edited by clare benson, mike martin and wesley till

fourth international primary design and technology conference

designing the future

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Fourth International Primary Design and Technology Conference –
Designing the Future

27th June – 1st July 2003, Birmingham, England

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THE DESIGN AND TECHNOLOGY ASSOCIATION

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DEDICATION

This publication is dedicated to John Eggleston, who, since its creation in 1997, did so much to support CRIPT in so many ways.

Introduction

Despite the current situation overseas, and the difficulties of travel worldwide, we are delighted that once again, so many colleagues have been able to submit papers for the Fourth International Primary Design and Technology conference hosted by CRIPT at the Quality Inn in Birmingham, UK from June 27th – July 1st 2003.

Whilst contributions relating to all aspects of primary design and technology are welcomed, this year several strands have emerged as in previous years. The development of children's creativity and thinking skills is now being promoted as the emphasis placed on literacy and numeracy by some Governments has begun to lessen; the significance of considering cultural values and appropriate contexts within which all children can work is highlighted; the effect that design and technology has on young lives and how this can shape their futures is illustrated; the importance of adequate training for students and further professional development for teachers is discussed; and sharing good practice of implementation in schools is exemplified.

This publication contains research and curriculum development papers presented at the Conference. The contributors, who are from every continent, are from a variety of backgrounds, including teachers, teacher educators, policy makers and students. They have provided everyone interested and involved with primary design and technology education world wide with information about a wealth of experiences and research, that will stimulate debate throughout the Conference and beyond. The previous Conference proceedings have already become an invaluable resource for policy makers, researchers and curriculum developers, highlighting world trends in the development of the subject.

Clare Benson / Mike Martin / Wesley Till

June 2003

CONTENTS

Page N°.

Dedication and Introduction

- Introduction – Clare Benson, Mike Martin and Wesley Till

Research and Curriculum Development

1 Developing and Celebrating Good Practice in Primary Design & Technology 2
A Seminar, the Recommendations and the Results – David Barlex
2 Developing 'Designerly' Thinking in the Foundation Stage – Clare Benson 5
3 Science and Technology in Primary Schools: 8
Teachers' difficulties in Implementing the Teaching of Technology – Marjolaine Chatoney
4 Contribution to Professional Activity and Ergonomics: The Elaboration of a Toolkit for the 12
Teaching of Technology to be Used by Non-Specialist Teachers in Primary Schools – Marjolaine Chatoney
5 Kotuku: Learning from the Past – Dawn Coburn 14
6 Deconstructing Skill: Embedding Design and Technology Education on to the Dreyfus Model of Skill Development – John Dakers 18
7 Unlocking Creativity Through D&T – The Young Designers on Location Project – Dan Davies and Alan How 22
8 An Experience of a Lifetime: Teaching Design and Technology Overseas 27
– Sarah Deeley, Kathryn Roberts, Rebecca Walker and Lorna White
9 Student Teachers' Perceptions of Technology Teaching in Scottish Primary Schools – Wendy Dow 31
10 The Pro EdaDe Program – Antônio Fontoura 35
11 Between Prescription and Reality, the Pedagogical Situation – Jacques Ginistie 39
12 Primary Students Grappling with Systems in Design and Technology – Ian Ginns, Stephen Norton and Campbell McRobbie 45
13 The Conflicts and Solutions Between 'Depictions of People and Animals' in 49
Design and Technology Projects and Interpretations of Islam – Cathy Growney
14 Design in Brazilian Primary Schools – Caroline Guedes 54
15 Understanding Mechanisms Through British Sign Language: An Example of How Deaf Pupils' 58
Communication Method Can Aid pupils with Special Educational Needs (SEN) to Understand Mechanisms – Nicole Hastie
16 A Holistic View of Assessing Young Children's Designing – Gill Hope 61
17 Educational Reform and the Living Technology Curriculum in Taiwan's Primary Schools 67
– Chia-Sen Jimmy Huang and Chuen-Wen Liao
18 A Study of the Development of Children's Creative Ideas and the Research Development of New Products in Business 73
– Ming-Hsiung Wu Professor and Chia-Sen Jimmy Huang
19 A Comparative Study on Assessment Criterion in Technology Education between Japan and England 77
– Masataka Isobe and Sadato Yamazaki
20 Curriculum Design for Japanese Lower Secondary Technology Education 83
and its Assessment of Pupils' Self-reflective Thinking – Daisuke Itoh and Sadato Yamazaki
21 Characteristics of Factory Pictures: Results of a Research Project at German Primary Schools – Astrid Kaiser 89
22 Looking Behind While Designing the Future: Can Practice Meet Theory in Primary D&T Curriculum? – Steve Keirl 99
23 The Implications of Knowledge Management for Technology Education in Primary Schools 103
– Chuen-Wen Liao and Chia-Sen Jimmy Huang
24 Product Evaluation in Pedagogical Context – Eila Lindfors 109
25 Teachers' Perceptions of Purposes for Writing Tasks in Design and Technology at Key Stage 2 – Julie Mantell 112
26 Designing the Future by Including Indigenous Knowledge – Kate Ter-Morshuizen 116
27 Technology Exemplars and the Matrix, a Hollywood Fantasy Epic or Useful Classroom Tool – Gary O'Sullivan 121
28 2-Days Lessons Are… Using a Collapsed Timetable Strategy to Teach D&T in Primary Schools – Chris Perry 125
29 Exploring Education for Sustainable Development through Design and Technology Education – Maggie Rogers 128
30 If the Cap Fits – Wear It! – Sue Vaughan 132
31 Design in the South African Technology Education Curriculum – Karen Ann Walstra 136

Developing and Celebrating Good Practice in Primary Design & Technology – A Seminar, the Recommendations and the Results

Nuffield Foundation, 28, Bedford Square, London WC 1B 3 JS

David Barlex, Nuffield Project – E-Mail dbarlex@nuffieldfoundation.org

The Seminar

***In February 2002 the Nuffield Design & Technology Project, DATA (the Design And Technology Association) organised an invitation seminar to bring together those who were concerned with developing and celebrating good practice in primary design and technology. The full report is available on the Nuffield Primary Design & Technology website** www.primarydandt.org*

Participants were invited from the following groups and organisations: primary teachers, primary head teachers, secondary design & technology teachers, primary and secondary teacher trainers, DATA, the Design Council, the Engineering Council, the Teacher Training Agency, Qualifications and Curriculum Authority, Department for Education and Skills, SETNET (Science, Engineering, Technology and Mathematics Network), Local Education Authority advisers, educational consultants and educational suppliers. The seminar took the form of four key inputs each followed by questions and discussion.

- ***Professor Clare Benson***
  The Initial Teacher Training Perspective
- ***Julie Mantell***
  The Independent Consultant Perspective
- ***Barbara O'Dwyer***
  The Head Teacher Perspective
- ***Peter Grover and Andy Mitchell***
  A KS3 perspective

The result was a fascinating picture describing the professional journey from novice to expert with issues to be addressed at each stage of the journey if the subject is to grow in our primary schools. Five key issues were identified.

The Issues

The first issue to emerge is that many primary teachers will achieve qualified teacher status with potentially little exposure to design & technology. This is due to a large number of initial teacher education courses failing to offer a specialist option in primary design & technology.

This leads to the second issue. If an intending primary teacher is fortunate enough to attend a university where there is a specialist option in design & technology they will find themselves in an environment in which there is opportunity for professional development if they take up employment locally. In addition there may well be Local Education Authority support but in recent years this has diminished in many areas. However, if the intending teacher attends a university in which there is no specialist provision, the majority, and if they take up local employment they may find themselves in a situation in which professional development in design & technology may well be a very scarce commodity. A disturbing case of "to them who hath shall be given".

The seminar acknowledged the considerable evidence that 'one shot' in-service sessions seldom result in sustained changes to practice. Professional development in primary design & technology is clearly necessary but, due to the funding arrangements, is generally limited to half day or one day sessions with no follow up. The third key issue is that current funding arrangements make it difficult for in-service trainers to provide the sustained support necessary to make an impact on practice.

No one at the seminar doubted the crucial importance of the head teacher in developing a strong design & technology curriculum. It was noted however that there are too few head teacher advocates for design & technology. Given the significance of the head teacher in enabling design & technology to take place in primary schools the fourth key issue is to identify mechanisms for influencing large numbers of head teachers to respond enthusiastically to developing the subject in their schools?

The seminary participants were in agreement that it was important to provide support for expert practitioners but at present activities to provide this support had yet to be identified. So the fifth key issue concerns identifying activities will enable the continued professional development for the emerging primary design & technology expert teacher?

Discussion of the five issues led to five recommendations

The Recommendations

1. A small working party of key players should be convened to develop a research framework and plan co-operative research activity utilising school – university links across participating universities with realistic publication deadlines.
2. A meeting with Ray Peacock at SETNET should be organised to develop more fully the primary design & technology dimension of the SETPOINTS STEM agenda.
3. A small working party of key players should be convened to develop models for financially viable long-term support for primary design & technology teachers concentrating on the development and maintenance of local networks.
4. A small working party of committed head teachers should be convened to develop a strategy by which they could influence their colleagues at local, regional and national levels.
5. A small working party of key players should be convened to develop a collective strategy for orchestrating Best Practice Research Scholarships concerned with primary design & technology across a range of co-operating universities.

CRIPT (Centre for Research in Primary Technology), DATA and the Nuffield Design & Technology Project committed to supporting these recommendations and asked for interested parties to make contact to form the necessary committees.

Recommendation Progress

Recommendation 1
The ITE Committee of DATA took forward the first recommendation the thrust of which is to enable primary teacher trainers to use their normal working activities to generate rich data that can be used as the basis for academic papers. The committee has members drawn from seven universities and is chaired by Marion Rutland. The first meeting attempted to identify key research areas and used these to widen the discussion to consider how to develop a major grant application.

It will be important for the group to parallel the work of developing a major grant proposal with that of the original intention of the recommendation as such a proposal will take a lot of work to produce and with revisions, delays and disappointments it might take up to four years to produce a successful bid. The aim of Recommendation 1 is to facilitate research activity without the need for a major grant although once a major grant is obtained then work started under Recommendation 1 could be subsumed within the major grant. Wider consultation on key research areas will be achieved by introducing the issue at the IDATA conference and through a questionnaire in the Journal of Technology and Design Education.

Recommendations 2 and 3
David Barlex, Clare Benson and Jenny Jupe met with Ray Peacock of SETNET and as a result of the discussion have developed a funding model for primary design & technology professional development involving continued support to be delivered by SETPOINTS. They are currently discussing with Ray Peacock how best to attract the government funding necessary to roll out this programme nationally over a five-year period with a total cost of 30 million pounds.

Recommendation 4
David Barlex convened the meeting with six head teachers. At the first meeting the head teachers were able to identify the four key features necessary for design & technology to thrive in the curriculum. The key features are time, resources, expertise and support. There needs to be sufficient time, of the right sort in which teachers have access to intellectual and practical resources that they have the expertise to use well coupled with on going support for teachers to develop their practice.

At the second meeting the group was expanded to include representatives form National Primary Heads Association and the National Association of Head Teachers and through discussion identified the wide range of local and national factors that had influence on the primary schools. National influences include DFES/QCA/TTA Initiatives, OFSTED, SATS, League Tables, National Targets, Unions, Professional Associations and Subject Associations. Local influences included Parents, Governors, the LEA and the surrounding community. The head teachers believed that raising standards through National Initiatives plus testing and OFSTED had improved performance in the Core Subjects but had led to a devaluing of those subjects outside the Core e.g. design & technology. The effectiveness of a head teacher to move against these prevailing values was dependent on the stance adopted by the head teacher. Possible stances of the head teacher were described in terms of several spectra: reactive to proactive, passive to active, playing safe versus taking risks, responding to taking the Initiative, conservative to radical. It was noted that in an accountability culture the influences push the stance to the left in which the prevailing values were reinforced and subjects outside the core were neglected.

The Government has appointed Dr Kevan Collins to lead the National Primary Strategy and the first report detailing this is to be published in May 2003. The head teachers working group is currently working on a presentation to be made to Dr Collins with the intention of gaining his support for Recommendations 2 and 3 as a means of providing the support needed for design & technology in primary schools to be a key subject through which to achieve the National Strategy's aims and targets. The group will also discuss with Dr Collins how he plans to involve the National College of School Leadership and how this might be used to stimulate head teachers to support design & technology

Recommendation 5
This was still born as the Government has cancelled the Best Practice Research Scholarships Scheme from 2004. However, the award was publicised widely and through CRIPT seven primary teachers have gained awards in 2003. At this stage it is not possible to determine the total number for England.

Conclusion

A promising start has been made in that meetings and committees have taken four of the five Recommendations forward. The emphasis on research activity in universities makes Recommendation 1 attractive to those who are involved in primary initial teacher training and with the community of practice appearing committed the prospects for some success look good. SETNET is keen to establish itself as an effective provider of continuing professional development and in working with DATA, CRIPT and the Nuffield Design & Technology Project can develop the expertise to be successful on a national basis. This bodes well for Recommendations 2 and 3. However these and Recommendation 4 are dependent on the National Primary Strategy and the extent to which this will support the attempts to develop wider good practice in primary design & technology. So in terms of effectiveness and impact the jury is still out. The next six months will tell whether the promising start will bear fruit.

Useful Websites

The following websites will enable conference delegates to find out more about the organisations cited in this paper.

- Centre for Research in Primary Technology (CRIPT)
  www.ed.uce.ac.uk/cript/
- Design And Technology Association (DATA)
  www.DATA.org.uk
- Department for Education and Skills (DFES)
  www.dfes-uk.co.uk/
- Nuffield Foundation
  www.nuffieldfoundation.org/home/
- Nuffield Primary Design & Technology
  www.primarydandt.org
- Qualifications and Curriculum Authority (QCA)
  www.qca.org.uk/
- Teacher Training Agency (TTA)
  www.canteach.gov.uk/
- Office for Standards in Education (OFSTED)
  www.ofsted.gov.uk/
- Science, Engineering, Technology and Mathematics Network (SETNET)
  www.setnet.org.uk

Developing 'Designerly' Thinking in the Foundation Stage

CRIPT, Faculty of Education, UCE, Perry Barr, Birmingham B42 2SU

Clare Benson, Director, CRIPT – E-mail clare.benson@uce.ac.uk

The Background

Since the introduction of design and technology into the primary curriculum, until the present time, there has been no major investment by the English Government into supporting the implementation of the subject into educational settings for children aged 3-11 years. Up to 1995, the National Curriculum documentation was thought by many to be confusing and overwhelming for many primary teachers who had little prior knowledge and understanding of the subject. OFSTED reports (1997-2002) reveal that, whilst the new document in 1995 did much to help clarify the requirements and offered teachers a structure through investigative, disassembly and evaluative activities, focused practical tasks and design and make assignments, there was still confusion and standards were lower in relation to designing. Designing still remains a concern (OFSTED 2002).

The Early Years (3-5 years) were not, and are not, part of the National Curriculum. In 1997 Desirable Outcomes (1997 SCAA) was published and that gave all the Early Years settings in England an overview of what could be covered. This document was followed by the Early Learning Goals (DfES 1999). Two additional changes were made. The name of the stage became the Foundation Stage and it relates to children aged 3-6 years. The curriculum is divided into six areas of experience: personal, social and emotional development; communication, language and literacy; mathematical development; knowledge and understanding of the world; physical development; creative development. Design and technology is included within knowledge and understanding of the world, but is also linked to the other five areas of experience. There was little detail to support teaching and learning in 'designerly and technological' activities and, unless teachers had a good understanding of the nature of the subject, experiences in this area are often limited.

An obvious starting point for action was the Foundation Stage – put in the initial building blocks. The Qualifications and Curriculum Authority (QCA) commissioned some research by Prof. Clare Benson to determine key areas for the development of design and technology capability in the Foundation Stage. Findings from this survey highlighted the lack of opportunities that young children are given to engage in 'designerly and technological' activity and the lack of confidence that many Foundation Stage teachers have in relation to planning and implementing appropriate activities to develop design and technology capability (Benson 2003).

At the same time the Government was setting up a strategy group for design and technology – one aim being to create an action plan for the subject's future development. One of the first decisions that has been made is to fund a major Foundation Stage project, relating to developing children's awareness of the made environment, including the investigating and evaluation of products. Through this work, it is intended that children's creativity and thinking skills will be developed, and they will be able to use these when they are designing and making their own products.

The Project

The timescale for the project was tight. Approval was given in November 2002 and, apart from the final evaluation, all work had to be undertaken by Easter 2003.

Personnel connected with the project include:

- Professor Clare Benson, Director of CRIPT, University of Central England – the Project Director
- Sandie Kendall – Regional Director South (Croydon LEA)
- Chris Cannon – Regional Director North (Lancashire LEA).

The project is in four parts:

- The creation of a mystery box of products and the materials to use in professional development with the tutors and teachers (November 2002 – January 2003)
- A course for 20 tutors (January 2003)
- Professional development days for 400 teachers (January – March 2003)
- Follow-up work with the children and the initial evaluation of the project (April – July 2003).

The follow up evaluations will be carried out during the Autumn 2003, and final analysis of data, conclusions and implications for the future reported on by April 2004.

The main aim of the project is to provide tutors and teachers with opportunities to develop their own knowledge and understanding of design and technology in the Foundation Stage and, in particular, to focus on how 'designerly' thinking can be developed through a range of activities, using a variety of products. The term 'designerly' has been taken from research into early years practice by Prof. Ken Baynes, Loughborough University (1994).

The professional development was focused around a box of products that each tutor and teacher had to take away. Initially, the 'big picture' was painted in relation to the nature of design and technology and how it fits into the Foundation Stage curriculum. Participants considered children's environments, and focus on certain products and how these could be used with the children. The products were chosen to include a variety of materials, purposes and users, and most were within the everyday experiences of all children. Whilst it was not practical to include a food product in the box, examples of work with food were included in the course.

The development of questioning skills is at the heart of many of the activities. Activities relating to the development of practical skills and knowledge and understanding are also included but it is not the intention to suggest that all Foundation children should be doing investigative disassembly and evaluating activities (IDEAs), focused practical tasks (FPTs) followed by a design and make activity (DMA).

Progress to Date

The Mystery Box

Because of the timescale, opinions from a large sample of educators relating to the contents of the box could not be sought. Using a range of materials, users and purposes as the main criteria for the products, the directors each produced lists of everyday products that they thought would be familiar to majority of children, taking into account ability, gender, culture and race. They were very similar. The lists were combined and a questionnaire was produced that was given to fifty early years teachers, attending design and technology courses, who worked with children from a range of backgrounds. The final products were chosen using the results of this survey.

The box contains:
A story book with simple moving parts; a baby's plastic drinking beaker; a pair of safety glasses; a scrub glove; an egg cup; a vehicle with a moving part; a spinning toy; two slippers (one that might attract a girl, the other a boy). All the products are put into a self-assembly cat carrying box-another product with a particular purpose. From the tutor evaluations, it is clear that they thought the products very suitable and fulfilled the criteria. A few alternatives, not replacements, were suggested. The analysis of the teachers' evaluations is not complete, but no significant negative comments were made during the directors' visits to 60% of the courses that were run.

The Tutors' Course

The Tutors

The project was advertised widely. 20 had to be selected to ensure a geographical spread (10 in the north and 10 in the south). It was felt that tutors should be linked to a Local Education Authority (LEA), as this would provide teachers with a contact point, and LEA personnel would have a good knowledge of the local situation. It was hoped that early years and design and technology personnel might be able to work together on the project. There is almost an even split of tutors between those with a strong design and technology background and those with an early years' background.

The LEAs taking part in the project are:

- Barnet
- Barnsley
- Bristol
- Cheshire
- Cornwall
- Lancashire
- Northamptonshire
- North East Lincolnshire
- Sefton
- Shropshire/Telford and Wrekin
- Croydon
- Durham
- East Riding of Yorkshire
- Harrow
- Kent
- Somerset
- Staffordshire
- Suffolk
- Walsall
- Wolverhampton

The Course

This was run over two days in January at UCE. It was felt that the activities should be undertaken in an environment that promoted good practice in design and technology, whilst being appropriate for the Foundation Stage. A teacher's book and a tutor's book were created.

The teacher's book contained a background to the project; an outline of each activity, together with learning outcomes; and relevant handouts. Space was provided for notes to be made during and after each activity so that the book became a learning resource for future use back in school.

The tutor's book contained a commentary on each activity and further background information to support the course.

The tutors undertook the course planned for the teachers. Through modelling the experience that the teachers would have, the tutors were able to evaluate the content, and how they might deliver it. After each activity, time was given for tutors to note any changes that they would make to content and to its delivery; in addition time was given on the final afternoon to review the materials and the activities and their purposes, on an individual basis and then as a whole group, to help tutors to feel part of the course development. Obviously the few changes had to be agreed by the majority. Activities relating to product analysis and evaluation were combined; the session on questioning was clarified; and more prominence was given to the overview of the nature of the project and the importance of using the outside made environment.

Analysing the Data from the Evaluations

Because of the timescale, this is only an initial summary. Tutors filled out a questionnaire and directors maintained an observation diary throughout the two days and completed a questionnaire. The following is a sample from the initial analysis.

Whilst all the tutors were from LEAS, they had a variety of backgrounds. 80% had been classroom teachers, but 60% were now part of the Inspection/Advisory services. Two teachers had been selected by inspectors to come on the tutor course and to deliver the teachers' course in their LEA as they had expertise in early years and design and technology. Other participants included two independent consultants working for LEAs, and curriculum and project development officers.

A significant number identified the fact that the course had been their only opportunity to undertake some professional development (PD) in this subject for many years. PD was often related to new procedures and to generic issues rather than to specific subject matter.

A significant number highlighted the fact that it was very different to deliver someone else's course, even if you have been part of its creation, than your own. "significant difference in delivering own rather than other peoples' courses-preparation for courses will still be lengthy." This was supported by observations made by the directors when visiting teacher courses around the country. Individual's values, knowledge and understanding and priorities do play a part in how something is passed on. This must have wider implications for national Strategies such as the literacy and numeracy strategies.

