,000 euros. Each school has to introduce technology in at least two year groups in three years time. So the VTB-project is quite popular and has created a big market.

Demonstrations, training and courses

Meanwhile there is a whole range of possibilities that can vary from a one hour speed workshop, as an introduction for a sceptical but curious school team, to a certificated post graduate course for school coordinators of technology in cooperation with the Inholland School of Education. This last course is quite popular because of the new approach. The future coordinator of technology attends all eight meetings of the course and brings with her/him the teacher(s) of year one on the first evening, where they do most of the year one activities. At the second meeting we do year two, etc. until year eight. This approach has been quite successful because all the teachers became interested in the course since they were there or they still had to go. They all knew the technology coordinator and what they could do in their classes. They also knew that the coordinator knew. This makes it possible to join forces instead of avoiding the coordinator because the teacher is not confident and does not like technology.

The book that was handed out on the course did not only contain all the worksheets for the activities, but also the theory behind them and the didactic approach, etc. in a summary, and of course the worksheets of the activities. Because every chapter corresponds with the year groups it also can also be used as a schedule of activities.

All the participants of the course were so enthusiastic that the VTB-bureau has now distributed the course manual on CD to all the other Faculties of Education in the Netherlands.

Further Information

Any further information relating to this conference, or courses, research opportunities and In-service work provided by CRIPT can be obtained from:

Professor Clare Benson
CRIPT at UCE Birmingham
Faculty of Education
Attwood Building
University of Central England Birmingham
Franchise Street
Perry Barr Birmingham
B42 2SU
England

E-mail clare.benson@uce.ac.uk

www.ed.uce.ac.uk/cript

CRIPT

CENTRE FOR RESEARCH IN PRIMARY TECHNOLOGY