The first interactive activity was linked to the nature of design and technology and to links across the curriculum as we felt it was essential for all to have a common understanding of the subject. Comments relating to this activity included "helped understand d&t; realise how little input we have had"; very important session practical activity for demonstrating the nature of D&T; essential part of the course; important session, links with F stage guidance important-felt a bit inadequate"; "opportunity to look at early learning goals welcomed". From comments and observations, it was apparent that many of those with much Foundation Stage experience did feel unsure about the nature of design and technology. Equally many with knowledge of design and technology were not confident about the principles of the Foundation Stage curriculum.

The sessions related to questioning were well received. "reinforces the value of being a reflective practitioner"; "vital session – reinforces need for open ended higher order questions to take children's thinking and learning forward"; "will be the most demanding session to deliver". It was felt that in the main teachers do not consider the types of questions that they ask; nor do they plan out a balanced set of questions before starting a session, but the importance of doing so was highlighted.

The session on using the environment and construction kits was very well received in that it focused on areas that are not covered adequately or well. "excellent – created awareness for discussion about design using the environment as this area is not capitalised on."

Overall, some of the other main points to out from the evaluations were:

- The correct identification of an area that really needs developing
- An appropriate collection of products
- The chance to network with colleagues from differing areas of the country and backgrounds.

Implications

As the analysis is still not completed, it is impossible to identify key issues in details. However possible issues that are arising are included here.

As CPD for those delivering INSET is often not available, strategies need to be considered that will help to address this need

Those with an Early Years background may need to undertake CPD relating to design and technology and those with backgrounds in design and technology may benefit from working with early years colleagues.

More consideration needs to be given to how difficulties of running someone else's course might be overcome.

Questioning and using the made environment are two specific areas that need more consideration when planning the curriculum.

The Future

The analysis of the tutor's course continues and the analysis of the teachers' courses begins. From a very brief study, the theme of the course has been very well received. It is an area of need; and the ideas and activities undertaken were very appropriate. Building on a firm foundation is nothing new. It appears that this project is well conceived and that it should give teachers the knowledge and confidence to provide appropriate learning activities related to 'designerly' thinking at the Foundation Stage that can be built on as the children progress through their education and beyond.

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Science and Technology in Primary Schools: Teachers' Difficulties in Implementing the Teaching of Technology

IUFM Aix-Marseille – Site UNIMICA, Technopole de Chateau Gombert, 60, rue Joliot Curie,14453, Marseille CEDEX 13, France
Marjolaine Chatoney, Lecturer – Telephone 04 91 11 38 85 or 04 91 11 38 38 Facsimile 04-91-11-38-38
E-mail chatoney@unimica.uni-mrs.fr

Introduction

The implementation of Technology and of its development in schools appear especially less obvious and rather difficult, as we are dealing with curricula whose prescriptions, in terms of data and processes, remain very confused and whose attempts at real applications are consequently not widespread.

Putting it to the test in the framework of ordinary classes of sequences whose planning is finalised by the production of technical objects is a way of treating this question. Generally, the sequence constructed by the teachers refers to a given theme of study and has some objectives regarding training skills clearly defined in advance.

The transcription and analysis of the recordings of video sequences, carried out in vivo, inform us on this issue with a view to do our research on the conditions of studying this subject. In particular, it is about selecting the patterns regarding the teaching of this subject, the type of activities and the nature of the targeted acquisitions or the teachers' methodology.

The analysis of several sequences whose main activity is devoted to the study and the making of an artefact, indicates that one of the major problems posed in teaching the subject is about the devolution of the task to be carried out and the absence of a problem to be solved.

The Difficulties Linked to the Tools Used by Teachers

The experimentation articulates the teaching, training and research. It is based on prior work that shows the limits of the written form and of the structure of the French programmes of study (Chatoney, 1998, 1999). For example, the syllabus in Technology, identifiable by the title is, in fact, essentially composed of contents and activities related to Physics and only a little to Technology; technological knowledge is evaluated by the means of transversal skills, or in relation to an application or trial in Physics. Besides, the transpositon offered in course books brings together contents in Technology with disciplinary skills in Physics and vice versa. For example, course books invite the readers using them to see in the technological activity just a means to confirm or to validate models in Physics. In those institutional transpositions, education in Technology generally appears as a vast field where everything is possible, provided that one undertakes concrete manipulations.

The choice of writing a syllabus for Technology that rides two disciplines, leads to confusion in the disciplinary registers in question. These confusions put the teachers in a difficult situation. They do not help with the implementation of the teaching of Technology in primary schools.

The identification of some educational and cultural paths to be developed at school for that teaching would allow three elements of progress:

- To re-align the training on the essential aspects and to legitimise knowledge with regards to the technological reference.
- To bring a precious help to teachers who can unwittingly believe that they participate to the elaboration of a technological culture, whereas in fact they are talking about Science. And so:
- To reduce cultural inequalities created involuntarily.

Challenges

Three challenges are the basis of our study:

- The first challenge is about the necessity to bring alive a discipline which only exists in written syllabuses.
- The second one is to promote the development of a technical and technological intelligence in children. It is about going beyond a simple quest for situations destined to put the child in a given activity. For example, to participate to the elaboration of certain concepts, the acquisition of notions and methods, to associate them with technological facts.
- The third challenge is to advance knowledge in the domain of methodology. The identification of conditions of the viability of knowledge in this domain, would allow the identification of the objects to be designed and to take up as closely as possible the challenges in disciplinary, interdisciplinary and other related subjects in schools.

Methodology

The methodology consists in observing, *in vivo*, a session used in the making of artefacts in two primary school classes. The project is to train teachers and to present it to the pupils, in all its aspects. The data is recorded on a camcorder. What is being said is transcribed in its entirety without changing a word. A coloured code in the text allows to distinguish between periods of speech, gestures and movements, reading, writing or drawing, and a manual activity.

This mode of communication reveals teachers' practices and the tasks given to pupils. The articulation between the teacher's logic and that of his/her pupils is perceived in the following criteria: the successions and the articulation of the different phases of the task, the existence of knowledge and its devolution. A preliminary talk allows the identification of the acquisitions that are targeted, the notions of construction and the concepts to be worked with. This analysis *a priori* is supported by the works on didactic transposition (Brousseau, 1992, 1998 / Chevalard, 1997, 1998, Joshua-Dupin 1993), the study of situations (Andréucci , Froment, Verillon, 1996) and professional gestures (Andréucci, 1998).

The teachers concerned are fully qualified; 27 pupils are 10 years old, and 14 are 6 years old.

Prior Discussions About the Procedure Used in the Making of Objects

The teachers concerned take Year 5/6 (10 year olds) and Year 1/2 (6 year olds)

The targets are not always specific. For example, the teacher in Year 5/6 does not specify his objectives; he wants them to make up a quiz or plays the ignorant teacher. He sets the production in the logical organisation of the topic he is working on (electricity). Thus, they have made circuits and know how to represent them in diagrams… They are ready to make an electric object that is battery operated… Theoretically they are ready to make it… The pupils know that they are going to make something… They have a list of material… They have to bring the necessary material… The teacher of Year 5/6 is more precise. It is about reading and analysing a worksheet with instructions, understanding diagrams to be used and make an object to be used in class. The sequence can happen at any time, with one condition: to adapt the study to the pupils' level (reading here).

The notions to be acquired are rarely anticipated. The teachers generally say that they intervene when asked by pupils. To re-enforce that intervention, they use the blackboard or cards and posters sometimes.

The time spent in the teaching and training in technology is generally half a school day (3 hours). It can be stretched as it does not prevent from doing French or Maths, quite the opposite!

The practical organisation does not pose a problem. Some have the material brought in; others stock up. Tools are at hand, as a rule. The artefact is produced and always prepared in advance to be shown as a model.

The working procedure. The practitioners generally organise the teaching sequence in three phases:

- The introduction to the situation of designing the object and to put it in a wider context
- The study of the object
- The production of the object

The evaluation, not always present, is postponed.

Practices Put to the Test

The elements of observation give an idea of the possible variations in transposition according to the practices and the teachers' methodology

The Situation in the Making of an Object

We can draw two types of transposition from this study. Some teachers transpose the making of an object in the framework of CPU (Conception-Production-Usage). Others transpose it as a manual activity as a continuity of a skill acquired previously.

In the first transposition, the project of making is a means of constructing the idea of a discipline. The project is based generally on the familiar environment of the pupils and on observation. In this framework the devolution of the project does not happen. The project remains that of the teacher.

In the second transposition it is about working on the particular function of an object. The project is thought about a means to justify knowledge in electricity and mechanics already studied. The passing on of knowledge has no reason to take place as the project is part of a logical continuity of a teaching activity.

The Approach

The approach regarding the project is sometimes transposed. It has an organisational effect on the teacher's activity. On the other hand, it curbs some didactic choices and is time consuming. Its systematic scanning produces a rambling development devoid of meaning for the pupils. This obstacle appears especially in the analysis of what is needed.

Generally, the time spent on studying the object is reduced, even non existent.

The situation that aims at introducing the object consists in naming it. The study of what is needed is sterile if the pupil does not understand what is required of him. The situation of conception is by-passed in order not to discuss the solutions anticipated by the teachers. The technique consists in displaying the object to show the technical solutions and in imposing its solutions by using the materials at hand. In those two cases, there is no situation allowing the activity of conception to exist. However, the institutional title "to design an object or a model" includes its conception.

The strategy written in the articulation CPU, widened to other registers of knowledge, is in particular: the language and codes, the names of documents, the function of use and the critical mind. The unveiling of the object is an occasion to make a link with its use. The articulation with the production goes through the reading process of a card with practical hints explaining how to make it. This kind of task is accompanied by an engineering process adapted to children. The card is an opportunity to build up the link between a technical action, a tool and safety.

The Production of the Object

The production, whatever the teacher's strategy, is always a succession of actions without neither real didactic preoccupation nor safety. The various steps are either communicated in writing on a range of making processes, or verbally. The written element ensures a certain autonomy. "If they manage to make, it is proof that they have read the card and that they are gifted readers". In that way, the range of production, when present, is more an object of evaluation than a training in how to use the document. The pupils' autonomy allows teachers to have the time to manage progressively all the individual "small problems" inherent to the making process. To reach that aim, some teachers develop treasures of didactic invention to support the manual activity.

The organisation, repairs and maintenance are the teacher's responsibility. The aspect of the practical organisation is important. When it is controlled by the teacher, the situation of production is simpler to manage by the teacher.

To Use the Object

There is no institutionalisation of knowledge in technology. The object validates that knowledge. The functional validation of the object is determined by its use: "it's working…it's turning!" pupils say after they have blown on their fun windmills. Sometimes it is postponed outside the school hours: "put your things away quickly!.. it doesn't matter, you can finish it at home!" says a teacher, who did not judge the time properly. This denotes the little interest shown in the final product.

Technological Knowledge

The study allows to distinguish between targeted knowledge (which could not be active in those situations), active knowledge and isolated knowledge. It shows a significant variation between the two models of teaching. The teaching which is in line with a thematic progression in Science and Technology aims at three areas of knowledge, of the object (electricity or mechanics, production and design). In these areas two kinds of knowledge are activated, including one before, with eighteen avoided. The teaching, which fits the relation between the CPU, targets six areas of knowledge (the need, the spoken language, the range of production, the reading of codes and specific language, the design and the production). In these areas, seven elements of knowledge are activated, among which one is wrong, twenty-five are put aside, with one in particular which cannot be devolved. This aspect shows that to teach technology, it is necessary to have a minimum of skills in this domain.

The Didactic Action

The transfer of knowledge in those observed practices is difficult to carry out. This comes partly from the project that remains as a strategy in the teacher's logic. But other reasons can explain the absence of passing on that knowledge. Pupils are never put in a situation of studying the design before the making; they are never put in a situation of evaluation except for noticing whether "it's working or it's not working"; knowledge never functions as a production free of its context. It is always subjected to the organisation anticipated by the teacher; the acquisition of knowledge is never done by adapting to the problem (in an environment defined by the teacher); there is no change of opinion in the articulation CPU because practice compels, guides and solves all the problems.

The study shows that the situation of making objects can be transposed in several ways. The intentions and the strategy put into place, are completely different depending on the methodology used by the teacher. Some teachers have a better feel than others for the challenge involved in knowledge. They function with a "feeling" for it.

The way the project is carried out ensures a framework for some teachers. However, its real application leads to them to a succession of situations that have little meaning to pupils. For example, teachers are torn between the logical process inherent to the discipline (the model procedure) and the need to impose the making of an object. The two being at odds, it all ends up with a situation that is meaningless to children and, in addition, does not help the objective in the making of the object.

The activity of production occupies a large proportion of time in the sequence. The construction is always guided and organised by the teacher. It is sometimes finalised by an evaluation of the product. The evaluation is empirical and consists in making the production of the object work.

The technological skills used in the sequence of the making of the object are very few with regard to the possibilities offered by the situation. Thus, on one hand a large number of potential skills are put aside. On the other hand, a certain amount of targeted skills cannot be used for want of a didactic action and transfer of knowledge.

Conclusion

The observation of various practices reveals that the implementation and the teaching of technology in France are directly dependent on the methodology and the didactic action of the teachers. It was foreseeable when we take into account the a priori analysis that we make of the weaknesses in the study programmes, the institutional instructions and books teachers have access to (1998). The practices which have been observed confirm, at best, a basic culture in Technology, at worse an absence of culture. The study shows that the articulation CPU is a working environment easy to understand by non-specialists. It does appear urgent to train teachers in those areas of methodology in Technology if one does not want to run the risk to turn the class of Technology into a succession of activities devoid of meaning, but so entertaining for pupils.

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Contribution to Professional Activity and Ergonomics: The Elaboration of a Toolkit for the Teaching of Technology to be Used by Non-specialist Teachers in Primary Schools

IUFM Aix-Marseille – Site UNIMECA Technopôle de Château Gombert, 60, rue Joliot Curie, 13453, Marseilles, Cedex 13, France

Marjolaine Chatoney, Lecturer – E-mail chatoney@unimeca.univ-mrs.fr   Guy Oliveri, Lecturer – E-mail oliveri@unimeca.univ-mrs.fr

Introduction

Many firms producing school material and teaching aids for the classroom, also make information packs for Science and Technology, to be used by primary school teachers.

These packs are designed as transposition of a ready-made sequence following the success of the project "Let's pitch in" by Charpack. They are usually thematic (air, water, wind…) and are more about Science than Technology. These products, made with the awareness of the difficulties met by teachers in the implementation of sequences in Technology, have made us think that a way to develop technological education is to elaborate a tool, a teaching aid for that subject.

Designing a working tool for teachers is not a simple task. Indeed, the transpositions of sequences for ready-made teaching, packaged with a pre-constructed system, do not take the teacher into consideration. They force him/her to apply a teaching project as a procedure than to make it his own. In order to do this, we have designed our information packs by combining teachers' practices, the idea of what the discipline is, and some of the wide technical and technological concepts for schools. All this, with the aim to give a framework to the transposition in Technology, without necessarily imposing a method.

The tool that we are presenting is a cross hybrid of observable facts, a research work in the methodology of the discipline and the needs expressed by primary school teachers, with whom we are working in collaboration. The aid to teaching consists in giving teachers an instrument, as much from the point of view of their practical organisation, as that of skills to be developed, whilst respecting their freedom to teach. Therefore, whatever the traditional production of an object that has been decided to make, the teacher is given freedom of choice regarding the methodology to be used, the conceptual instruments, and the method and tools to conduct his class, which go beyond the simple production of an object.

The Design

1.1 The Initial Idea: To Implement Technology at the Present Moment

Technology in France finds it difficult to find a place in the scientific and technological mix of current curricula. However, there is a favourable space given to this discipline. A good number of teachers have objects made. It is written in their practices. The production of objects is important to them and they make many; they devote, on the whole, a sizeable amount of time to this kind of activity. Our initial idea is to use that time spent on making things for technological ends. It is about breaking skilfully with the tradition. To achieve this, our strategy consists in not offering the production of a ready-made sequence for a particular object, as it is done via the internet or publishing houses. Our strategy aims to make every sort of production possible. In brief, our toolkit must be flexible and adaptable to all objects.

1.2 A Framework Made Up of Four Large Concepts

The analysis of practices carried out by Chatoney (1999, 2002) indicates that to the problem set by the scientific-technological mix, are added other difficulties with regard to the implementation of Technology. These difficulties lie directly with the teachers. They are of epistemological and pedagogic nature. The means we have found, in order to tighten up the epistemological framework of the making process, goes through the identification of some wide concepts of the object. On one hand, by simply using the toolkit, a teacher knows that he has several conceptual fields at his disposal to conduct the activity. On the other hand, he knows which one (or ones) he is using during the procedure.

Among the wide concepts, three have appeared to us dominant: the tool, the equipment, and material. To these main concepts, we would like to add the one about instruments to be used and which is essential to us, as far as the technical activity is concerned (LePlat, 1997; Rabardel, 1995), an activity we favour. Teachers have altogether at their disposal four essential concepts that they must address; they give them ideas and open up perspectives on the technological enquiry found in the conceptual fields identified by them. That is:

- The availability of a variety of tools for the same technical action (punching, for example) allows to articulate manual dexterity with the quality of the operation and the technique.
- The basic material is made up of a lot of small finished products (such as paper fasteners, glue, rubber bands…). It allows to experiment and to solve the technical problems of assembling or transmission… The materials meet, in particular, the connections to be made (such as mobiles, fixed structures, to be disassembled or not); how to adapt them and link them to issues of energy.
- The material is represented by temporarily finished products, which can be shaped (profiles, intertwining shapes, paper…) Each material has its own properties and shapes. Many can match the object. But some are more suitable than others.
- Instruments correspond to graphic representations which are more or less figurative and necessary to communicate at primary school and have models of technical documents, such as a system of organisation for a given activity (organisation charts, in particular)

1.3 A Strong Desire to Take Control

The choice not to place the toolkit at the centre of the concepts that the object is founded on has three advantages. Firstly, the toolkit leaves the choice of objects to those teachers who are in charge of the training. It accepts all objects and respects individualities and the needs of everyone. Secondly, it leaves them free to direct situations. According to the making of the object he has in mind, the teacher has the final word. He can choose a particular type of activity and put others on hold. He can elaborate some experiments. Thirdly, the absence of ready-made construction of sequence forces teachers to use the material and instrumental resources which they have at their disposal. They take over the teaching by designing sequences for their own class. For example, they have at their disposal a written model of a procedure to make an object, an example on how to represent it, of an internet address…

Description of the Toolkit "Technology, Get Cracking!"

Our project aims at the following:
- To learn, conceptualise and build one's own connection with objects from nursery school, when it comes to the making of objects or models.
- To apply to all objects currently used in class, to all mechanical, electrical, manual and/or computerised ones.

It allows the design and making of objects on several levels:
- It is an aid to constructing the teaching project: The teacher is inspired by the contents of the toolkits to give priority to another particular skill during the study phase and the making of the object.
- It is an aid to the identification of technological contents and to the general aspects that go necessarily with them.
- It is an aid to the lesson procedure. The set sorts out all the organisational and material problems. Each toolkit can be an instrument for class experiments.
- It is an aid to purchasing the necessary materials for its production, without making too much of an error on the main characteristics of the products shown in catalogues.

The set is based on four main ideas which have their place in Technology in primary schools: the object is made by man with tools, it has a structure, it is a combination of shapes obtained from materials, it functions and in order to do that it needs energy. At present, the set is organised into seven distinct toolkits. We have taken into consideration the issues of ergonomics to do with small hands, as well as safety, especially with glues and some other materials:
- Assembly of parts
- Tools to be used

Materials

- Made of paper
- Balls and round shaped
- Profiled pieces
- Threads and bits and pieces

Sources of Energy and their Transmissions

- Electrical and
- Mechanical

Instrumental Resources

The set forms a whole. The seven toolkits are kept on a trolley . But they can be piled up. What is missing up to now is a handbook of resources for what instruments to use and a catalogue for ideas of what object to make. But we are getting down to doing it!

This is below a decorative piece of furniture which can have sometimes other functions!

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Kotuku – Learning From the Past

Dunedin College of Education, Private Bag, Union Street East, Dunedin, New Zealand

Dawn Coburn-lecturer – E-mail dawn.coburn@dce.ac.nz

Introduction

Between 1938 and 1941 the children at Jacks Mill School primary school, Kotuku, New Zealand, built and furnished a house. Today those "children" are actively engaged in maintaining their historic bungalow, and the old school buildings and grounds, as a window on the past. Edward Darracott, a teacher with vision, guided his pupils onto a pathway that stretches into the present. Their words, along with images from past and present combine to tell the story of Kotuku; a township transformed by the school at its heart. Darracott believed in the children's abilities, he valued the practical doing, but he also expected them to take responsibility for other aspects of the project. They corresponded with firms, kept financial records and wrote a regular column describing their progress for a city newspaper. Was this Technology Education? The story of Kotuku raises questions about the expectations of today's teachers, the constraints of school systems and the promise of the New Zealand and other Technology curricula.

In 1935 the little sawmill town of Kotuku, on the West Coast of New Zealand, was about to emerge from the depression years. Schooling was dominated by the proficiency examination at the end of the primary years and the students worked toward this in surroundings that were far from stimulating. When Edward Darracott, a young teacher from the city, arrived to be the new headmaster, he was very unimpressed, as we shall hear later, by the township and Jacks Mill School, named after the local saw millers. He believed that children were influenced by their environment and that there was value in practical education, not just book learning. Darracott set about transforming his school and in doing so, began for the O'Brien family, who you will shortly see on video, and others, a journey that has not yet ended.

Early developments included putting the children into uniform and grand fund raising schemes. Hockey was introduced to the community and symmetrical gardens were constructed to beautify the grounds. Their center piece was a statue of Peter Pan, floodlit by "a light automatically controlled by a time switch from the school office" (Darracott: 1940, 5).[1] The little two-roomed school, previously surrounded by gravel and swamp, was now, in its commanding position at the crossroads, the centre of local attention.

Despite Darracott's endeavours he did not immediately win over the community and he nearly left at the end of his first year. The election of a new school committee enabled work on the school grounds to be resumed and Darracott (1940, 5) commented on "matters .... becoming easier" and a "gradual return of enthusiasm and keenness". Later, in writing a report for the Minister of Education, he noted "A certain area is still remembered vividly as having been completed under the light of the moon by a very happy band of youngsters." (Darracott: 1940, 5) Over the next two years the gardens continued to develop, with the children fully involved, and his school gained international recognition through the quality of a project about the local district, sent to Dulwich College, England, as part of the New Education Fellowship scheme for sharing students' work from around the British Empire. Large trees on the school site, grown by the children, from seeds sent by overseas well-wishers, are the living legacy of this project.

By 1937 the fame of the school had started to spread and, as the visitors' book shows, they came from far afield at a time when travel on the west coast was difficult. Roads were rough and unsealed, while high rainfall compounded problems. A rail link to Christchurch on the other side of the Southern Alps lessened isolation. However, there was still a substantial walk from the railway station to the township. But the people came and as Darracott's students became involved in their most remarkable project, the number of visitors swelled, with up to 69 passing through the school in one week in 1938.

Through the words of the visitors it is clear that Darracott's practical approach to education differed from the norm.

> *"A pleasant and unique departure from orthodox methods."* (Stillwater)
> *"A rare school. It endeavours to correlate its teaching with life's real work and finer pleasures."* (Christchurch)
> *"A revelation in education."* (Greymouth)
> *"Have only seen two things that impressed me before I visited this school. The Notre Dame and the Jenolan Caves."* (Winchester)
> *"Really practical education".* (Greymouth)
> *"I am delighted to see the beautiful and useful work of our future citizens as exemplified in the specimens of school work here".* (Christchurch)
> *"As an educational institution, a lesson to the cities".* (Auckland)
> *"Wish I could come to your school".* (Jacks' Mill School Visitors' Book: 1938, 39)

What was this remarkable project? In Darracott's words (1940, 7) it was the "designing, building, and furnishing of a model home." He explains:

> *"For long past it had seemed to me, that the teaching, particularly in the two senior classes should be on more practical lines and that above all the child should be taught to think for himself, not to take his lessons spoon-fed from the hands of the lecturer. More still, this training to think and act should be in situations as life-like as possible. ... In doing so he must learn to create for himself and thus acquire the consequent feeling of power". (Darracott: 1940, 7)*

Now is the time to move to the children's perspective and let the O'Brien family tell the story. (15 minute video will be used at this point). I have a transcript of this available

We often talk glibly about "making a difference". Having listened to the O'Briens' story – what do you think? These people and Albert Rouse, another student we have traced, are adamant that their school experience totally shaped the path they took. Albert has been involved with major construction projects in New Zealand and only retired last year in his seventies. With reference to another student of Darracott's era, we read, a son's comment in the present day visitors' book: "Great to see what makes Mum tick now." (Jacks' Mill School Visitors' Book: 2000)

Tom and John are still recreating their school for the visitors who once again travel to Kotuku to view the now 'historic bungalow' the children built, and the associated museum, housed in the school and outbuildings. Every Sunday the school is opened to the public. Rosemary has stitched a flag to show the Kotuku (white heron) in flight and repaired the large rug she helped to weave as a child.

For many years "Domestic Science" was taught in the bungalow at a time when country children sometimes did not have access to secondary schooling, or to manual training centres. In the 1950s, when rural depopulation decreased its roll, the school was closed. Alterations were then made and it became an Outdoor Education Centre providing accommodation for young adults on an intermittent basis. When returning pupils found it in a neglected state in the 1990s they resumed the pursuit of beauty and order begun by Darracott. John and Tom O'Brien, then nearing seventy, were heavily involved in this project. Structural changes were made to restore the buildings, as far as possible, to the school it was. Remnants of the garden layout were uncovered and considerable ingenuity was shown, in using bunks removed from a ship, to create a sturdy fence around the perimeter of the school grounds. Their pleasure in restoring and maintaining this memorial to a remarkable teacher, and the school days they celebrate, is unfortunately underlain by worry about money required to purchase the site so that it can be retained by the people of Kotuku.

I was attracted to the story of Jacks Mill school and Edward Darracott through my strong belief in the importance of Technology Education. In New Zealand we have an holistic approach intertwining societal and environmental aspects, and technological knowledge and understanding with technological capability (Ministry of Education: 1995). We discuss and debate issues of authentic technological practice for primary children and pathways towards technological literacy. I now work with practising teachers and pre service teachers and I place a strong emphasis on engaging children in solving real problems and dealing with real situations drawn from the context of their classroom, school, home and community. The importance of allowing children to make decisions that matter is recognised, while mistakes, or failures, are regarded as learning opportunities. Links with the community are strongly encouraged and although units are still regarded as a convenient means of curriculum delivery, mention is also made of the potential to extend Technology Education into everyday discussions and into undertakings that span time well beyond the conventional unit. The garden does not stop growing after a few weeks. Goods for sale at a fair may be accumulated over months. Redevelopment of the school grounds can be a project spanning years.

I have asked myself many questions about the relevance of Darracott's approach for the 21st Century and the extent to which it is consistent with Technology Education. Can we have the impact he had in transforming his school and the lives of at least some of his students? First let us look at the background to his ideas. He initiated the bungalow project, in 1938, as a vehicle for practical and contextualised learning, encouraged by a meeting called by school inspectors that emphasised the freedom available to teachers. New Zealand teachers were already aware of new currents in education. In 1937 schools were closed for a week to allow 6000 teachers to travel to various venues to be part of the New Education Fellowship, an international conference brought to the South Pacific (Ewing: 1970). The work of John Dewey, with his focus on practical education, may also have been known to Darracott. When the new freedom became available with the removal of the proficiency examination, it seems that Darracott could realise his dreams. As one visitor said, "Tis nice to see ideals made into realities". (Jacks' Mill School Visitors' Book, 1938).

I consider that the learning opportunities provided by Darracott are largely consistent with Technology Education, although embedded in a significantly different, post depression, social context. His approach went well beyond contextualised trade training with an instructor providing close guidance and teaching skills. In fact Eileen Banks, Darracott's assistant teacher, found herself to be, in today's jargon, a co-learner. Now in her eighties, she has clear recollections of her time at Jacks Mill School. She explained to me that she was a teacher with a degree in French who had to learn how to upholster and sew in order to work with the children on aspects of the project (personal communication, Eileen Banks, July 2002).

At the macro level, there was no problem for the children to solve, except to design a bungalow as requested by their teacher. However, the planning of the bungalow involved all the children. According to the newspaper accounts written by a student (Christchurch Star, 1938) they used stones and blocks to shape their houses, then the older ones developed detailed, scale plans, before Rosemary O'Brien's design was chosen. What is considered remarkable is that "a twelve and a half year old girl ... managed to put into her design all of the ideas that were in the minds of private architects ... who at precisely that point in time were submitting their first open plan, English Cottage style, state housing designs.' (New Zealand Historic Places Trust: 1995, 2) This could raise questions about other influences, and yet you have heard Rosemary modestly say that it was her design. So ownership of the project surfaced at an early stage. At other levels, from the O'Brien's story it is certainly evident that they made their own decisions, solved their own problems and learned from their mistakes, giving support to the idea that it was a project consistent with Technology Education.

Aside from the construction of the building and the making of the furniture and furnishings, the students were also engaged in other aspects of the project, which brought them in touch with individuals and businesses within and well beyond their community. Sponsorship was sought for materials and equipment through letters written by the students. They kept accounts, arranged insurance and wrote regular reports on their progress for a Christchurch newspaper.

We know building the bungalow was a powerful learning experience for Darracott's pupils, but to what extent can we learn from what he did? It is apparent that there are obstacles for today's teachers who might want to follow a similar path. A glance at the photos shows children in positions that would certainly not meet with Occupational Health and Safety requirements today. The telephone was a link between house and school, and from comments not included in the edited video, we know that the children worked there unsupervised, and were called back to the classroom as required for specific lessons. However, Eileen Banks (personal communication, July, 2002) also recalls being asked to take both classes to release her headmaster to work outside with the other students. They returned to school in the evenings and worked there with their teacher; a risk teachers would be unlikely to take today. New Zealand teachers would possibly say that meeting curriculum requirements and the need for a strong emphasis on literacy and numeracy would be the biggest impediments to following Darracott's sustained, practical learning pathway.

But let us not focus on the barriers. Primary children can be fully involved in reshaping their environments, from developing gardens, constructing feeding stations to attract birds, adding comfort to their classrooms and libraries with cushions and beanbags, and staging foyer displays. They can design, if not build, playgrounds and skateboard facilities, then work with councils and schools to have their designs implemented. Our local councils are required to consult regarding community facilities. We can push for this consultation to become more than a token and advocate for children's input as a way of providing ownership that may reduce vandalism. They can also engage in the construction of props and sets for dramatic purposes, or video production. Interestingly, that was another facet of Darracott's teaching. We have photographs of an extremely large shoe used for a performance choreographed, by pupils at the next school Darracott taught at (personal communication: John O'Brien, 2001).

Conventional designing and building can still occur, but on a more restrained and smaller scale. Creating a playhouse to be raffled for school funds, illustrates this approach and fully engaged students at a Dunedin intermediate (Year 7 and 8) school, in 2001. Unfortunately, in New Zealand, putting large numbers of this age group, through Technology Centres for short bursts of tuition, often divorced from their other learning, tends to reduce opportunities for integrated and extended learning of the kind experienced by the children of Kotuku.

I would challenge our teachers by suggesting that some curriculum impediments are more perceived than real. I have insufficient knowledge of British systems to comment on constraints you face. But there are New Zealand teachers who meet requirements, who pursue themes that run for long periods of time and who spurn the constraints of timetable boxes. These few have sufficient confidence in their personal educational philosophies to refuse to allow children's learning to be interfered with unnecessarily and they are part of, or have the support of, senior management. There are integrated approaches to learning that enable continuity and interest to be sustained and these can incorporate literacy and numeracy in highly motivating contexts. I believe Technology Education has tremendous potential to not only enable children to achieve the goals of the Technology curriculum but also to provide opportunities for a wide range of other learning, while developing and strengthening links with the world beyond the school. Technology Education is not an extra imposition to be squeezed into an already over full school year; it can provide real work, the satisfaction of a job well done and outcomes that must withstand the scrutiny of others and be justified to peers and adults. The Kotuku students knew their work was real. They were not just engaged in classroom activities and they had a teacher who believed that children could build a house. For those who teach 10 – 12 year olds, do you believe that your students could build a house, or take on a relevant contemporary project of similar scale and significance in your community? Would it be a worthwhile learning experience that could change the course of young lives?

Last year I was privileged to be involved with our national Technology exemplar project. To supplement this we have written a matrix (unpublished papers) which will probably be criticised, as are most attempts to describe student achievement in Technology Education. However, there is one facet of that project that the group is particularly proud of. We have an unleveled aspect that addresses being innovative, creative and taking risks. We wrote it with students in mind, but should not this apply to teachers too? Darracott was an innovative, dedicated teacher and a risk taker. Would our children respond if we were brave enough to accept the challenge, take the risks and expose the students of today to learning experiences, different in detail, but similar in quality to those offered by Edward Darracott at Kotuku, sixty years ago?

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1 This was a novel feature as at this time many rural New Zealand communities did not have electricity available for household purposes.

2 The copies of newspaper cuttings do not include exact dates, page number, or source. From personal communication I have been told of the source, but this has not yet been verified.

Deconstructing Skill – Embedding Design and Technology Education on to the Dreyfus Model of Skill Development

Department of Educational Studies, Faculty of Education, University of Glasgow

John Dakers, Lecturer in Technological Education – E-mail jdakers@educ.gla.ac.uk

Introduction

***Human understanding was akin to knowing how to find one's way about in the world, rather than knowing a lot of facts and rules for relating them. Our basic understanding was thus** a knowing how **rather than** a knowing that.*
(Dreyfus and Dreyfus. 1986:4)

Technology education involves, amongst other things, the development of skills. We talk about making skills, problem-solving skills, tool-using skills to mention but a few. But what do we mean by the term 'skill'? This paper will seek to deconstruct the term 'skill' based upon the Dreyfus model of skill development. It will consider various conceptions of skill: is competency more a measure of ability than proficiency? Are skills hierarchical and if so are the levels determined by the degree of complexity and discretion involved?

Dreyfus Model

The Dreyfus approach began in the 1980s with the work of two brothers. Hubert Dreyfus, a philosopher, and his brother Stuart, an industrial engineer who had worked in the field of computing. This joint work began as an investigation into how to train pilots in the USA. They drew upon research into teaching and learning skills, especially for driving and chess playing. The work culminated in the publication of their book *Mind over Machine: The Power of Human Intuition and Expertise in the Era of the Computer*. (1986) This became a broadly based theory of skill development, which they labelled Novice, Advanced Beginner, Competent, Proficient and Expert. More recently Hubert Dreyfus (2001) has transformed the theory into a seven-stage account of skill development. This paper will limit itself to considering the first five stages.

Dreyfus sees skill development as a progression from novice to expert. This model works on a phenomenological basis of experiential learning as against a rationalist model of analytical reasoning and is grounded in "Merleau-Ponty's claim that perception and understanding are based in our capacity for picking up not rules, but flexible styles of behaviour". (Eraut. 2001. p109) This is in direct opposition to behaviourist methodologies which place emphasis on direct instruction, behaviourist modelling and coaching towards exam success.

Fundamental to this model is the emphasis upon learning from experience which supports the thinking behind Vygotsky (2000) and Bruner's (1996) emphasis on social constructivism, Engestrom's perspectives on Activity Theory (1999), Dewey's experiential learning (1996) and Dweck's theory of motivation. (2000) The strength of the Dreyfus model lies in "the case it makes for tacit knowledge and intuition as critical features of professional expertise in 'unstructured problem areas'" (Eraut. 2001. p112) such as design. Kimbell and Perry (2001) support the need for tacit knowledge as an essential component in the design process. They see the whole ethos of the Design and Technology classroom environment as being "packed with opportunities to explore and exploit designerly hunches." (p8) This is in direct contrast with what Dreyfus refers to as the 'calculative rationality' approach to skill development. Design taught as an hierarchical and linear process entirely dependent on skill procurement exemplifies calculative rationality.

The following model maps skill development in Design and Technology education on to the Dreyfus (2001) model as follows:

Novice

Learning and teaching new skills begins by decomposing tasks into what can be figuratively described as 'bite sized pieces'. Essentially, tasks are broken down into simpler, context free elements or parts. These parts are based upon rigid adherence to taught rules or plans, have little situational perception and allow for no discretionary judgement. At this level the teacher supplies the facts and procedures which the pupil needs to learn in that particular domain. The teacher would demonstrate psychomotor skills involving tool use. Great emphasis upon the correct procedures associated with that tool, including safety aspects would be made. The pupil would emulate, within the confines of their particular ability range at the time, the use of the tool. Repetition by the novice plays an important role within this domain. Whilst a degree of creative flexibility and rule breaking should be encouraged in what might be loosely described as the design process, rules governing the design process would begin to be introduced at this stage.

In Design and Technology education novices, typically, will have low metacognitive ability when relating to any particular skill or set of skills. As a consequence, by simply following basic rules, novices will produce poor results when expected to combine a set of previously learned, situationally-independent skills, to complete a more complex practical task which has no situated or meaningful context for the learner. This inflexible model of teaching has been observed in cases set within, for example, the Scottish curriculum where exam performance influences teaching methodologies. (Dakers & Dow. 2002) Atkinson (2000) also reports that "...inflexible models provided by teachers during public examinations in Design and Technology, have on the one hand, enabled many pupils to achieve success in terms of performance, whilst on the other hand, they have wasted valuable education opportunities for the development of higher order thinking skills at a crucial stage in a pupil's education." (p277) In this case assessment of skill development will relate to isolated, context free performances rather than to learning set within a creative, problem-solving environment.

"Understanding a language or a science is much more than memorising the elements and the rules relating to them. The student needs not only the facts but also an understanding of the context in which that information makes sense". (Dreyfus. 2001. p34)

Advanced Beginner

Experience sees the novice more able to deal with more complex situations. Prior experience becomes an important factor and whilst situational perception is still limited, it is seen to be developing. Dreyfus illustrates this with reference to learning to drive a car. A novice learner driver will rely on the rule that when the needle on the speedometer reaches 20 (non situational), he should change up to third gear. The advanced beginner will become accustomed to the engine sounds (situational) and less on the speedometer. He relies now on what Dreyfus refers to as 'maxims', or rules of thumb. When the engine starts to race change up a gear, when the engine starts to labour change down a gear. For the novice, using a saw will rely on the many discrete rules both described to them and observed by them, which relate to the correct way to saw a piece of wood into two halves: Hold the saw in the prescribed way; adopt the correct posture; make sure that the motion of the saw is perpendicular to the work piece; move the saw over the wood using a backwards and forwards motion, etc. (non situational) The advanced beginner, however, begins to have a feel for the relationship between the saw and the wood. They may use the maxim: start off with small saw strokes and lead on to larger strokes as you feel the saw beginning to take.

Design becomes less 'free style' and more contextualised in order that the pupil can become more aware of its significance. A more involved approach to learning and teaching is adopted with the pupils adopting a less passive role and teachers acting more as facilitators than instructors. Assessment becomes more formative, having a focus on the process rather than the product. The various processes involved in Design and Technology education such as design, manufacture and evaluation are no longer seen as discrete entities but necessary relations in the design process.

An interesting emotional response now becomes apparent in the transition from advanced beginner to competency level. A certain degree of anxiety and even fear sets in as the pupils begin to realise how overwhelming the sheer number of rules and procedures are that they need to be able to apply to novel situations. The performance of these tasks now becomes nerve racking and exhausting. An analogy of cooking a meal for friends may illustrate the point. A novice might prepare ready made foods from the supermarket where the learning is more associated with operating the oven and cooking the various ingredients to the prescribed methods and timings, or following a well written recipe to the letter. In this model the novice would need to learn what the term 'to sauté each side for 2 minutes' or 'to shallow fry for 10 minutes' meant and would follow the instructions and timings precisely. Advanced beginners would, through experience, have learned and practiced a number of procedures such as sautéing and would begin to sauté the meat whilst developing an intuitive feel for when it was cooked. They would nevertheless, still be apprehensive as to whether they had succeeded or not as they exchanged their reliance on the support of the instructions and timings prescribed for their skill development through experience. Similarly, as the child starts to ride the bike without stabilisers, or as the child starts to swim without armbands, a state of anxiety is a necessary attribute on the way to achieving competency level.

Competence

Competence can be seen as "the climax of rule guided leaning and discovering how to cope in crowded pressurised contexts." (Eraut. 2001. p110) Competence requires the learner to develop a stronger personal sense of what is important in any given situation. Actions are now beginning to be seen in terms of longer-term goals. Learners start to deal with multi tasking and conscious deliberate planning. Previously learned material becomes routinised and standardised. Prioritisation becomes more relevant and personally involving. Learners "must decide for themselves in each situation what plan or perspective to adopt, without being sure that it will turn out to be appropriate". (Dreyfus. 2001. p36) At this level, the learner becomes anxious about any failure which, as a result of their decisions would be attributable to them. They can no longer rely on, or blame when it does not succeed, the prescribed methodology given by an 'expert' who when it failed, could be accused of giving the wrong rules. However, when the outcome is a success the competent learner then feels elation and an emotional involvement unknown to the beginner. A sense of satisfaction is achieved, not by being told that the product is good, but by beginning to know, metacognitively, that the process involved in achieving the desired outcome was personal and involved some degree of risk. Barlex (2003) outlines the association between risk, personal endeavour and originality. "If the outcome is certain to be successful, all possibility of 'failure' is eliminated; if there are no 'butterflies in the tummy' at some stage in the endeavour then the outcome will be mundane." (p9) This is the defining factor in achieving competency. Whilst the beginners follow predetermined rules in order to gain experience, they are not emotionally involved in choosing an action even although they might be involved in the outcome. They simply take part in the experience based upon their own motivation. At the level of competence there is an emotional investment in choosing an action and this emotional investment is grounded in the learner taking responsibility for their choice of action.

The synthesis of the design, manufacture and evaluate process in the Design and Technology education domain is a perfect example of competency in the Dreyfus model. "Design tasks are typically multi-dimensional, messy and value-laden … designers have to optimise solutions bearing in mind competing priorities. They have to take a project from inception to completion." (Kimbell & Perry. 2001. p6) Learners need to be able to propose and defend a decision whether it be justifying the colour of an artefact, selecting the correct tool or challenging the received wisdom of another. As learners take on more responsibility, and significantly take more risks, there will continue to be a need for some kind of supportive framework or scaffolding. (Bruner. 1996) Dreyfus argues eloquently that if we were disembodied beings free from our emotions, such as a computer or robot, our responses to our successes and failures would lack any seriousness or excitement. Given, however, that we are beings in the world who are influenced by our various cultures, it can be argued that as beings in the world of the culture of school, pupils will be influenced by their teachers. In the culture of the Design and Technology classroom where teacher demonstration and support plays a crucial role, then the enthusiasm, or lack thereof that a teacher displays, will affect whether pupils withdraw into 'disembodied minds' who produce "superficial work associated with the presentation of their design portfolios at the expense of the main core of designing and making activities." (Office for Standards in Education. 2000. p2-3) The teacher and the teaching environment in Design and Technology as a consequence, play crucial roles in the development of a learners skill ability towards competency level.

In a study of nurses' skill development Benner (1984) employed the Dreyfus model. She found that "the competent nurse lacks the speed and flexibility of the proficient nurse but does have a feeling of mastery and the ability to cope with and manage the many contingencies of clinical nursing. The conscious, deliberate planning that is characteristic of this skill level helps achieve efficiency and organisation." (p27) It seems that the ability to deal with 'big picture' differentiates between competency and proficiency. The competent performer may be proficient at individual components of a task or situation. The nurses mentioned had two years' experience on the job in order to reach competency in Benner's study. Can we expect more from a pupil at school?

Proficiency

"Proficiency marks the onset of quite a different approach to the job: normal behaviour is not just routinised but semi automatic; situations are apprehended more deeply and the abnormal is quickly spotted and given attention." (Eraut. 2001. p110)

Situations at the level of proficiency begin to be seen holistically rather than in terms of the various aspects involved. In design, the pupil needs to be an "holistic integrative thinker … managing the messy and often contradictory strands of thought within a project." (Kimbell & Perry. 2001. p6) Learners can begin to discriminate what is important in a situation and their decision making processes become less laboured and difficult. The positive and negative emotional experiences encountered at competency level will begin to strengthen for successful performance and inhibit unsuccessful ones. "[T]he performer's theory of the skill, as represented by rules and principles, will gradually be replaced by situational discriminations, accompanied by associated responses. Proficiency seems to develop if, and only if, experience is assimilated in this embodied, atheoretical way. Only then do intuitive reactions replace reasoned responses." (Dreyfus. 2001. P40).

Expertise

*"The **proficient performer**, immersed in the world of his skilful activity, sees what needs to be done, but has to decide how to do it. The expert not only sees what needs to be achieved; thanks to his vast repertoire of situational discriminations, he also sees immediately how to achieve his goal. Thus, the ability to make more subtle and refined discriminations is what distinguishes the expert from the proficient performer."* (Dreyfus. 2001. p41) (Italics in original)

Expert level is thus seen to be at a level which is more in keeping with a well established craftsman or designer. In order to achieve expertise, the performer has to be a specialist practicing within a specific domain with a vast amount of experience in that domain. This level of skill development is clearly beyond the scope of school education.

*"An expert generally knows what to do based on mature and practiced understanding … An expert's skill has become so much part of him that he need be no more aware of it than he is of his own body … the expert business manager, surgeon, nurse, lawer, or teacher is totally engaged in skillful performance. **When things are proceeding normally, experts don't solve problems and don't make decisions; they do what normally works."*** (Dreyfus & Dreyfus. P111) (Italics in the original)

Expertise suggests a large degree of immersion in the specific subject domain and less of a generalist approach. Evidence suggests that for skills to be acquired at this level, authentic practise contexts are required. (Hager & Hyland. 2003. Dreyfus. 2001.)

Discussion

This paper has set out to embed the concept of Design and Technology education into the Dreyfus model of skill development. It does not suggest a template for measurement. It does not suggest that performance related tests should be designed to allow progression from one level on to the next. On the contrary, it attempts to suggest a way of thinking about skill development in Design and Technology education, not as the mastering of a set of prescribed competencies which are based upon performance goals, but more upon the development of the person in the world of Design and Technology which is based upon learning goals. (Dweck. 2000)

> *"…products are not to be seen as the artefacts that learners produce, be they novel furniture, computer mouses, hats or control systems. The real products of design and technology are empowered youngsters; capable of taking projects from inception to delivery; creatively intervening to improve the made world; entrepreneurially managing their resources; capably integrating knowledge across multiple domains; sensitively optimizing the values of those concerned; and confidently working alone and in teams."* (Kimbell and Perry (2001. p19)

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Unlocking Creativity Through D&T – The Young Designers on Location Project

Bath Spa University College, UK

Dan Davies and Alan How, Senior Lecturers – Telephone +44 1225 875675

E-mail d.davies@bathspa.ac.uk

Introduction

This paper reports on findings from research designed to explore ways in which creative thinking skills can be fostered through technology education. The Young Designers on Location (YDoL) projects were funded by the National Endowment for Science, Technology and the Arts (NESTA), and involved two discrete groups of 11 year-olds working intensively with 'design-related professionals' (DRPs) for a week in two locations (Bath Spa University College and Ironbridge Gorge Museum, Shropshire) and subsequently in participants' schools. The project provided a number of insights, including some related to the ways in which children interact with different aspects of a **'Creative Ecosystem'** ***(Harrington 1990), which the authors suggest is a key concept in understanding creativity in educational settings.***

Creativity in Design and Technology Education – the Context for the Project

Creativity is not always understood as something that can be 'taught' to pupils; yet there is a growing body of literature that identifies educational practice that have a significant effect on an individual's creativity (NACCCE 1999; Howe et al 2001; Craft *et al*. 2001) to which this paper seeks to add. Creativity can be seen as *'imaginative activity fashioned so as to produce outcomes that are both original and of value'* (NACCCE 1999 p29), going beyond the *conventional agreed* (Craft 2000), a process leading to *'cultural production'* (Sefton-Green and Sinker, 2000), *'a function of intelligence'* (Robinson, 2001) or *'a state of mind'* (Lucas in Craft et al 2001). In the context of D&T we are drawn to the NACCCE definition as it refers to the capability to produce something that is new to the individual. 'Production', in educational contexts can be thought of as an idea or prototype as well as a completed artefact. Harrington (1990) brings the factors of process, people and physical environment together within a theoretical framework of the *'Creative Ecosystem'*. The ideal conditions of Harrington's 'ecosystem' in which creativity may flourish are:

- An atmosphere or 'ambience' of creativity
- Stimulation
- Opportunities for 'play'
- Easy access to resources
- Mentors and role models
- Permission/support
- Motivation/Encouragement
- Information
- Open-ended assignments

We designed the YDOL project to bring as many of the elements of Harrington's framework together as possible.

Project Design

The above findings, together with other significant considerations that emerged from focus-group discussions with designers, educators and children, informed the detailed planning of the project structure within the two locations referred to above. The design needed to be flexible and adaptable, not only to accommodate participants' interests and chosen directions, but to ensure that it was transferable to different locations. Since the physical environment of our two projects appeared from the literature to be of considerable importance to children's creativity, we selected the parkland campus of Bath Spa University College as one location and the heritage architecture of the Ironbridge Gorge Museum for the other. Both locations had the advantage of being visually stimulating and of having considerable space and resources with which children could work. The adults in the project needed to be equally carefully selected to ensure a creative ecosystem was developed and maintained – this resulted in the appointment of a team of educators and design-related professionals at each location who could work together with a shared understanding of creativity and the aims of the project. Outcomes were not pre-specified; however at Bath Spa materials available included willow 'withies' from which structures could be built, a range of sheet materials, fluorescent paint and digital media; at Ironbridge the focus was on food, textiles and ceramics. These reflected the DRP's specialisms.

Research Questions and Methodology

We selected the following research questions as potential areas for enquiry within this field:

1. What is the relationship between teachers' judgements of children's creative potential and their performance in an out-of-school creative project?
2. In what ways do 10 and 11-year-old children interact with 'design-related professionals' during a collaborative creative activity?
3. Are there forms of interaction which are more productive than others in stimulating children's creativity?
4. What roles does the immediate environment play in stimulating children's creativity?
5. What are the medium-term effects upon children's attitudes towards their own creativity of an out-of-school creative project?

We used a range of methods of data collection including participant observations and semi-structured interviews of case-study children, digital photographs of the 'location' in which children were observed and of the process and product of the activities, semi-structured interviews with the parents, teachers, and design-related professionals involved in the project.

This data were collected by a group of three co-researchers from the department of primary education at Bath Spa University College. Interview transcripts and observational notes were analysed using the qualitative data management package ATLAS.ti.

Findings and Discussion

In the findings reported below, children have been given pseudonyms.

1. What is the relationship between teachers' judgements of children's creative potential and their performance in an out-of-school creative project?

Factors Used by Teachers in Nominating 'Creative' Children

We did not direct teachers to nominate children who were particularly 'gifted' in creative activities, but described the project to them and invited them to derive their own criteria.

We found that teachers made judgements on some evidence of attainment in subjects where creativity is most valued, but also on more 'generic' criteria of interest and motivation. Conversely, there was evidence that several had taken an 'anti-elitist' stance and chosen children whom they felt such an experience would 'benefit' although their performance at school was not good generally:

> *"My first thoughts were to think of a child who, perhaps was creative but maybe doesn't necessarily come across at first instance as being creative but needs that extra support."* (John's teacher)

In some teachers' eyes, their perception of a 'creative' child was one who was perhaps a 'bit of a loner', or slightly eccentric. One teacher described both of her nominees as having 'social needs'. Such children, whilst pursuing their own creative agendas enthusiastically, found working collaboratively in school difficult.

Children's Performance During the Project in Relation to Teachers' Selection Criteria

Some of the design-related professionals (DRPs) questioned the basis upon which teachers had made their selections, possibly not aware of a strong anti-elitist sentiment in primary education in the UK:

> *"I don't know how teachers selected these children. I wouldn't have chosen some of them."* (DRP during Ironbridge Project)

This DRP appears to have had the expectation of working with 'gifted and talented' children. Peter, a DRP on the Bath project, took a different approach to identifying the creative qualities of selected children over time. In relation to the case-study children, he noticed several of the characteristics identified by the teachers being given opportunity to develop in the less structured environment of the project:

> *"'Darren's been fascinating to watch because he's been very independent and the least conformist of them all and certainly full of energy and vitality … He's taken more responsibility for his own actions and I think certainly seeing the product of some of his photographs and his play, what he perceived as a play, running around being a bit mischievous with the camera has certainly come up with some interesting results."* (Peter, DRP during Bath Project)

Darren's behavioural needs, identified by his teacher during interview were certainly manifested during the first two days of the project, during which he challenged authority and pursued his own agenda with great enthusiasm. It is easy to see how this behaviour could be difficult to manage in a classroom situation, yet because of the fascination he developed with the digital camera and the sense of achievement he felt when some of his photographs (e.g. Figure 1) were identified as having creative qualities, the project succeeded in channeling his energy in a fruitful direction, resulting in outcomes that showed greater originality than might have been the case had he been more conformist.

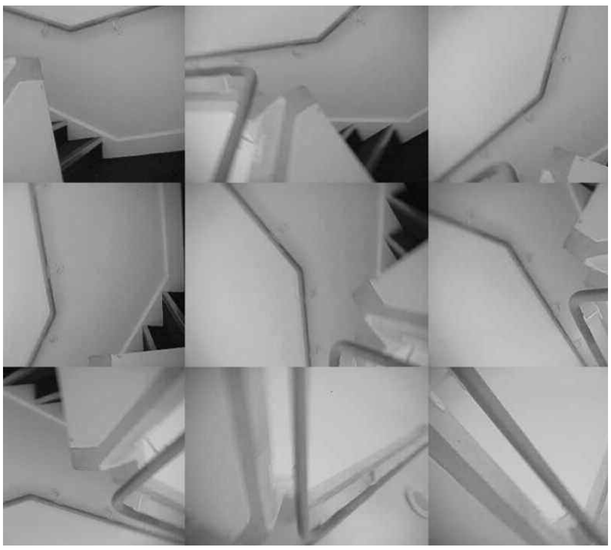

Figure 1. Darren's digital photograph: movement on a staircase

2. In what ways do 10 and 11-year-old children interact with 'design-related professionals' during a collaborative creative activity?

Initially, many children had expectations of the DRPs as taking on a 'teacher' role, and found it difficult to adjust to the more informal 'co-worker' relationship. The professionals concerned needed to offer much reassurance that they were there to support, rather than judge:

> *"Making them feel that whatever their decisions are the right ones"* (DRP in Bath Project)

By sharing their own work practices with examples, designers made themselves vulnerable and helped to create a climate of confidence and trust. One DRP in the Ironbridge project 'modelled' the activity to research motifs from the environment first, then encouraged the children to become involved by helping them to clarify and reinforce their ideas, adding vocabulary and exploring the potential of what they were offering.

By the end of the main week, when relationships had had time to establish, the interactions between children and DRPs were very productive. They were genuinely able to 'bounce ideas' off each other and challenge formulaic thinking. There was a sense of shared purpose, and the distinction between adult and child had begun to dissolve.

This also was the phase of the project in which the tensions between product and process began to surface and affect the relationship. Although the team of DRPs in Bath had been very clear from the outset that children's engagement in a creative process and developing awareness of their own creativity had been the main aim of the project, the proposal to put on a mini-exhibition of the structures they had been working on (Figure 2) for parents to see on the last day began to exert the pressure of 'having something to show for the week'. This certainly changed the nature of some of the interactions, for example between Peter and John:

Peter: "Where's your print out of your titles and labels?"

John: "We've done them."

Peter: "I want you to do your writing please. Come on, shut this down. Don't get lazy on me John."

Peter and John are beginning in this exchange to fall into a teacher-pupil type of relationship because of the time pressure. However, several children identified that a key factor in the experience was the opportunity to work with 'more experienced others' in a concentrated way for long periods. This contrasted with their experiences of school, where "we only do things for an hour, then it's time to do something else."

3. Are there forms of interaction more productive than others in stimulating children's creativity?

Figure 2. Structures in the end-of-week exhibition

One of the partially unintended benefits of running the project in two locations with semi-autonomous management was that significant differences emerged between the approach adopted by DRPs in Bath and Ironbridge. As indicated above, the DRPs in Ironbridge tended to adopt a more 'teacherly' approach than those in Bath; their interactions were generally more directive within an apparently 'tighter' structure of carefully timed stimulus activities involving specific skills input before inviting children to opt for one of the key materials with which to work on their 'major piece'.

In summary, the tightly-structured, more directive interactions between DRPs and children in Ironbridge appear to have been more successful in providing children with a secure skills-base from which they felt confident to go on and produce outcomes of which they were proud (even if the nature of such outcomes was to an extent pre-determined). This was a 'safer' and more familiar form of interaction to which children could readily adapt, and the clear boundaries could potentially be progressively relaxed in order to encourage greater risk-taking. By contrast, children found it difficult to adjust to the more 'open' style of interaction in Bath, simply because they were not used to it from their school environment. Arguably, they learnt fewer 'skills' and were constrained in their ultimate choices by the lack of specific input earlier in the project. The 'lack of rules' also created some management difficulties for the DRPs at different times, though most children had taken on a high degree of autonomy and personal responsibility by the end of the week. Their 'cognitive outcomes' in terms of their insights into creativity were of an arguably higher order than those of the Ironbridge children, although no direct comparison was really feasible.

4. What roles does the immediate environment play in stimulating children's creativity?

The ways in which the physical environment was used differed between the locations; in Ironbridge the industrial architecture was used directly as a source of motifs for the outcomes (under the general heading of 'heritage'). At Bath Spa the natural environment was used as the location for one of the stimulus activities, but otherwise the suite of rooms allocated to the project, together with their immediate surroundings formed the backdrop to the activities, rather than their inspiration.

One of the initial activities at Ironbridge was a treasure hunt to encourage children to focus on details in the built environment by matching a series of close-up photos to their real locations. In one of the research activities for the major project Claire, the food technology DRP, invited children to fill one page of their sketchbooks with samples of colour from the natural environment – petals, leaves and stones. She then asked them to use pencils to colour and match the shades and tones they had collected, labelling where they had come from. The children were also working directly within some of the heritage buildings, providing an unusual interior environment and demonstrating a change of use.

At Bath Spa, some children cited the lake, trees and other natural features of the campus environment as inspirational to their designing:

> *"I think it's a very pretty nature place because we can get our ideas by walking and take pictures to put onto our structure."* (Natasha)

More children mentioned the significance of being in a university, and were fascinated by the students they saw around (several took photos of students using the digital cameras). It seemed important to them to be in a learning environment which they regarded as high-status – this enhanced their own self image and gave them confidence to be creative.

In summary, although the Ironbridge Project used the environment in a more obvious way than that at Bath, the physical layout and size of the workspace, together with light levels, ease of movement and general 'atmosphere' had an important impact upon children's perceptions of what was possible.

5. What are the medium-term effects upon children's attitudes towards their own creativity of an out-of-school creative project?

At the end of the Bath project many children were able to identify significant features of their own creative processes (e.g. "learning to play with ideas") and sources of inspiration (e.g. "things you see and remember; the work of others; talking with people"). Several recognised aspects of their own creative development during the project. These developments were recognised by others, including the DRPs working with the children during the project, their parents and class teachers:

> *"(Many have)…a greater understanding of creativity, motivation and self-esteem, a sense of purpose…"* (Elaine, creative director of Ironbridge project)

> *'(He has) greater confidence about being independent. He's not so ready to 'follow', more inclined to 'lead',* (teacher response to Ironbridge questionnaire)

For some children, the project gave them an insight into the emotional factors that made a difference to their own creativity:

> *"Don't try very hard otherwise that spoils it. That always happens when I tried too hard it spoils it."* (child from Bath project)

One of the children, 'Darren', was tracked over the year after the project. He was able to continue taking photographs as he was bought a digital camera by his parents, who were very keen to support the interest and promise he had shown on the project. Some nine months after the project Darren had compiled a portfolio of over 200 images. Bath Spa University College agreed to finance Darren to work with a professional photographer Andy Kemp to organise an exhibition of the work during the Bath Arts' festival. The project provided him with a new and lasting enthusiasm, a sense of achievement in an area where he has performed with high levels of creativity, to offset the low self-esteem he holds in other areas of his life.

The three case-study children, Natasha, John and Darren, were interviewed again 18 months after the project had finished. In John's case, the effect of the project seemed to have 'worn off'; he expressed largely negative views about it and his subsequent creative development. Natasha, however, acknowledged the confidence the project had given her to work collaboratively with others. Unfortunately it would seem the liberating influence of the YDoL project had become overlaid with the rigidity of the secondary education system and the disaffection of encroaching adolescence.

Conclusions and Implications

The findings presented above provide insights into ways in which components of a 'Creative Ecosystem' – namely the physical environment and personal relationships – can stimulate children's creativity. The importance of uninterrupted time to focus and concentrate has also been highlighted, as have the emotional and social factors necessary for children's creative development.

This research reports on an out-of-school project. Blocks to creativity are systemic within the English schooling system. The project design could not be currently replicated in school due to constraints of the curriculum, timetable and inspection regime. If schools are places where, through the establishment of 'creative ecosystems', creativity can flourish, much needs changing. Alternatively, very different experiences to those in the classroom need to be offered to children if they are to develop an understanding of their own creative potential. It should be a matter of concern to all educators, especially those involved in D&T where creativity is at the heart of innovation and production.

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An Experience of a Lifetime: Teaching Design and Technology Overseas

Faculty of Education, University of Central England, Perry Barr, B42 2 SU, UK

Sarah Deeley, Kathryn Roberts, Rebecca Walker, Lorna White – Final Year Specialist Design and Technology Trainees

E-mail sj_deeley@yahoo.co.uk; kathryn.roberts@btopenworld.com; becwalker50@hotmail.com and lorna@southstaffs.freeserve.co.uk

We wish to include thanks to Claire Bhalla, trainee, who played a full part in all the activities in South Africa but was unable to contribute to this paper.

Introduction

When the chance arose to spend some time visiting, and teaching design and technology in South Africa, it was the perfect opportunity for us all to gain experience of a different overseas system and culture without committing to a lengthy exchange programme. This was not possible for any of us for a variety of reasons at this stage in our careers. The visit enabled us to teach in a school, to visit schools, to experience a teacher in-service session and to sightsee.

The three schools that we visited were very different-a rural, small town school, a township school and a school for children with physical disabilities. This variety was important to a short visit; otherwise we could have been left with a very narrow view of South African schools and the education system. Of course, we realise that even with this experience it would be impossible to generalise, but it gave us so many experiences that we will be able to draw on as we begin our own teaching careers.

This paper focuses on the teaching experience in Bredasdorp Primary School, but includes lessons learnt from the whole visit.

The Planning

Perhaps the most daunting part of the whole experience was the fact that we were not able to plan in detail what we were going to do in the school before we arrived. We are so used to preparing, in detail, medium and short-term plans for all our teaching, that to go into a new school, let alone a new country without knowing precisely what we would be doing made us feel nervous. In addition we wanted to demonstrate that we could teach design and technology successfully. We knew that we would work in two groups, one with the younger children and the other with the higher grades; that many of the children would have Afrikaans as a first language; that the children had experienced some design and technology; and that the school had a specialist room that the older children used for design and technology.

Prior to departure, we discussed different aspects of design and technology, before deciding to focus mainly on working with card and paper, linked to mechanisms. We made this decision for a variety of reasons. Even if the children had some experience of this work we could easily build on and extend the activities; it is easy to differentiate these types of activities for all abilities; all children have experience of these materials; and it was manageable to take the tools, equipment and materials needed for these kind of activities. We wanted to take most of the materials to ensure that we had what was required.

Final planning took place the night before we started teaching. By this time we had had the opportunity to talk with Anne Barnard, the design and technology leader in the school. We learnt how the subject teaching was organised, what classes we would be taking, what additional resources would be available and what activities the children had already undertaken. In addition, we fitted in a brief visit to the school, so that we could see the environment in which we would be working. The younger grades would be taught in their own classrooms, whilst the higher grades were taught in the specialist room. We were to take all the classes, approximately two hours for each session. It was decided to carry out a mini unit of work with each class, so that the children had experience of the whole design and technology process, and they were able to complete a project.

The sessions were planned so that time was spent discussing the different contexts.

For the older children we asked them to consider designing and making a flyer/leaflet to promote their town.

The main learning outcomes were:

- To understand what a mechanisms is and does and to be able to give examples from their own environments
- To design and make a flyer with moving parts

For the younger children we asked them to design and make a moving picture that showed a favourite character from a story or TV programme.

The main learning outcomes were:

- To understand what a mechanism is and does and to be able to give examples from their own environments
- To be able to design and make a picture with a moving part

Teaching and Learning

The Younger Children (aged 6-9 years)

As an introduction, we discussed the word mechanism and what it meant, before asking the children to look around the classroom and identify different mechanisms, helping to put the activity into a realistic context for them.

They were encouraged to talk about how the mechanisms moved, why they were used and how it made it easier to move things. At all times, we spoke in English but worked with the teacher to translate any of the terms and questions into Afrikaans. Many of the children tried answering in English and it was apparent that many understood the tasks but could not speak confidently in English. We hoped that they would all have past experience on which to draw as time was limited for research. We used illustrations on the board and labelled drawings to aid understanding and these turned into a reference for the children, if they were unsure of what their next step was.

We then introduced the teaching aids that we had made that demonstrated mechanisms such as hinge, lever, and slider and asked the children to match them to mechanisms in the room. They were able to see how they could be taken apart and put together again. Time was given then for children to discuss with a partner their choice of character from a story or TV programme and what movement they wanted in their picture. Although we had shown them two, three or four different ways (depending on their age and understanding) a few children saw that the movement they wanted did not match the movement they were able to get from the mechanisms that were on display. They then spent time modelling how to create the movement they wanted. Many children tried out the movement with paper first and a few went straight into production without modelling. None drew a design first. It was suggested that they complete the background to their picture first, before incorporating the moving part. This was suggested because:

- It gave us longer to talk with each child about his/her ideas and understanding.
- It meant that immediately they could work independently and we could offer support more easily when it was needed.
- The children had more time to reconsider ideas as they were drawing and talking to their partner.

It appeared that the children did really think about different possibilities and were well aware of how to make other parts of their picture move.

At the end of the session the children used their moving picture as they were telling their stories to the rest of the class. Whilst there was not time for all children to do this, they all showed their picture to a partner and explained how it worked. No formal evaluation of each one was carried out, but on-going discussion with the children as we circulated took place and some summative questions were asked to the class as a whole.

Several key points were raised from these sessions.

- The importance of the use of language and the many opportunities for its development were obvious.
- Almost all the children remained on task all the time.
- They were very proud of their work and wanted to show adults at home.
- They wanted to extend their task by incorporating more mechanisms.
- Although we did not approach the sessions in depth because of time constraints, the children did understand the purpose and user, they did design in their heads and some modelling and evaluation was carried out mainly during the time the children used their pictures.
- We constantly had to adapt teaching strategies to take account of different working environments. Rooms were laid out differently (tables in rows, in groups, individually) and children were used to working in these environments.

The Upper Grades (10-13 years)

The children were taught in a spacious specialist design and technology room; this shrank considerably with large group sizes of 50 children in some sessions! The benches allowed the children to sit in groups, thus aiding group work and discussion, though it was hard to move around the room offering individual support. We showed the children some leaflets that we had collected, showing us tourist places. We suggested that they were not very interesting for children and asked the children to think of ways of making them more interactive. They came up with the idea of introducing moving parts. We explained that we wanted them for children that we would be teaching in England in September. We allowed class time to discuss ideas for the content, whilst we talked to each group to ensure that they understood the task. The class teacher helped by translating anything that was not clear to the children. After ideas were feed back, we asked the children to share what they knew about mechanisms so that we could build on that and explain about different mechanisms to them. We differentiated by using a range of mechanisms, including different levers for the older ones and sliders, levers and spinners for the younger children. We encouraged the children to work in groups and we felt that this was something that some children were not used to doing. Some groups needed much support to delegate tasks. Throughout, we encouraged them all to use the correct vocabulary, and to think about user and purpose.

There were three of us leading the sessions and we divided up the tasks and took turns to introduce the lessons, demonstrate skills and resources and lead the plenary. Panic nearly set in when a class arrived out of turn and we were faced with 50 plus 13 year olds. However, we managed and the children worked well. This certainly gave us confidence in our ability to think on our feet, to be able to be flexible, and to use skills that we have developed over our four years of training.

Lessons Learnt

We learnt many lessons, and we each had some different ideas but we agreed that it would be difficult to put them in a hierarchy.

- Children do not need many expensive resources and equipment to learn about something and to design and make a product that they are proud of. This was further reinforced when we visited a school in Khalyitsha.

- Visual demonstrations and many different strategies for non-verbal communication helped to overcome language barriers.
- Because the children waited patiently without causing disruption to others, it was very easy to assist children almost as soon as they needed support.
- As the children were so eager to learn, contributed answers to questions, listened attentively to instructions even though they did not understand everything, it was possible for the teacher to keep the pace of the lesson going and to quickly sort out any problems as they arose. It was a delight to have so many eager learners.
- As the children had used many of the resources before and listened carefully when they saw demonstrations relating to new equipment, they were then able to make their own decisions about what they needed and helped themselves from a resource table.
- The children's finishing techniques were excellent particularly in the lower grades. The use of vibrant colour was spectacular. We need to look at the equipment we give children for colouring and the emphasis we place on a good finish.
- The children were creative, using so many different ideas with enthusiasm.

Areas for Development that we Identified

It was difficult to imagine what the environment, the children and their past experiences would be like, but looking back we can see that we could have improved in some me areas.

- Whilst we did take out some pop up cards and books, with more time we could have gathered some local examples.
- We could have made large boards with different mechanisms on, so that the children could have seen more easily how they worked.
- Whilst time was a constraint, we could have given the children more time for modelling their moving pictures.
- Large flash cards could have been made to reinforce the vocabulary that was used.
- We could have undertaken activities using construction materials if we had sent planning ahead of our visit and asked the children to bring in items from home.

Conclusions

The greatest difference for us all was the lack of planning that was undertaken before the delivery in the classroom. We all had parts to deliver but no detailed lesson plans. This was beneficial as it showed that we could still teach; we had internalised the skills necessary to support the delivery of a session; we were able to adapt to the needs of the children and change direction as necessary. Our confidence in our teaching abilities was given a boost as we realised that we could teach and enthuse the children, without always having a detailed plan. Planning is important but sometimes it is the planning, rather than the real understanding of what we are doing and why we are doing it that takes over.

We worked as real teams, all aware of each other's parts and all prepared to take over or add comments to improve the delivery of the sessions.

We all enjoyed the experience of teaching overseas in an environment that was so different to any we had experienced. We hope to build on this in our first teaching positions in September. We will be keeping in contact with the school and have some of the children's work. We hope to replicate the activities in our new schools and send over some of our children's work to Bredasdorp, hopefully creating a greater understanding of each others' values and cultures.

Design and technology is a subject that is enjoyed by children worldwide and lack of language was not a barrier to the children's learning and enthusiasm. In addition, we all felt admiration for the children and teachers, who spoke at least two languages.

Aside from the teaching experience, we feel privileged to have seen some fantastic scenery and to have met such welcoming people – this was really a unique experience.

Finally we would like to say a tremendous thank you to the head, Anne Barnard and all the teachers and children at Bredasdorp Primary School, South Africa.

Student Teachers' Perceptions of Technology Teaching in Scottish Primary Schools

Department of Educational Studies, Faculty of Education, University of Glasgow

Wendy J. Dow – E-mail wdow@educ.gla.ac.uk

Introduction

This paper explores some aspects of technology teaching in primary schools through the experiences of a cohort of Bachelor of Education students. Students in the second year of a four year degree course leading to a primary teaching qualification were issued with questionnaires following a six week placement in primary schools across a range of local authorities in the south west of Scotland. The questionnaires were designed to investigate their perceptions of the status of technology in relation to other areas of the Environmental Studies curriculum and to explore the nature of technology teaching in Scottish primary schools.

A new technology curriculum was introduced into Scottish schools in 1993. The intention was to introduce "purposeful, practical activity involving design and creativity" (SEED 1993) across the age range from 5-14 (i.e from the first year of primary school until the end of the second year of secondary). Although the technology component formed part of the guidelines informing the wider Environmental Studies curriculum, for the first time, technology was to be treated as a distinct and separate subject within the primary school curriculum.

Early research into the introduction of this new programme, however, suggested that the extent to which technology was implemented in primary schools was mixed (Black & Atkin, 1996.) This was partly a result of the fact that the whole 5-14 programme in Scotland comprised guidelines, rather than a national curriculum per se. As a consequence *"…there could be no way of tightly controlling the detail of what went on in the classroom"* (Black & Atkin, 1996 p23)

Subsequent investigations also suggested that an important factor in determining the implementation of technology in primary schools was the confidence of teachers and the extent to which they were given support in a subject for which they felt inadequately prepared. (Harlen, Holroyd & Byrne, 1995, Dakers, 2001)

In addition to this, it was considered that the complexity of the existing 5-14 Guidelines militated against their use (Dakers, 2001).

In 2000, therefore a new set of 5-14 Environmental Studies Guidelines was produced by the Scottish Executive, accompanied by a more detailed guide for teachers and managers. Embedded within these were revised materials and examples of classroom practice produced in conjunction with the Nuffield Foundation who also developed a complete pack for purchase by schools. The intention was to try to overcome the perceived problems of lack of confidence and experience on the part of primary teachers by providing support in the form of detailed materials. Several local authorities also produced their own packs in an attempt to help teachers successfully implement the subject at the primary stages. Despite these developments, however, the extent to which technology is actually being taught, and the manner in which it is being taught in primary schools in Scotland is not altogether clear. This paper attempts to explore these issues through the experience, during school placement, of a cohort of students studying for the Bachelor of Education Degree (primary stages) at a Scottish university.

An investigation of the experience of students in school placement has two main advantages. One is that it gives an indication of the situation in a wide range of local authority schools. The other is that it gives a different and in some ways perhaps a more candid indication of the status of technology within the primary school curriculum than a similar questionnaire to teachers might produce.

Methodology

One cohort of 120 students on the second year of the Bachelor of Education course at a Scottish university was issued with a questionnaire designed to explore their experience of technology in primary classrooms. The respondents had recently completed a six week school experience placement in primary schools in twelve different Scottish education authorities. During this time they had been expected to become familiar with the entire 5-14 programme and to be involved in the observation and teaching of subjects across all areas of the curriculum. The stages taught ranged from P4-P7 (approximate ages, 8-12).

Respondents were questioned about their experience of and involvement in all three areas of the Environmental Studies curriculum. A comparison of the three areas was made in an attempt to determine the relative importance awarded by schools to each. For those who were involved in the teaching of technology, some details about the nature of the topic and pedagogy employed were requested. These findings are analysed and discussed.

Results

Eighty-five useable questionnaires were returned, representing 70% of the year group.

A total of 31% of the respondents stated that they had absolutely no experience of technology being taught in the primary class with which they were involved during school placement. Respondents in this category had been involved in neither the teaching nor the observation of technology lessons. They were unaware of the existence of any classroom displays of work related to technology in the schools in which they were placed. They were, moreover, totally unaware of the subject featuring on the timetable outwith the period of their school placement. The timetables relating to the school year had made no mention of technology being taught as a separate subject. Respondents in this category had been involved in schools in six different local authorities, although 42% of cases were in one particular city authority.

A further 24% of the respondents had had no personal involvement with the subject during school placement, although there had been some evidence of technology being taught at a different point in the school year. Only six of the twenty-one students in this category was able to give any indication of what the technology topic was.

A total of 45% of the group, therefore, had been involved in either the observation or teaching of technology lessons. This compared with an 85% involvement in social subjects and 74% involvement in science.

Across the range of schools, the number of hours per week which appeared to be devoted to the three different areas of the environmental studies curriculum revealed a similar imbalance. The majority of time appeared to be devoted to social subjects with a range of one to eight hours per week. This was followed by science with a range of thirty minutes to three hours per week. The amount of time devoted to technology appeared to range from thirty minutes to two hours per week.

This imbalance was further reflected in the involvement of students in contributing to resources and worksheets or to displays of work for classrooms and schools. Whereas 66% made contributions of this type to social subjects and 59% made similar contributions to Science only 23% had this kind of involvement in work relating to the technology curriculum.

In terms of the amount of space devoted to displays, again social subjects emerged as the subject which had the most extensive displays of the three subjects. In only two schools was the largest wall display seen to be devoted to work in technology.

Thus technology emerged as the least salient subject across all areas.

Technology Teaching

Those students who had been involved in the teaching or observation of technology lessons were asked to provide some detail of the topic taught, the type of resources used, methods of assessment and the ways in which the children worked.

Along with the emphasis on practical work, there are many benefits which have been identified in relation to the teaching of technology. These include the development of creative processes, the ability to relate learning to the real world and the opportunity to promote collaborative working practices. There are also valuable opportunities to create meaningful experiences through the development of cross curricular links and to promote an atmosphere where risk taking and the acceptance of challenge is encouraged and where children are intrinsically motivated to acquire new knowledge and skills.

In a number of cases cross-curricular links were apparent, with the activity clearly designed to fit in with the social subjects topic being covered. Thus, in a number of schools, the technology lessons included such activities as making parachutes, Anderson shelters (for protection from World War II bombs), Victorian toys, Roman chariots, Jacobite puppets and Medieval catapults, according to the period of history being studied. Whilst the use of cross-curricular links is valuable, however, the technological outcome behind the projects was not always apparent, since the product appeared to take precedence over the processes involved in its manufacture.

With regards to other topics, cross-curricular links were less apparent. These included activities such as making boxes, pop-up books, board games, carrier bags and designing room settings. In these, however context provided by attention to real world links may be detected.

Technology lessons across schools clearly varied in the degree of complexity apparent both in the processes involved and in the materials and resources employed. Thus whereas the production of board games, for example, involved the use of such resources as hacksaws, wood, dowelling, paint and corrugated plastic sheeting, Victorian toys, were made using card, paper plates and coloured paper

The emphasis on creativity and the design process also appeared to vary markedly from school to school, with many tasks being clearly prescriptive and relying on kits or work cards from which the pupils worked. Some schools indeed appeared to rely solely on kits with task cards being used along with geo shapes or Lego mechanic models

Worksheets were observed in use in 46% of the schools in which technology was observed to be taught. Where worksheets were used, these were perceived as being mainly produced by local authorities. In only five of the schools were commercially produced worksheets in use. In another four cases, worksheets were produced by teachers themselves.

Within technology lessons, children were seen to be working individually, in pairs and in groups. In the majority of cases, however, regardless of the grouping arrangements, the outcome was an individual, as opposed to a joint or collective end-product. Thus although there was an appearance of collaborative working, in only a minority of instances was there evidence of pupils working together to accomplish a shared goal. Thus the opportunity for pupils to benefit from true cooperative learning was in most instances, lost.

Perhaps as a result of this focus on an individualised end product, the majority perception was that pupils compared their work with others in the class. Interestingly this was perceived to be the case whether children worked together or individually, and whether the end product was individual or joint. Only three students stated that the children did not compare work. In two of these cases, children had worked individually and produced individual artefacts, while the third was an example of group work with a group end-product. The majority of children were also regarded as competing with each other to produce the best work in the class. Again this was perceived to occur regardless of whether the outcome was an individual or group product. In only three cases were children considered to be non-competitive in relation to the finished work and all these were in cases where children were working individually to produce an individualised outcome.

In the few cases where there was an awareness of work being assessed, all but two of these were in cases where the work was drawn from packs produced by the local authority or commercially produced packs such as Nuffield Primary Solutions (Nuffield: 2002). Assessment in all cases was based upon informal observation based on criteria such as the standard of gluing, evidence of ability to follow out instructions, fitness for purpose and the general neatness of finished work. This suggests that where assessment criteria is not built in to a particular project, it will not be regarded as priority.

In all cases but one, praise was given for completed work and this was supplemented in three cases with a concrete reward.

A number of issues appear to arise from this investigation. One involves the perceived status of technology in relation to the other areas of environmental studies. Whilst the various initiatives which have been taken recently both by local authorities and the Scottish Executive Education Department appear to have been successful in raising the profile of science within the primary school system, technology still appears to be lagging well behind. This is despite the incorporation of commercial material into 5-14 technology programmes in an attempt to increase the confidence of teachers in relation to the subject. The variety in complexity in terms of both process and product also suggests that there is still much to be done in increasing the confidence of teachers in the subject. It seems clear that the level of personal interest and confidence of individual teachers is still an important factor in determining both the topic and the level of complexity of the processes taught.

Another issue involves the methodology employed in the teaching of technology. The processes involved in technology, for example, appear to lend themselves well to the use of the type of collaborative processes, which have been shown to enhance learning:

> *"Cooperative learning experiences, compared with competitive and individualistic ones, promote more positive attitudes towards the subject area, more positive attitudes towards the instructional experience and more continuing motivation to learn more about the subject"* (Johnson & Johnson p205)

Individualistic structures on the other hand in which social comparisons are possible have been seen to have a detrimental effect on children's judgements of both their own ability and the task being undertaken. (Ames, 1992)

Dweck (2000), moreover, makes an important distinction between performance goals and learning goals which is particularly relevant to technology education. If the focus in an activity is on doing better than others or meeting some normative standard, then performance goals are more likely to be adopted. When performance goals are adopted, the attention of the pupil will focus on appearing competent in the task and avoiding the appearance of incompetence. This, in turn, is more likely to lead to the avoidance of tasks which are perceived to be challenging and to giving up more easily when difficulties arise. In addition, difficulties encountered are more likely to be attributed by pupils to some global level of ability, rather than simply to the level of a specific skill at a specific time within a specific context.

Where learning goals are encouraged, attention is focused on acquiring new skills, welcoming challenge and improving on previous attempts. There is no longer a need to make comparison to the work of others. In this type of structure, risk taking, perseverance in the face of difficulty and the welcome of failure as a challenge to be overcome are more likely to occur. Failure is attributed to factors over which there is control, such as effort, or the necessity for practice leading to improved skill development. These seem particularly important goals to foster in the field of design and technology where the focus is on creativity and innovation.

Closely related to this is the evaluation of the processes involved in the technology lessons. Dweck (2000) suggests, for example, that where praise is aimed at the product of learning, rather than the effort involved in the process, then performance goals are more readily adopted. The focus then is on the outcome rather than the learning of particular skills. When the end product becomes associated in the pupil's mind with ability rather than effort, the result is the need to preserve self esteem and to continue to appear competent in relation to others. Thus in future, challenging tasks will be avoided in favour of easy ones which will preserve this sense of comparative success. In the assessment of the technology lessons described, whilst there was some focus on processes such as gluing, or following instructions, in most cases, the only form of evaluation used was in the form of praise (and in some cases reward) for the end product. Thus this procedure, combined with the individualistic nature of the activities, seems likely to promote the type of competitive structure within which performance goals will flourish.

Conclusion

This paper has dealt with the perceptions of technology of one group of student teachers during one school placement. Whilst it must be recognised that this provides only a snapshot of the school year, the overall lack of involvement in technology in relation to other areas of the Environmental Studies curriculum suggests that this is an area which merits further investigation. There is also evidence, that whilst the materials and resources may be available within schools, there are issues arising from both the extent to which, and the ways in which these are being utilised. Addressing these, issues, along with the pedagogies and evaluation methods adopted seems to be essential if the full value of the technology curriculum is to be recognised in Scottish primary schools.

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The Pro EdaDe Program

PUC PR – Pontifícia Universidade Católica do Paraná UFPR – Universidade Federal do Paraná
CEFET PR – Centro Federal de Educação Tecnológica do Paraná, Curitiba / PR / Brazil
Dr Antônio M Fontoura – E-mail amfont@matrix.com.br

Introduction

We have, since 1999, been developing a research project that we called "EdaDe – Educação de crianças e jovens através do design" [Children and young people education by design]. It was begun in the Production Engineering Post Graduate Program of UFSC – Universidade Federal de Santa Catarina, Brazil. The main aims of this work were: to investigate the pedagogic potential of design activities, to study the educational basis of design activities, to study international experiences in this field and to build a Brazilian model of design education for our primary schools. It resulted in a doctoral thesis that was presented and approved, on July 11, 2002. Since then, we have focused our efforts on applying its results and to continuing the research. Among the results we will highlight are: the development of a theoretical and pedagogical basis to EdaDe; the elaboration of a strategic plan to implement an experimental and complementary program to teach and to learn by design; and the design of a Centre to study, to research and to promote the EdaDe, presented and proposed to the Faculty of Design of PUC PR – Pontifícia Universidade Católica do Paraná.

What is EdaDe?

Design is much more than a profession. Some people think it is a kind of art; to others it is a pure technical activity that is trying to attain a scientific status and that solves human problems. In a wider point of view, it can be considered as a family of professions that make and transform environments, objects and services. It can still be considered as an element of social transformation and of culture construction. However, above all these ideas and behind all of them, design appears as a kind of thinking and as a way of leading thought. It can be taught, learned and practised by anybody. Following this argument, design activities can be used as a powerful tool to teach, to promote learning, to develop skills, abilities and to build knowledge and understandings. Thus, the EdaDe is characterised as a smart and creative way to teach and learn, that uses the design thinking and design activities associated with technology.

We think that EdaDe is more than a simple didactic resource or a teaching method. It incorporates an educational philosophy; in other words, it is a way to think 'education' and at the same time, a way to do 'education'. It is a pedagogic proposal and a new way to reconsider the old and sometimes fragmented educational practices in our schools. EdaDe emphasises the use of design activities.

It is important to remind ourselves, that we are speaking about Brazilian educational reality. There is a tradition to use of industrial arts, crafts and other manual activities in Brazilian elementary school but EdaDe or D&T is still a very recent idea in that context. Teachers, co-ordinators and the staff of our primary schools hardly know anything about it. For EdaDe to be known, it should be published, promoted and formented. Some schools have already adopted Technology in their curricula but the relations between Design (as thinking) and Technology (as doing) are unusual in them. When Technology appears, it is more closely connected with Science. In spite of their interdisciplinary intentions, the connections between Art, Design, Technology and Science are almost always neglectful in our schools. Frequently Technology is associated with Information Technology (the use of the computer in the classroom), sometimes with robotics, but rarely with Design (creation, conception, development of products, systems, etc.). In reality, there still is an ignorance about Design in our society and consequently in the our schools. Our design culture is in a development process (slow but continuous). Officially, our designers are graduates from universities or colleges, only since 1963. Before that time, they had different qualifications, they were architects, engineers, artists, technicians and self-taught professionals. We believe that our design culture will be built more quickly by our new generations. The EdaDe can contribute, in a significant way, for this.

In this paper we would like to present the main aspects of the program.

The Pro EdaDe Program

One of the most important practical results of our doctorate work, was to organise a Centre to study and research the EdaDe in Brazil. We are progressing and we are trying to transform this idea into a reality through a proposal of work that we called 'Pro EdaDe program'. We use the word 'program' because it refers to a group of organised, planned and co-ordinated activities that will be realised by the new Centre's staff. The word 'program' was used as 'a plan', as 'a project', as 'an intention'. The prefix 'pro' was used to indicate 'in favour of', 'for'. And 'EdaDe' is the abbreviation of 'Educação através do Design' [Education through Design]. The program is limited and has a local and institutional ambit, but it aims at a national performance. At least, in Portuguese it is grammatically correct [Programa pró EdaDe].

Main objectives of the program:

Among the objectives of the 'Pro EdaDe program' is the establishment of a Centre for EdaDe, where we will pursue:

- The development of new researches in this field in Brazil;
- The promotion of the scientific initiation of undergraduate students;
- The improvement and training of primary teachers;
- The improvement of researchers;
- The promotion of collaborative and interdisciplinary work (interdepartmental work);

- The development and experimentation of new resources and didactic methods to EdaDe;
- The development of resources to promote and publish the EdaDe;
- The promotion of collaborative works with other Centres and Institutions.

Justification

EdaDe creates opportunities to involve children and young people in oriented activities, in a generic way, called 'design activities'. Those activities are promoted in well defined contexts and they use, develop and forment some skills and essential abilities to the children's integral education. They integrate knowledge from several curriculum areas.

The design activities can appear formally inserted in the primary curriculum, as happens in the English National Curriculum and in other educational systems. They can appear informally, as in some programs promoted by museums, foundations and cultural entities. They can also appear as non formal programs, as complementary actions that integrate curriculum subjects and their contents. As it is known, in Brazil, we still do not have formally (documented, official, curricular) experiences. We have only some informal experiences, developed separately and discontinued by just a few researchers (Guedes, 2002; Fontoura, 2002; Bordenouski Filho, 2002; Bueno, 1999; Medeiros, 1990).

Through the research that was done, the pedagogic potential of design activities was made clear. When they are well used in the process of children's education, they make possible the building of new knowledge and understandings, they promote active teaching and learning, develop mental and physical skills, promote the examination of the values of our material culture, and they explore critical and creative thinking. Then, we believe that EdaDe should be also an integral part of Brazilian children's education. In the short term, we believe that EdaDe could be put in practice through complementary and non-formal programs.

As a consequence of the EdaDe application associated with other curricular experiences (by formal or non formal way), we believe that our children will be better prepared to interact with the rapid changes that occur in the contemporary world, to meet the challenges; to understand the influences of art, design, technology and science in our lives, and to participate as an active, conscious and responsible citizen, in world changes.

In a more pragmatic way, design activities, when they are used to educate children, support the development of a capacity to make and build things. Children develop the reflexive capacity to think about what must be done or about what has been done. Finally, design activities develop the capacity to imagine, create, conceptualise, adapt and invent things and ways to do those things. Repeating the seemingly and nonsensical sentence, we can say: 'Design is to design a design to produce a design' (Heskett, 2002, p.5).

Projections and Repercussions

We think that the proposed Centre should be created in a higher education institution that has undergraduate courses in Education and Design. We proposed this program to PUC PR and it is being discussed.

To create a Centre in a University or in a College, provides the possibility of placing it in the national vanguard of Education through Design. Besides this, it transforms the Institution in a model to be followed by others in this knowledge area.

To establish the Centre means to create opportunities to make future exchanges and national and international agreements with other institutions. It represents the possibility to extend University action in the community. Moreover, it is a way to obtain some official financial resources. (We must think of its maintenance).

Internally, the Centre presents the possibility to promote and improve the scientific production of undergraduates and it can promote graduate researches. It makes possible interaction among academic departments and it allows the consolidation of new research lines in the Institution.

The consolidation of this Centre becomes possible with limited investments when compared to other research fields – the relationship between the cost and the benefits seems very good. Its repercussion will be very positive in the academic environment. We should remind ourselves that several resources are already available in PUC PR. There are good relationships and connections between the Faculty of Design and the Faculty of Education. The PUC PR offers a graduate course in Education (Master in Education), degrees of Bachelor in Education, in Design (Graphic Design and Industrial Design), in Architecture and in some Engineering fields. It has some lecturers and professors qualified to guide and develop researchers. It already has a necessary minimum infrastructure in the Faculty of Design (e.g. offices, work rooms, internet connections, computers, telephone, fax, and support laboratories).

Another important aspect that must be evidenced is that Brazilian designers were never concerned with education issues. On the other hand, teachers and educators were never concerned with design issues. EdaDe promotes the approach between the Design and the Education. The Centre will be able to contribute to this.

The role of the main activities that will be undertaken

The main activities will be:

- To structure administratively the Centre as a interdisciplinary place to study and learn about EdaDe in PUC PR, close to the Faculty of Design;
- To search for and obtain external financial resources;
- To develop joint activities with other Faculties and University Departments;
- To make connections (agreements) with other institutions and centres (national and international) that promote education by design and technology education;
- To promote workshops about EdaDe for educators, designers, graduates, teachers, parents, children and young people;
- To promote internal and external lectures and meetings about EdaDe;
- To participate in national and international events (congresses, symposia, meetings, fairs and exhibitions);
- To produce materials (books, papers, study aids, materials to teaching training, etc.) to promote the EdaDe;
- To research new methods to teach and learn through design activities;
- To structure optional courses (subjects) about EdaDe that will be offered in degree curricula of Education and of Design;
- To publish reference material about EdaDe; and
- To promote courses and teaching training.

Description of the expected results and the beneficiaries of Centre's activities

Expected results:

- Consolidation of the first interdisciplinary Centre to promote, forment and develop researches about primary education by design (and technology);
- Development of EdaDe in Brazil;
- Educational qualification in EdaDe in Brazil;
- National projection of the Centre as a promoter of education by design;
- Publications about and by EdaDe;
- Elaboration of didactic materials; and
- Offer of some educational services and sales of educational materials.

Beneficiaries:

- Pupils and teachers in primary schools, initially, from Curitiba town (the Capital of the State of Paraná) and its metropolitan area;
- Undergraduates of Design and Pedagogy (Bachelor in Education) from PUC PR and fother High Educational Institutions.
- Researchers (Masters students, PhD students, educators, designers, lecturers and professors) that will find in the Centre, space, resources and appropriate support for the development of new researches in this field; and
- Primary schools and the educational system (public and private).

Infrastructure, services, institutional support and the staff necessary to begin the works:

Facilities:

- A co-ordination room;
- Classrooms;
- A lab of material, structures and models (equipped);
- Telephone, fax and internet connections;

Services:

- Administrative services (a clerkship service);
- Access to library services;
- Access to copy and print services;

Institutional support:

- Support of Design Faculty Chairman;
- Administrative support of Institute of Exact Science and Technology Dean;
- Academic support of the PUC PR Rector.

The staff:

- A research co-ordinator (from PUC PR);
- A vice co-ordinator (from PUC PR);
- Collaborators (lectures, professors and researchers form PUC PR and other institutions);
- Grants holders (PIBIC or of another kind);
- Trainees (undergraduates of the Faculty of Education and the Faculty of Design).

Demand for resources and equipment

Initially:

- Information technology equipment (personal computers, a printer, a scanner, a CD recording, software, a digital video and photographic camera, etc.);
- Complementary equipments and tools for the laboratory of materials, structures and models;
- Usual materials and equipments for practical activities and workshops;
- Eventually transport expenses;
- Specific bibliography and a technical material collection;
- Examples of didactic materials.

Conclusion

In spite of its size and its initial limited aims, we believe that the Centre will be a very important initiative to start and to promote the development of EdaDe in Brazil. It cannot be the only initiative but certainly it is very necessary. We believe that the Centre will be able to help and consolidate some non-formal and informal programs of education through design for our children, immediately. Let us hope, in the future, that the Centre will be able to participate in the implementation of formal programs of EdaDe in our elementary schools. We have a huge task in front us and certainly, we will need good partners. The new Centre will be open to those who want to collaborate with it. We are aware that we must work hard to consolidate this idea in Brazil but it is very challenging and always motivating. We are enthusiastic because almost everything is still to be done in this field in our country.

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Between Prescription and Reality, the Pedagogical Situation

UMR ADEF, IUFM Aix-Marseille, Marseille, France
Jacques Ginestié – E-mail j.ginestie@aix-mrs.iufm.fr

Introduction

We can describe technological problems as an interaction between a social need and a social group: to become a problem, the need must be identified and described as not satisfied. The identification and description of the need involves the social group, the context, the environment, the purpose and the constraints. This description can be specified or largely implicit, but, in either case, there appears, on the one hand, the user's need and, on the other hand, the problem to solve. This is the starting point of the process for putting on the market a new product, organised in different steps, articulating design, production and use. Solving this problem brings on to the market a new product that answers the initial need's description.

Many countries adopt this process when implementing technology education. The aim of this paper is to present how this implementation appears in the French curriculum and how teachers organise pedagogical situations. Through some examples from research, we try to characterize the distance between the prescribed curriculum and the real curriculum and, from this point, we look at the importance of organising pupils activities. The methods used to understand these interactions between prescription and reality are based on task analysis and activity analysis.

France, as the UK, started Technology Education (TE) in the middle of the eighties. I explained in the last CRIPT conference the idea we have in France about developing subjects through a general approach at primary school level. The aim of this paper is to analyse aspects of this implementation identifying strengths and weakness. It is evident to say that technology education has not a great place in French primary school. This fact is due to a variety of different causes including the profile of teachers (a large majority are from literature for human science courses and not scientific or technological courses), the general devaluation of technology knowledge in French schools and French society, and the general decrease of the number of students in scientific or technological university courses (Ginestié, 1996a, 2000a). Over these general and external causes, we discuss this through our research interests about the teaching-learning processes and about the pedagogical organisations implemented for the transmission, and the appropriation, of this specific knowledge field of TE. Classically, we work here on two kinds of research: analytic (to account for what it happens) and prospective (to think of new organizations, new situations or new plans). This research takes place within the framework of the didactic disciplines, not in the English sense that is pejorative, but in its French meaning that defines the study of school organisation as a specific field among all the research about education. We adopt a sociological perspective finalised by the needs of teacher training and the teaching process. This orientation has some consequences on developing work from the viewpoint of research objects, methods and methodologies, and theoretical fields. (Ginestié, 2000b).

We start from narrow bonds and, therefore, interrelations that exist between the matter to teach and the manner to teach it. Looking at conditions of study in technology education allows us to understand the scholastic organization's impact on the pupils' learning and allows us to think of new plans to constitute resources for teacher training or for teaching. We do not consider the distance access of these resources as a principal aim for our research; we do not study the question of the accessibility as such, but we use existing work and advances undertaken in others frameworks. My presentation introduces some of our work, specifically those concerning primary education. Remember, if we want to make a correspondence between Britain and French school system, that primary school is divided in two schools, nursery school (for pupil from ages 3 to 6) and elementary school (from ages 6 to 11).

Conditions of Study in Technology Education

An analysis of the conditions of study of TE's knowledge supposes, in terms of questions for research, a strong agreement with two points:

- There is some thing to study in technology education;
- There would be multiple study conditions, perhaps different.

These two points don't make evidence, specifically if we speak about TE at the primary school level (as suggested by the introduction presentation of this conference) and, more specifically, if we consider the French political situation. A majority opinion is that TE is simply a kind of mix between handicraft activities and elements to highlight vocational training choices (Ginestié, 2000a). All the knowledge comes from science and TE is only a question of activities or applications. Evidently, open investigations field from the above mentioned entry with the two indicated points reflect some political and philosophical postures. This entry organises, in our laboratory, much research, beyond technology education, that study the social functioning of scholastic situations as descriptions of interactions between the three actors of this situation: the pupil, the professor and the knowledge. My purpose is to retrace an historical perspective of this current of research in didactics through some key spots. We can thus notice the specification and identification work that operates in this process of scholastic institutionalisation. School institution is characterized as the placement of interactions, surely tensions, between these three poles. As soon as we wish to describe these interactions, we are confronted with a problem of methodology, methodology that derives of course the framework in which place our study. Thus, analysing the conditions of the

study is going to concern us in what the school institution puts to the study and the manner whose this study functions. This crossing of analysis rests on the articulation between task and activity:
- The task is significant to the knowledge put at stake in the elaborated situation by the teacher in the framework that is fixed (curricular organizations, conditions of exercises, particular constraints, etc.);
- The activity is significant to the work undertaken by the pupil to progress in the task that is appointed it by the teacher and representative of the knowledge's learning process.

It concerns us to define a framework of analysis that allows looking at the functioning of a teaching situation. I have undertaken these analyses in my thesis for more than ten years, concerning the teaching-learning process of concepts about description and design of automated systems with a specific technical language, the GRAFCET (Ginestié, 1992). The initial framework, elaborated by these analyses method, does not prejudge the:
- Knowledge put at stake, their presence or not and their school form;
- Organizations elaborated by the teacher so as to organize conditions of the study of these knowledge;
- Activities developed by the pupil that are induced by the organization put in game for this study.

These two cross analyses, task and activity, allow characterising interactions that exist between three complementary existing logics but that can also appear as rival: the logic of subject, the logic of teaching and the logic of learning. The first one follows from knowledge organisation and requires an epistemological study; the second one takes in account the professional activity of the teacher considering his organisation, his style, his manner to do, the professional gestures he develops; the last one can be highlight by the learning theories, specifically the viewpoint of socio-constructivism theories. I do not plan to develop more these three logics as many works have shown the incidence of these logics in the school situations and how they are inscribed in different references and different temporality. In fact, stressing these three logics in a school institution can be looked at in different manners; some what concerns us, in my team, we are interested really only in what it happens in a class. In other words, we try to look and to analyse effects produced by this placement in tension (Ginestié, 1996b).

On the one hand, this approach allows for the identification of organisational and structural elements that act and interact in the process of teaching-learning. A first distinction in the two terms of this process allows situating the task as the preferential expression of the teaching's logic. It concerns to express simultaneously what is at stake, the context in which it is situated, what it is waited and what it is necessary that the pupil makes to achieve the task. In this senses, the task is a concentrated expression of a totality of values, models, elements of theories, knowledge that base the subject's references and that identify the teacher in a teaching population. The analysis of the task is therefore significant how curriculum is implemented, in the particular intimacy of a specific class. It is equally significant activities that it induced at pupils. According with numerous analyses, we can investigate a significant part of the distance between the prescribed curriculum and the real curriculum. This distance is based on epistemological, curricular, didactic or pedagogical presupposition that task analysis allows characterising (Ginestié, Brandt-Pomares, 1998).

On the other hand, the passage to the real supposes to put in place an analysis of the activity of the pupil. The pupil's perusal of the task, the manner he has to organize its activity and to orient its actions, what it takes in consideration and what it does not see even, allow characterising his learning process. In this perspective, we can notice difficulties that he meets, the manner whose he processes them, adopted strategies and the planning of his different actions (Ginestié, Andreucci, 1999). Reading activity through the description of the task allows proceeding pupil's activity with some precise characteristic elements of the task. We can value difficulties met by the pupil and identify which are relevant to the context (the formulation of the task, the organization of conditions of the study, the use of models, materials, etc.) and which notices obstacles to the learning (Amigues, Ginestié, 1991).

Analysing conditions of study in technology education allows us to notice, identify and characterise gaps between prescription and reality, that this is to the micro level or to the macro level. That entered in an open adjustment perspective of conditions of the study to the breadth of the didactic organization impact on processes of transmission and acquisition of knowledge (Amigues, Ginestié, Johsua, 1995).

School Organisation and the Work of Pupils

Organizations implemented at school, in the classroom and by the teacher have a direct influence on the work of the pupil and on the result of their work. Concerning technology education (but this is not specific to these disciplines), it is important to specify and define what is important to the pupil, recourses he disposes to get there, the manner in which he gets there and therefore the evaluations of the breadth of the goal and the nature of the goal or the manner to get there. It is in discussing this intimacy between goal, means and manner that we are interested in the process of transmission-appropriation of knowledge in technological education. We do not situate in a curricular approach that has for object to define contents of teaching and to determine goals to reach; we discuss goals fixed by the institution, their institutional pertinence, their coherence in a scholastic organization datum. In fact, the debate between prescription and reality imports us only as soon as the characterisation of gaps instructs us on the reasons of these gaps. Of course, the temptation is great to believe that we could have act on prescription as to reduce these gaps. The evolution of curriculum shows that this kind of actions is limited because it enters in social negotiations that the research can illuminate to defect to inspire them, even to affect them. Looking process of teaching-learning rests, whole at least in works behaved to Marseilles, on the crossing between an anthropological approach and a didactic approach (Ginestié, 1998; 2001a).

The anthropological approach allows registering knowledge in a theory of the activity and in a social field identified. The evoked articulation above between task and activity is incomplete if we do not speak about the manner to make. The manner to make relieves of the technique employed by the person to realise the task, that it is appointed by the situation or by himself. The articulation between the task and the technique defines a know-how that expresses the manner to realise a determined task type (Ginestié, 1995). To get off this private organization either to account for the activity, or to clarify the manner to make, supposes the utilisation of a linguistic mediator. To tell the manner to make necessitate proceeding to an extraction of the individual praxis to elaborate a praxeological organisation, significant of the manner to realise the type of tasks and the context in which these tasks are registered. In fact, it concerns to give the senses in the typical articulation between tasks and techniques by elaborating a field of meaning in connection with a technology, perhaps with a theory. It is this elaboration of meanings on the practice that defines, in the anthropological perspective, knowledge. This approach allows rendering account organisations of knowledge as relationships between praxis, taken in the senses of the activity oriented to a finality, and a field of significations that allows referring practice to a technology and/or to a theory (Ginestié, 2001b).

To return to school organization, the problem is not the transposition of praxis but the transposition of praxeological organizations. It is not difficult to ask to pupils to make something, but it is to allow them to construct the meaningful on what they make. This question of the transposition of praxeological organizations can be looked in an epistemological framework according to curricular organizations or to the breadth of didactic situations. The epistemological entry is interested in the nature of knowledge (well obviously in the evoked anthropological perspective above) and to the demarcation of a field of reference (Ginestié, 1997). This question makes the object of some debates on the international scene. We can display some conceptual fields that we work in Marseilles so as to drive, on the one hand, analyses of tasks proposed to pupils and, on the other hand, a more prospective manner, to design plan for the usage of the teachers' training and/or the teaching. Thus, some articulations allow to think these fields, objects to know that are fastened there and the manner of which they are or been able be, taken into account in the framework of a technology education:

- The world of technical objects, their mode of existence and social organizations by and in order that these objects exist so as to register the technological education in the human and social activity field;
- The articulations between functioning, function, structure, form in the senses of a lighting of interdependences and the different manners to describe an object;
- The articulation design, production, utilisation notably for marks given on process put at stake in each of terms, but equally, of a more global manner, either in a specific approach on an object, or from an evolutionist viewpoint, in a perspective of an history of technical activities;
- The articulation object, activity, language in an ergonomic inscription (from the thing to the object, the object to the tool, the tool to the instrument) as revealers of the bonds between gestures and techniques, techniques and technologies. The report to techniques is thought in this framework as a demarcation; the report to languages notices the elaboration of symbols (in a relationship meaning, meant) but equally tools to think the world of technical objects and to act in this world.

Well obviously, this qualification of fields is a bit coarse, it needs to be specified, notably if we want be able to read existent curricular organisations, perhaps to propose evolution of these organizations. In this perspective, we focus some investigation on the curricular approach in the way of knowledge's organizations for purposes of teaching. A recurrent object in this kind of works rests on the comparative study of different curriculum in act in different countries or school structures, according with the organization of the education in the examined countries. This approach is not simple, mainly by reason of practical difficulties that fasten there. We have to work on original texts that put the problem of the language and the comprehension of the context. Then, it is certainly more relevant to research what is common in first perusal, what emerges as common beyond first appearances and on what play really distinctions. The temptation to research differences at all costs relief of a larger temptation of valorisation of these differences, the risk to tell it is better here that elsewhere. In other words, it is necessary to keep to privilege a particular idea of the technology education to understand installation organizations in others country or in others institutions. Finally, the question of the methodology is essential. Beyond cultural and linguistic questions, to notice common grinds, what there is similar supposes to elaborate a grille of perusal so as to notice references, epistemological choices, the manner whose these choices are translated in teaching objects, according to what articulations, in what progression, with what presupposed on interactions in the class, on modes of organization of the class, on the activity of pupils in reference to what model of the apprenticeship.

Furthermore, the curricular entry is envisaged in our works as one of the stages of the didactic transposition process: that the placement in text of teaching objects in an prescriptive aimed that has to organize the teaching activity, to the breadth of the production of these teaching objects in the framework of the class to elaborate some objects of study for pupils, objects of study that are going to determine activities of pupils. This placement in text defines the matter to teach and induces the manner to teach it.

The entry by didactic situations is the most largely worked in the team that this is an analytic viewpoint to render real situations of classify or in a prospective perspective to think possible evolution. I have already given some indications on the framework used in this approach to the breadth of the utilisation of the crossed analysis task-activity. If we advance a bit in this question, the analysis of the task allows to account for the placement in text (or the placement in word) of the object of study. This placement in text constitutes one of the last stages of the didactic transposition, stage in the course of which the teacher anticipates and executes the production of the object of study that it makes return in its class. Many indicators allow to characterise some ingredients of the organisation that it counts to put in place:

- The nature of knowledge that he exhibits,
- The display of the result expected at the end of the sequence,
- The spatial and temporal organization type that he puts in act,
- The strategies that he gives to orchestrate the activity of pupils,
- The different levels of evaluation on which he counts to lean (evaluation his activity, the progress of his sequence, the activity of pupils, the breach of results),
- The devices of mediation and remediation that he envisages,
- etc.

Others indicators allow to notice explicit or implicit models that he uses for the organization of this production:

- Model of the logic of pupil learning organized around acquisition of competence noticed to the breadth of significant observable behaviours versus a constructivist approach based on the elaboration of knowledge;
- Model of the activity of pupils according to a logic of smooth away difficulties versus a logic of confrontation to obstacles;
- Model of the teaching organisation according to a logic of guidance of the action of the pupil versus a logic of problem-solving;
- Model of the organization of knowledge references that one can caricature in a binary alternative: in technology education, there is nothing to know versus there is only knowledge.

The construction of these models supposes the elaboration of a theoretical reference strong that allows to think laws of appearance of objects of study and to become them in school organisations. There are of course risks of viability in the instant of the class, the course that is going to unfold here, to this hour; there are also risks of viability in the duration of the class, in the articulation of sessions between they and in their succession with recurrent risks of progression; there are finally risks of viability in the durability of a teaching at such level, in such class, in such context with risks of evolution, development, interaction with the other disciplines, general educative ecology.

The analysis of the activity, as for it, tries to understand the logic of pupils in their evolution to achieve the task that is confided them and the manner of which they adapt conditions organised by the teacher. Retained indicators refer directly to theories of the apprenticeship, notably in:

- The strategy they adopt,
- The manner to organize their actions,
- The manner to notice and to anticipate difficulties and to overcome them or to avoid them,
- The manner to notice or not constraints imposed by the situation and to take them into account them or not,
- etc.

Analysing the activity of pupils is a powerful tool that allows to notice, to qualify and to valorise gaps between what the teacher waits them, what they obtain really and the manner that they use to reach this result. It concerns, on the one hand, to give indicators of efficiency of a device concerning learning and, on the other hand, indicators on the manner to conceive plan. To adopt a criterion of efficiency of plan put in place by teachers is not easy. That supposes to place the question of the acquisition of knowledge by pupils to the heart of the educative act, what is not without consequences.

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Anchén
Graad 2.1
Klaswerkboek

Primary Students Grappling with Systems in Design and Technology

Centre for Mathematics and Science Education, Queensland University of Technology
Victoria Park Road, Kelvin Grove QLD 4059, Australia
Ian S Ginns, Stephen J Norton and Campbell J McRobbie – E-mail i.ginns@qut.edu.au

Introduction

The importance of studying systems in design and technology has been acknowledged in curriculum and policy documents worldwide. However, more research into students' learning of key content and processes in design and technology is required. Upper primary school students' acquired understandings of concepts embodied in the Systems strand of a technology syllabus are reported in this paper. Qualitative research methods were used to examine the activities and discourse of the students as they engaged in a technology unit of work, which focused on the design and construction of a variety of systems. Data sources included video and audio recordings of classroom interactions, students' notes and drawings, and student interviews. As the unit of work progressed, changes were noted in students' abilities to identify the components of systems and analyse how the components worked together. Student learning is benchmarked against the relevant prescribed learning outcomes of a technology syllabus.

Curriculum developers in many countries have drawn attention to the importance of systems in technological artefacts and processes. In Queensland, Systems is recognized as an identifiable syllabus strand and is defined as "a combination of components that work together to achieve a specific purpose or goal. Systems consist of inputs, processes and outputs. System components may function in simple or complex ways," (Queensland School Curriculum Council (QSCC), 2002, p. 16). Similarly, the importance of studying systems is also acknowledged in national statements such as Standards for Technological Literacy (International Technology Education Association, 2000) and A Statement on Technology for Australian Schools (Curriculum Corporation, 1994). Research into students' understanding of systems will enable teachers to capitalise on the presence of systems all around us in our increasingly technological society and foster students' capabilities such that abstract principles, theories, or models, are evident in their discourse and activity.

Theoretical Framework

Cajas (1999) and Jones and Moreland (2000) argue that one of the foci of research in technology needs to be on students' learning of key technological ideas and processes at the more abstract levels. However, studies conducted so far (e.g., Bennett, 1996; Davis et al., 2002; Gustafson et al., 1998; Levinson et al., 1997; Roth, 1998), indicate that students' understandings are generally at a descriptive level relating to specific artefacts. There is little extension into thinking at a level where principles, accepted theories, or models, are evident in their explanations and decision-making

Limited research has been conducted into primary school students' understandings of concepts embodied in systems in technology. Several papers have discussed respectively the nature of information systems (e.g., Lievrouw, 1994), and the emerging need to study technology because of the increasing complexity of systems (Hoepfl, 1998). Chen and Stroup (1993) proposed that several dimensions of systems theory make the unification of technology and science education a possibility in classrooms. The dimensions they described were: a system – interacting parts operating as a whole; change – transformation with time as a referent for change and dynamics; feedback – provides mediation between the goal and system behaviour; and interactions – the input and output of matter, information and energy. These dimensions are clearly evident in the definition of systems provided previously (QSCC, 2002), and are also evident in core learning outcome statements for the Systems strand of the same syllabus document (Table 1).

Table 1

Level	Core Learning Outcome Statement
1.1	Students identify familiar systems and describe how these are used in everyday life.
1.2	Students sequence steps to develop simple systems to carry out familiar tasks.
2.1	Students identify and describe the order of components in familiar systems.
2.2	Students combine components to assemble systems in order to meet their needs and the needs of others.
3.1	Students identify and describe relationships between inputs, processes and outputs in systems.
3.2	Students assemble and trial systems they design by considering inputs, processes and outputs.
4.1	Students identify and explain the logic of systems and subsystems.
4.2	Students incorporate feedback to refine and modify systems and/or subsystems.

Systems Strand – Core Learning Outcomes against Level (QSCC, 2002, pp. 32-34)

The core learning outcome statements describe what students know and what they are able to do with what they know as a result of technological activity. Levels are indicative of the progression of students' understandings and capabilities from Grades 1 (Level 1) to Grade 7 (Level 4) of Queensland primary schools. The dimensions provide an interpretive framework that can be used to make judgments about a student's ability to identify system components and the interactions between the components and systemic behaviours. In addition, the framework can facilitate the matching of students' relevant understandings with the syllabus core learning outcomes.

The aim of the study was to investigate primary school students' understandings of concepts embedded in the Systems strand of a Technology curriculum, as a result of engagement in meaningful technology learning experiences.

Methods and Techniques

An interpretive research methodology (Erickson, 1998) was utilised in order to understand the meanings and purposes that the participants attached to their activities (Guba & Lincoln, 1989). Trustworthiness, authenticity and the benefits of the hermeneutic process were the criteria for quality interpretive inquiry. Multiple data sources maximised the probability that assertions were valid.

The participants in the study were a whole class of Grade 6 students, approximately 30, in a Brisbane primary school. For eight weeks, the class engaged in a technology unit of work consisting of learning experiences of approximately 2 hours duration per week. The classroom teacher prepared and implemented the unit in consultation with the researchers.

During the first four weeks, the students explored a number of simple systems, for example, bottle diver; telephone system; gears; pulleys; and sub-systems on a bicycle. The students worked on the construction of robots from the *Lego Mindstorms – Dark Side Developer Kit* for the remainder of the time. The robots included a motor, light sensor and simple feedback response programs. A moving robot could be programmed to respond to a beam of light, for example, stopping, stopping and pausing before continuing, or stopping and reversing. The students worked in groups of three.

Data Sources

All students were interviewed in order to determine their prior understandings of concepts embodied in systems. Each participant was asked to identify the components of a hand cranked model generator and describe how those components interacted together to produce light, and then asked how she or he would modify the generator so that light of constant intensity was emitted from the bulb. The interviews were videotaped and transcribed in full.

Six focus students, representing a range of understandings of systems evident from the initial interviews, were purposefully selected (Guba & Lincoln, 1989) for in-depth study using video and audiotaping during the technology unit. The in-depth component of the study enabled us to observe the actions of the six focus students and record the fine-grained details of the discourse between the focus students, other students in the class, and the teacher. Other data sources included observations of classroom activity, and each student's logbook of her or his involvement in the learning experiences such as drawings, descriptions of stages of construction, descriptions and results of tests on constructed artefacts, and appraisal of artefacts.

All students were interviewed for a second time at the completion of the technology unit. Salient portions from the interviews, videotapes and audiotapes, which contained evidence of students' use, or development of concepts embedded in systems, were transcribed. The data were analysed to determine if students' understandings were at a descriptive/artefact level (e.g., Level 1 – Table 1) or if they could demonstrate reasoning in terms of the general components and interactions at an abstract/generalised level (e.g., Level 4 – Table 1). All names used are pseudonyms

Findings and Conclusions

Important findings related to primary school students' understandings of systems are summarised briefly below.

Data from the initial interviews indicated that most of the students, exemplified by Clarissa's response, were able to identify and describe several components of the hand-cranked generator by pointing at the components and describing them in sequence.

> *Well there is a crank, and a magnet, there is north and south, there is a crank and it winds around and makes the whole thing go, there is a light bulb and there is some wiring, some metal coils.*

Some students were able to refer to the interactions as the model was being operated. However, explanations were at a descriptive level with little evidence of abstract thinking, for example, attempting to explain what might be happening, in terms of inputs and outputs, when the wire coil was spinning in the magnetic field of a horseshoe magnet. Overall, the students did not appear to view the components of the system as part of an integrated whole.

During the technology unit, the students engaged in investigations of the nature and properties of materials, and developed knowledge of design practice, which included the establishment of design criteria for the construction of artefacts. At the same time, they were challenged to identify the components of systems present in the artefacts they were constructing or examining, and describe the relationships between inputs, processes and outputs. Changes in students' ability to identify the individual components and analyse how they worked together were noted. An exemplar of this change may be seen in a statement in one focus group's logbook about the propulsion system of a bicycle, "When you peddle (sic) the cog rotates, and the chain goes with it, making the tyre rotate as well. The input is the leg moving the peddle. The output is the wheel rotating," (Alice, Kate, Suellen).

In the open-ended problem solving task, the students designed and constructed robots incorporating a basic feedback system. They also developed and tested designs and continuously evaluated the results of the tests in order to improve the operating performance of the robot. The students reported accurately the design of the components responsible for a robot's movement, for example, the configuration of cogs needed to turn wheels, or the interactions of cogs and cams to move legs. They conjectured about the role of the sensor in providing feedback for the response programs to initiate movement, stopping, or changing the robot's direction of movement.

Data from the final interviews revealed that students possessed improved capabilities for designing, analysing, and evaluating systems, and were able to demonstrate reasoning at a more abstract/generalised level. Most students saw a link between the sensor, as a source of feedback, and subsequent system behaviour, in terms of the interacting components, as evident in the Cameron's statement.

The output was going backwards, there was an interaction of all the little bits and pieces (cogs and cams) to make it move. The motor turns the cogs, and the motor spins faster than the cogs, the cogs make these little bits (cams) move, one one way, the other the other way and they are joined onto the legs that make it work.

While not all students could give as detailed an explanation as Cameron, the level of explanation was improved compared to the explanations provided in the initial interviews.

Benchmarking Understandings Against Core Learning Outcomes

At the end of the technology unit, all groups were able to identify inputs and outputs, identify components of systems, and speculate about the dimension of feedback and its usefulness in systems. The students could also identify and describe systems in the world around them where control was evident, citing examples including thermostats in air-conditioning or refrigeration systems, burglar alarms, and fire alarms. Few students could demonstrate these capabilities at the commencement of the technology unit. It is reasonable to conclude, therefore, that most students demonstrated attainment of the level 3 core learning outcomes (Table 1) – students identify and describe relationships between inputs, processes and outputs, and they can assemble and trial systems of their own design. Field notes and videotape evidence revealed that some students (e.g. Alice) may have attained the Level 4 core learning outcome for systems – students can identify and explain the logic of systems and sub systems.

The assessment of students' attainment of core learning outcomes of the systems strand of the technology syllabus (QSCC, 2002) using the interpretive framework has been demonstrated above. However, it was noted that students recognised and discussed the properties of materials they used in the construction of artefacts. They also worked technologically through active and critical participation in the design, construction, testing and evaluation of their artefacts.

Conclusion

The students demonstrated, through engagement in a technology unit focusing on systems, understandings of key technological ideas and processes at more abstract levels. Several dimensions of systems theory (Chen & Stroup, 1993) provided an interpretive framework that enabled the researchers to make judgments about students' ability to identify components of systems and relevant interactions. The similarities between the meanings of the dimensions of the framework and the concepts embodied in the syllabus core learning outcome statements of the Systems strand facilitated this process. We suggest that an interpretive framework of this kind could be an important source of information for assisting teachers to assess students' ongoing and summative performance in technology learning experiences.

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The Conflicts and Solutions Between 'Depictions of People and Animals' in Design and Technology Projects and Interpretations of Islam

Roehampton Institute, University of Surrey

Cathy Growney, Lecturer in Initial Teacher Education, D&T – Telephone +44 (0) 118 966 6035

E-mail cgrowney@roehampton.ac.uk or cgrowney@tinyonline.co.uk

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Abstract

"Islamic tradition condemned the pictorial depiction of the Prophet – and of the family of the Prophet – in all artistic expressions. It further discouraged the representation of living creatures for fear that such representation would lead to pagan or polytheistic worship." (Matar, 1992)

There are Muslim children in England who follow this tradition to the extent that it is forbidden (haram) for them to represent any being that has a soul. Yet, frequently these children compromise their beliefs at school when they are asked by their teachers to design or make pictures or models of people or animals.

This paper sets out to discuss the implications of this Islamic belief for teachers of design and technology. It examines the current QCA schemes of work as illustrated by examples of the areas of concern, then suggests ways in which teachers can review their schemes of work to ensure that their projects are inclusive of all children without compromise and celebrate the rich diversity of the population.

The paper has arisen out of some action research relating to design and technology projects undertaken by primary PGCE students at Roehampton, University of Surrey.

The Issue of Concern

I told my class of primary 'Post Graduate Certificate in Education' (PGCE) students that they were going make a glove puppet. I asked them to collect images of characters to base their puppets on. A student told me that she did not portray caricatures of people since it was against her religion, she asked permission to make a puppet of a plant or flower instead. She told me that she was a Muslim. It had never occurred to me that I might already have asked a Muslim student to compromise their beliefs by asking them to illustrate. I suspected it had not crossed the minds of many other teachers so I thought it was worth finding out more. The student, Mahjabeen Sheik, has collaborated with me in my research.

> *"With almost two million Muslims living in Britain, Islam is now the largest non-Christian religion in the country. It is important, then, that Muslims and non-Muslims in the United Kingdom gain a greater understanding of, and respect for, each other's way of life, and come to appreciate the many values which they hold in common."*
> (The IQRA Trust, 2003)

Muslims in Britain

According to The IQRA TRUST, after Roman Catholics and Anglicans, Muslims are the largest religious minority in Britain; there are 2 million Muslims, the figures are changing quite quickly with the influx of refugees. The distribution of the Muslim population around the country is concentrated in the major cities and age profile indicates a high percentage of Muslims being of school age.

> *"One fifth of the human race call themselves Muslims; the other four-fifths know so little about the faith that many Muslims believe it to be the most misunderstood religion."* (Badawi 2001)

Table showing the main countries of origin of British Muslims	
Pakistan	564,000
Bangladesh	164,000
Middle East	109,500
India	114,000
Kenya	71,100
Malaysia	27,000
Egypt	46,500
Libya	15,000
Morocco	13,600
Total	**1,124,700**
others are Greek, Turkish, Indonesian, Philippine and Singaporean.	

Source: The Islamic Foundation, 1991 in Parker-Jenkins (1995) p4

Islam followers are split into two main (there are others) sectarian divisions, 'Sunni' and 'Shia'. Sunni Islam is sub-divided into four schools of thought known as madhabs; these are Hanafi, Hanbali, Shafi and Maliki. Each madhab has equal standing. Mahjabeen belongs to the Sunni 'sect' of Islam and she follows the 'Hanafi' madhab. The orthodox views that Mahjabeen holds are also held by many other Muslims, some of whom are also Sunni Muslims following the 'Hanafi' madhab but many who are not; Islam, like other religions can not be summed up into a neat definition of a single collective identity. Muslims in Britain have come from a diverse variety of backgrounds, each having their own cultural and political beliefs as well as traditions and socio-economic differences. In addition, the levels of religious adherence go from liberal to orthodox (also known as traditional, devout, strict or fundamental).

> *"Muslims in Britain are by no means a homogeneous group" … "[The] Muslim community is multiracial, multicultural and multilingual in nature" … "[Muslim is a descriptor of] religious affiliation only." "[All Muslim groups have] differences in religious interpretation."*
> (Parker-Jenkins, 1995)

Non-Muslims are often confused by the differing values, beliefs and views held by different Muslims, including those affecting school and education. Educators are concerned to meet the needs of all their pupils although sometimes they are bewildered in trying to satisfy all groups at all times. Earlier this year, The Guardian reported (Wainwright, 2003) a headteacher who had banned books featuring pigs in case they offended Muslims. The instruction was later withdrawn after an appeal from The Muslim Council of Britain as the action was unnecessary.

The Problem

Mahjabeen believes that she is prohibited (haram) from drawing, representing or modelling any living being with a soul, be it human or animal. Included in this rule are life-like beings or inanimate things, which are given human or animal features, in other words inanimate things that have been brought to 'life'. Mahjabeen told me that according to the teachings of the Qur'an, it would be unlawful to draw people, saying, "The punishment of the hereafter (akhirah) for the act of drawing (such subjects) is severe". The law extends to cartoon images if they include animate beings, photographs (although this is a grey area), life-like drawings as well as puppets and masks.

Mahjabeen acknowledged that Muslims do not interpret all the laws literally or make differing decisions on how far reaching the law should be. She added that there are Muslims who are unaware that such a law exists or that they do not know its correct prescription and that since "God has given mankind free-will", some simply choose not to follow the law. For example, she believes many newspapers in Islamic states have photographs in them; there are murals painted on walls in Iraq depicting Saddam Hussein or in Iran murals depicting Ayatollah Khomeini and some families still take and keep family photographs.

Islam is complex and there are many interpretations of the Hadith (sayings of the Prophet[a]). The general belief is that people should not imitate the work of Allah by creating images of people or animals, as 1) the creativity of ordinary people is not worthy of being likened to Allah's creation and 2) such art could be used to glorify false idols (Shirk).

> *"Whoso ascribeth partners to Allah, he hath indeed invented a tremendous sin."* (Pickthall, 2000a)
>
> *"Whoso ascribeth partners unto Allah hath wondered astray"* (Pickthall, 2000b)

Qur'an and Hadith authority, Sheikh Qaradawi's interpretation shows it is clear that 3-dimensional art is totally forbidden but 2-dimensional figures may be acceptable although disapproved of:

> *"Probably in the early period of Islam the Prophet (peace be on him) was very strict in prohibiting all pictures, as the Muslims had only recently come out of the state of polytheism and idol-worship, and were prone to sanctifying figures and statues. As the belief in the Oneness of Allah became deeply rooted in their hearts and minds, he allowed them two-dimensional figures, that is, drawings and prints. As for himself, he disliked having curtains or drapes with figures and pictures in his house, not exempting even drawings or prints on, cloth, paper, or the wall."*
> http://www.radwan.cwc.net/drawing.html 20/03/03)

In March 2003, Hassan Radwan wrote to me saying that "It has long been accepted at Islamia School and indeed most Muslim Schools up and down the country that drawings and pictures of animate objects can be used in the context of the school."

Usamah Ward, the Education Officer at Muslim Educational Trust (MET), had a more conservative view. He said,

> *"Amongst the scholars of Islam there are some differences concerning the extent of prohibitions. Moreover, amongst Muslims what is acceptable varies more widely, partly because some are more religiously observant than others, and partly because it is perhaps an area not as well understood as it should be amongst some Muslims … aspects of art which involve human images and iconography are specifically prohibited. Ideally, a school's art curriculum should include a study of Islamic art and architecture, making it possible for Muslim pupils to realise their full potential in this field … illustrations of people or animals are mostly avoided ... any necessary image might avoid certain details, e.g. not showing facial features." He added, "There is no reason – at any key stage – why Muslim pupils should be made to contravene the guiding principles of Islam in their study of art. The use of portraits, such as murals depicting leaders, to glorify individuals and attempt to create adulation or even worship is anathema in Islam."*

The book "Muslim Nursery Rhymes", published by the Islamic Foundation has illustrations of children. In another children's book I found the following sentence, "Muslim scholars say that the only way any pictures of people or animals are allowed is if they don't look very real, are meant for children and are obviously not to be taken seriously" (Emerick, 1998: 185). So it seems a minority of British Muslims like Mahjabeen insist on prohibiting all depictions. This however does not mean their beliefs should be discounted; it is a human right to be able to practise one's faith without fear of prejudice.

Islam and Education in Britain

Nabi Saqeb (1996), cited several concerns for Muslims in Britain, that trainee teachers should be taking on board, making special reference to curriculum areas such as sex education, modesty in PE, dance, drama and art. Others include music, RE, PHSE in general and school assemblies on this list. They also make the point that 'art' is not the only curriculum area where pupils are required to draw; teachers should be aware of the needs of Muslim children when considering the *whole* curriculum.

As explained by Parker-Jenkins (1995), there are numerous potential conflicts between secular and Islamic philosophies of education. Some say that it is not possible to be a devout Muslim and attend State secular schools, that undermine Islamic faith and culture, favouring 'Islamic' denominational schools that are run by advocates and enlightened educationalists. However, many consider this separatist view isolationist and retrospective, reducing the possibility of further increased mutual understanding between educators and the Islamic community.

Parker-Jenkins (1995), states that "multicultural/antiracist teaching has for many schools become somewhat maginalised" since the Education Reform Act 1988 as schools have so much prescriptive work to do and accountability is more public. However, Saqeb (1996), contradicts this view, believing that "Muslim issues have become more prominent in the last decade" since the inclusion of Islamic Education.

There is no disagreement however on statistics of increased Islamaphobia and racism since, among other things, the publication of Salman Rushdie's book "The Satanic Verses"; the McPherson Enquiry; the terrorist attacks of September 11th 2001; 2001 Race riots in northern England; immigration and Blunkett's suggested "Oath of allegiance"; the two wars on Iraq as well as those of Bosnia and Afghanistan; and in April 2003 bacon being laid on the corpse of an elderly Muslim in a London mortuary (Dodd, 03). Indeed Randeep Ramesh (2003), describes a "religious community under siege". These events have exacerbated the misunderstandings and divisions in society that have also led to some Muslims becoming *more* devout in an attempt to counter the contrary values of the country in which they live.

Paul Kelso (2002) reported that British Muslims are balancing their basic human rights to practise their religion and maintain their Islamic identity thereby "not … adopt[ing] certain values that will contradict Islam". He found that the needs for understanding and integration are more intense and it "would be easier if there was a better grasp of their faith among non-Muslims".

The Experience of Muslims in School

Mahjabeen's experience as a pupil at secondary school is interesting. Although overall it was positive, she felt that the teachers in the school were 'tolerant' rather than respectful or celebratory, they were also inadequately informed and some were embarrassed to discuss controversial issues. She gave me one example; after attending a discussion group at her mosque when she was 15, she first became aware of Islamic laws in terms of art. Her parents had not known of these laws. Mahjabeen was keen to live by the laws of Islam (Shari'ah) as she understood them and when her art teacher wanted her and her class to draw portraits of each other, Mahjabeen introduced him to the concepts of it being unlawful for her to partake in such an activity.

She said, "He looked at me as if I was making this up and he'd never heard anything so ridiculous." Mahjabeen felt inadequately knowledgeable of her own religion, as she was not able to explain it. Having no support to make the protest, she continued to draw animate beings against her will until she left school. She felt her beliefs were marginalized and her religion misunderstood.

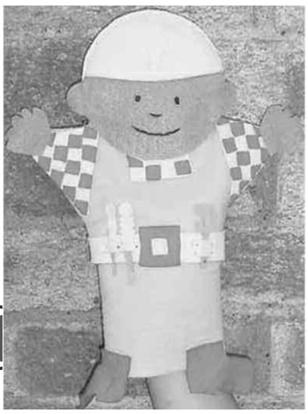
After leaving school, Mahjabeen studied her religion in more depth and tried to follow its teachings more thoroughly and she now feels that she is in a position where she *can* take a stand and not compromise on what she believes. Mahjabeen partially explained this increased orthodoxy, with the political climate associated with Islam. As Muslims live in increasingly diverse societies, and especially since the increase in Islamaphobia, many need to adhere more strongly to the orthodox aspects of their beliefs. Mahjabeen is also concerned to see that her pupils do not suffer the same kind of oppression for their religious beliefs.

Mahjabeen's view is contrary to that of Professor Zaki Badawi, Chair of British Council of Imams and Mosques. His line of thinking is that British Muslims should take the best from the two cultures (Muslim and British) and marry them together. He has said that when Muslims find the demands on them in different contexts conflict with their faith, they need to adapt and sacrifice the concerns that hinder them. In his interview with Jack O'Sullivan (2003), Badawi said, "There is no theological problem in Islam taking on a great deal of western culture and values and incorporating them." Badawi has influenced "Islamic thinkers in Britain, challenging the traditional inward-looking, rule-based education of most British imams with a broad, multi-faith training grounded in western philosophical study".

As a trainee teacher, Mahjabeen's experience has been mixed. She said the University staff had been 'quite accommodating' and had even instigated discussions. Her problems had arisen on extended school experiences. She said the children had been fine with her, they were open minded, they saw she looked differently from them, especially wearing a veil (hijab), but they were curious, they asked her why she was wearing the hijab, she explained and then they got on with the activities. The parents and staff had found it difficult to communicate with her, they had trouble consulting with her and with eye contact and as a consequence on her following practice Mahjabeen had decided that in terms of developing her own education she needed to compromise and would remove her hijab (as Badawi has recommended). She had not had any difficulties teaching all curriculum areas including RE, and had not felt that her religion had been compromised. However, the opportunity to teach music, dance or sex education had not arisen and Mahjabeen predicted difficulties at these times.

Concerns for Muslim children and the Qualifications and Curriculum Authority (QCA) Primary Design and Technology (D&T) Schemes of Work

The QCA Primary D&T Schemes of Work are not statutory but are merely examples of possible schemes through which schools can implement D&T. In many schools, few teachers have had formal training in D&T and many lack confidence in how to implement it so the QCA schemes are commonly followed. However, on looking at some of the projects with Mahjabeen some of the projects raised concerns:



The pictorial and sculptural representation of animal or human beings is forbidden (haram). A Muslim with Mahjabeen's views says it is also forbidden to make inanimate objects 'come alive' by giving them human features or characteristics so "2B, Puppets" and "3C, Moving monsters" could be problematic. Similarly, "2D, Joseph's coat" could raise the same issue; it is a serious breach of Islamic Law (Shari'ah) to illustrate Prophets[a] and Joseph is a Muslim Prophet[a]. It is possible "2C, Winding up" and "5C, Moving toys" could fall into this area. Some Muslims believe it is also forbidden for Muslims to play or listen to music unless it is the call to prayer; this includes percussion instruments so "5A, Musical instruments" could also cause difficulties.

Caution must be taken with the subject matter (avoiding animal or human characters) in "1A, Moving pictures", "4B, Storybooks" or "3D, Photograph frames". There would be dietary issues (as with any pupil) to consider for the "3B, Sandwich snacks" and "5B, Bread" projects. Finally "6B, Slippers" could raise concerns since modesty is such an important part of a Muslim's life and the removing of footwear to have one's feet measured may be considered intrusive especially if children of opposite sex work together, more significantly when the children are older.

Implications for Teachers of D&T

Teachers have the responsibility to cater for the religious, cultural and curricular needs of all their pupils. This includes consideration of the conflicts Muslim children have concerning their own identities, integrating with their peers but also respecting their faith. Curricular needs must respect specifics that religions allow and forbid but also must celebrate the rich diversity of the class and population, avoiding tokenism or bolted-on activities, for example carrying out D&T projects with an Islamic dimension or perspective as shown in Mawji and Waljee's (1992) teaching pack on patterns, lettering and buildings.

When activities *are* set that may conflict with a pupil's religion, the teacher must also make provision for equivalent activities that will not compromise the pupil since participation is better than withdrawal. These must be of equal challenge, fun and value (educationally and in assessment). At this time it is worthwhile asking if the extra preparation time for two activities can be justified. Now more than at any other time educators must encourage accommodation rather than confrontation or assimilation and they can do this through addressing their own curricula and classrooms. Indeed incorporating global and cultural perspectives across the curriculum should also reduce the disenfranchisement and under achievement of black children and other minorities.

The onus is on Initial Teacher Education to take responsibility.

> *"Teachers cannot be expected to translate educational theory into practice without adequate training, both pre-service and in-service in multicultural skill, knowledge and values."* (Parker-Jenkins, 1995: 132)

Many trainee teachers use the QCA schemes of work; Initial Teacher Educators should be informing them how to use these and how they can design their curricula to be more inclusive with global perspectives.

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Design in Brazilian Primary Schools

Pedagoga, Mestre em Engenharia de Produção,Universidade Federal de Santa Catarina, Florianópolis – Santa Catarina – Brazil
Caroline Lengert Guedes, Teacher – E-mail clguedes@pop.com.br
Alice T. Cybis Pereira, Profa. PhD. do Programa de Pós Graduação em Engenharia de Produção – E-mail pereira@cce.ufsc.br
Pontifícia Universidade Católica do Paraná, Brazil
Antonio Martiniano Fontoura, Prof. Dr. do Curso de Design – E-mail amfont@matrix.com.br

Abstract

This paper discusses the insertion of design activities in Brazilian primary schools by using a cooperative project with computer resources. Over one semester, students from three schools participated in this project. Design activities were developed while students needed to develop the project and the scale model of a house for vacations. These design activities involved the research into design concepts, activities in different subjects in the curriculum – mathematics, portuguese, geography, history and arts – plan elaboration, and construction of the scale model of a house for vacations. Through this work it was possible to verify the potential of the design for education in Brazil. It was possible to identify the contribution of design for the students' learning process and for constructing new knowledge. Computers, used as educational resources over the project, contributed to communication and information exchange among students and also to create a multimedia portfolio in CD-ROM.

Introduction

The increasing amount of information and the progress of communication technology indicate the arrival of a new era, marked by the use of modern technologies and by changes in the whole society, including the education area.

Sometime ago the abilities and knowledge taught at schools were useful and applicable for a long time, practically along a lifetime. Nowadays, the same knowledge becomes obsolete in a short period of time. These fast transformations that characterise the post-modern society (Silva, 1998) bring with it countless challenges to education, among them the need to rethink teaching and learning processes.

An expectation exists that education, in this changeable society, will help students to develop competences (Perrenoud, 2000). Therefore, the education of the new generations needs to focus on the individual's preparation in order to be capable of thinking, questioning, working in groups, and learning constantly. The great education challenge is to modify the pedagogic practices; to adapt them to the emerging education paradigm (Moraes, 1997), and to discuss possible proposals to assist these changes.

However, Brazilian schools have some way to go to reach this goal. Instead of space for developing creativity, students receive pre-prepared materials. While they should be experiencing interaction processes in order to build their knowledge, students are required to memorize facts, to repeat ideas, to copy contents (Moraes, 1997). By promoting the memorization and the discursive intelligence, schools forget to work with the intelligence for designing (Bonsiepe, 1997), thus hindering greatly students' integral development.

Adopting new ways to teach students to be increasingly dynamic and questioning are urgently needed. The simple memorization of facts does not meet the requirements anymore of the demands of the current world. A society that lacks active individuals, with flexible thought and great innovation capacity, needs to adopt education strategies and formation to supply this need. Design appears then, as a promising perspective for education for the new generations.

Design in the Primary School

Nowadays, little is known in Brazil, about the application of the design in education. Researching for references relating to design in Primary Schools, one can find experiences in other countries, especially United Kingdom, that already uses it in their schools.

The pedagogic work involving design is quite promising for Brazilian education. Starting from it, students can develop ideas for a project to produce a product, making possible the creation of objects or tools for the world around them. The design contributes to the learning process through learning by doing, including manual production, and through the elaboration of a project, assembly and construction of an object. These activities stimulate creativity, challenges, the unexpected, demanding from students abilities that are not always present in classroom. Working with aspects of the daily world, providing space for invention, creation and innovation, design allows a different pedagogic practice, where the students notice the importance of their participation in the construction of a better world.

As a challenge to implement design activities in some Brazilian schools, design was taken as the guiding axis for the development of a cooperative project. The main challenge for teachers and students during one semester was to develop the project of a house for vacations.

The work was developed during the first semester of 2002, involving groups of 4th series of the fundamental teaching in three schools.

Development of the Cooperative Project

The cooperative project was entitled "Building Houses Project" and the first step was a planning meeting with the teachers of the participant groups. In such meeting, the deadlines, the stages and the procedures for the accomplishment of this work were defined. With the students, the project began in March 2002, with a presentation of the work, the objectives and the stages of development.

Each class was divided in four groups defined by colour names: yellow, red, blue and green. For the cooperative work, a website was built, that housed all the necessary information for the project development. The website can be accessed in the address http://projetocooperativo.vila.bol.com.br. The communication and the exchange of information among the groups happened through the chat and the discussion forum tools, that could be accessed through the project website.

Initially, the children developed a design concept and they exchanged some information with the friends of the other groups through forum. After some researching and discussions, students gained an understanding of the design concept, and elaborated their own definitions.

> *Design is not the same thing as drawing. Before doing something we have to plan, to design.* Gibran
>
> *Design is drawing, it is used practically in everything that is projected, and it serves to give an idea of things that will be built, manufactured or printed.* Luca
>
> *Design is the project of a product.* Mariana

After they consider the design concepts, the children noticed its importance for the development of a product. They understood that when you have an idea it is not necessary to develop it immediately. In addition, it is necessary to undertake a study, to determine if there will be interested consumers in this idea and if it is really useful, before this product is produced.

When they began to think about the construction of the house for vacations, the children received an architect's visit in the school. The architect explained to the children the similarities and differences between the architect and designer's work. She spoke well on the importance about building a house, in relation to the sun. She also showed some plans; she explained about the use of scale in the elaboration of plans and models. She commented about the elaboration of a house roof and, finally, she presented to the children a scale model modelled in wood.

Figure 1. Children watching a wooden scale model of a house

During the whole project, until the final materialisation of the holiday home scale model, the students worked the design together with other activities, involving contents of several disciplines:

- In History – the students accomplished a research on different house types. They discussed the different types of houses in different times and in different areas, the conditions of the people's life, the existence of simple and luxury homes, the enormous growth of the buildings, mainly in the great cities. They cut out engravings of houses and they set up a great panel on this subject.
- In Sciences – studying the differences among house types, the theme was enlarged for the problems of the life quality, including subjects such as traffic, house, education, health, feeding, safety, and work.
- In Geography – they studied the maps, to know how to be guided and located through them. They also studied the characteristics of the rural and urban way of life, observing the differences between the houses that are located in the city and in fields, as well as the conditions of people's life, the accelerated growth of the great cities and the fast expansion of the slums.
- In Mathematics – studying the maps, the children also studied scale. They learnt about the measure units, about the function of the scale and how to reduce and to enlarge the size of the objects using the scale. They took measures to establish the ideal size of the house for vacations; they developed the drawing of the house plan and they developed calculations for the elaboration of the scale model of the proposed holiday home.
- In Arts – they identified the different architectural styles, studying mainly the Baroque style; they created drawings of the facade of the house and they developed the scale model of the house for vacations.

Figure 2. Front view drawing of a house for vacations

Figure 3. Plan created by the red group

Figure 4. Plan created by the blue group

Starting from their drawings, students created, using cardboard, a scale model of the holiday home. The first task for the creation of the model was the cutting of the cardboard. After all the pieces had been cut out, they joined the pieces together, thus creating a 3 dimensional model of the holiday home. Then, the scale model was painted with the colours chosen by the group. Painted, final finishing touches were added, portraying the style and the location (rural or urban) previously chosen.

Besides the model, the students created a multimedia presentation, developed with an authoring software, showing their research, the discoveries, the works and the drawings produced at each school.

The registration of the whole project was made through a portfólio. Drawings, compositions and research were part of the portfólio and they constituted important materials for the observation of the cognitive process development and of the creative abilities manifested by the students.

To bring the project to a conclusion, an exhibition happened with all of the produced works, where students could meet personally each other and to present the research accomplished as well as the scale models developed, discussing all the design techniques that they had used.

Figure 5. Scale model created by the blue group

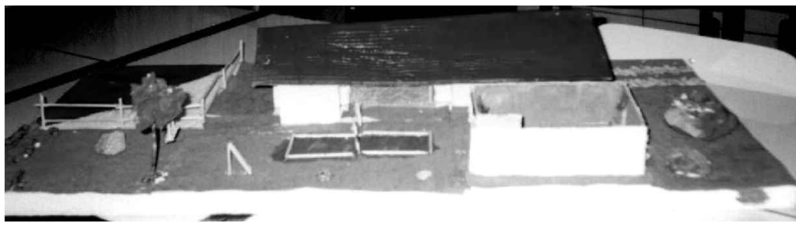

Figure 6. Scale model created by the red group

Conclusion

The inclusion of design in Brazilian schools, through the accomplishment of cooperative projects, is one of the roads now suggested to improve education. We believe design is a way to organize the school knowledge, valuing the interdisciplinarity and motivating effective participation of children in the school activities.

The fact that the activities have been developed through a cooperative project, facilitated the support given by design to the teachers involved in the project. During the project, the teachers could learn and develop the activities with the students, having the opportunity to try design activities, not just in theory, but also in practice.

For the students' learning, the contributions made by the design activities were countless. Working with design, it was possible to develop and to stimulate the multiple intelligences, because the children worked with activities that were well diversified. They were involved in interdisciplinary activities that promoted integration among the disciplines. They learned by experience, being involved in an active process and integrated in a meaningful social context.

During the Building Houses Project, the children developed abilities in: cutting out, painting, drawing, resolving problems, manipulation of materials, elaboration of ideas, planning, argument, creativity, analysis, synthesis and reflection. They improved their writing skills through the composition of ideas, facts and opinions and they experienced the stages through which a designer passes for the development of a product.

The involvement and the interest demonstrated by the students during the whole project and the pride which their models produced, show that design activities can really contribute to the children's growth.

It is known that is necessary to begin the work with design at schools by letting them know the purpose and the advantages of applying design in the primary education. Knowing the advantages of the work with design, schools can buy the necessary tools, materials and technologies and also prepare their teachers to work with design in the classroom.

Clearly, in order to implement this idea in the Brazilian schools, it will be necessary for both the participation of teachers, who believe in the importance of this work for the children's development, and of the designers, in order to teach and qualify teachers so that they can develop design activities in the schools.

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Understanding Mechanisms Through British Sign Language: An Example of How Deaf Pupils' Communication Method Can Aid Pupils with Special Educational Needs (SEN) to Understand Mechanisms

Elmfield School for Deaf Children, Greystoke Avenue, Westbury on Trym, Bristol BS10 6AY

Nicole Hastie, Teacher – Telephone +44 1242 702118 E-mail classes5and8@talk21.com

Introduction

Pupils who are deaf, and use British Sign Language (BSL) as their first language, often find it hard to access the National Curriculum through English, managing far better in a Sign Bilingual setting that provides access to learning and English through BSL. In design and technology, it is the wide range of technical vocabulary that is often the most difficult for them to cope with. However, BSL is a language with unique expressive qualities that allows users to accurately model and describe mechanisms and designs without the need for written or spoken vocabulary. In my opinion, this skill could also be used to help pupils with special educational needs, who find the written and spoken vocabulary of design and technology difficult to access.

Working with Mechanisms

Design and technology in the primary curriculum offers pupils the opportunity to work with, and create, a wide range of mechanisms. Whilst it is always best to approach mechanisms in as many ways as possible, be they written, visual or discursive, in the main these rely on knowledge of technical vocabulary.

As a teacher of deaf pupils, I have discovered that a flexible approach to learning about mechanisms is required. The chance to see and use a real mechanism is, of course, of primary importance. Often we do much of our preparation and designing work by sketching and discussing with pupils how their mechanism will work and review the final shortfalls or successes of their work using appropriate technical vocabulary. While many pupils acquire this vocabulary with ease, there are pupils whose linguistic or developmental levels are behind their peers. I believe my experience of working at Elmfield may offer SEN pupils an accessible and highly enjoyable way to learn about this more challenging aspect of primary design and technology.

The background to Elmfield School for Deaf Children and its Sign Bilingualism approach is given below:

Elmfield School for Deaf Children has a Sign Bilingual teaching approach. This allows pupils to use the language in which they are strongest, usually BSL, to help them develop knowledge of English and to access the National Curriculum.

The Year 5-6 (ages 9-11) pupils in my class are deaf BSL users. This means that their first language is not English or a signed version of English but a separate language with its own grammatical structure and syntax. The British Deaf Association defines BSL as:

> *"…a language of space and movement using the hands, body, face and head."*

In March 2003, BSL was recognised as an official language of the UK. Some background into the current understanding of BSL and its place in Britain may be useful.

The Importance of BSL

> *"It belongs to deaf people. It is not a communication system devised by hearing people. It is a real language which has evolved in the UK's deaf community over hundreds of years. It is a natural language that is as accessible to deaf people as English is to hearing people. Deaf children who are exposed to sign language can develop linguistically at the same rate and level as hearing children. This early access to language opens the gateway to lifelong learning."*
> (www.bda.org.uk 2003)

How successfully children process information and express ideas depends on their ability to access and use language. I use both BSL and English to support my pupils' learning. The principal language used in design and technology lessons is BSL. Most importantly, because it is the pupils' first language, it is the best system for ensuring that a challenging level of work and discussion occurs. Also, because design and technology can provide an opportunity for learning unhindered by levels of ability in reading and writing, it makes sense not to rely on written English. Lastly, the visual clarity and three-dimensional aspect of BSL makes it ideal for imagining designs and structures, understanding mechanisms and motions, and developing spatial awareness.

Understanding Mechanisms

The National Curriculum for design and technology in Key Stages 1 and 2 in England (DfEE, 2000) specifies that pupils should be taught the following aspects of mechanisms:

- 4b how mechanisms can be used in different ways [for example, wheels and axles, joints that allow movement].
- 4c how mechanisms can be used to make things move in different ways, using a range of equipment including an ICT control program

However, knowledge of mechanisms also underpins much of the understanding needed when designing and making and problem solving. Pupils need to know how levers work before being able to choose the most appropriate one to make the desired effect in their storybook. When pupils are undertaking product evaluation, they are encouraged to observe, use and where possible disassemble a range of mechanisms that fulfil a similar purpose. Building on this, focused practical tasks can include the task of making part or all of a working mechanism and testing out its suitability. This is easier if pupils can talk about and explain the workings of a particular mechanism, knowing the names of parts and understanding the forces involved.

For pupils with English as a second language, or with special educational needs, be they linguistic, developmental or sensory, the amount of technical vocabulary can be overwhelming. Consider the different forms of motion:

Mechanisms – Glossary
Linear Motion
Motion in a straight line eg. the motion of a train
Rotary Motion
Circular motion eg. the motion of a bicycle wheel
Reciprocating Motion
Repeating backwards and forwards motion eg. the motion of a piston in a car engine
Oscillating Motion
Repeating forwards and backwards circular motion eg. the motion of a clock pendulum
Equilibrium
A state of balance when both sides are equal
Fulcrum
Pivot, a point about which things rotate
Linkages
Two or more levers connected to produce a desired motion

www.dtonline.org

Each of these concepts means something to us. However, very few of them carry any easily accessible linguistic clues that aid a pupil in recalling their meaning. However, take a look at the concise explanations and it is possible that a simple image will appear in your mind of this form of motion. It is this mental image that can unlock the knowledge of mechanisms for pupils with special educational needs. BSL, or a gestural model based on BSL, can be a universal method for creating the image. Video clips to be shown at the conference show pupils creating different motions using BSL. The BSL shown is quite gestural as the child is describing something real. This description comes naturally for a child who uses a physically represented language but can be easily picked up by any child needing a clear way to demonstrate a type of motion. In the video, we can see a pupil continuing the rotary motion with signing, which gives us a clear image of circular movement.

BSL as a Guide to Gestural Modelling

In using my pupils' work I want to show that not only those with BSL skills can develop this way of exploring mechanisms. Rather, I am suggesting that the essence of BSL, a physical language that offers pictorial information to the recipient, can be used to inspire pupils to develop a simple, clear repertoire of hand movements that can illustrate motions and mechanisms.

I have filmed pupils at Elmfield using BSL to explain mechanisms that are part of work in:

Unit 4B Storybooks

Vocabulary: knowledge and understanding: *e.g. linkage, lever, pivot, flexible, shape, joint, hinge, area, surface, covers* types of movement *e.g. rotary, linear*

The pupils can be seen articulating their understanding of how mechanisms work, modelling ideas for their own designs and describing the processes they have gone through to create a mechanism. For instance, some of the pupils in the video are explaining mechanisms they have found in other storybooks. In two clips, the pupils show the importance of a pivot by modelling how the pivot controls the movement. There are also two examples of pupils with additional special educational needs. These pupils find it hard to write down their procedures but can show clearly what they have done to create a moving part by signing and referring with pointing, directly to their work.

What BSL users have that is of benefit and can be developed in all pupils are:

- Visual literacy – seeing ideas as images
- Good spatial relationships gained through placement *[showing where things are in sign]*
- Uninhibited expressive arm movements allowing the signer to feel a movement or force
- A language that demonstrates cause and effect
- Ability to follow directional signs and signals
- A willingness to demonstrate their ideas to a group as BSL is always 'shown' to others in a face to face setting

To create a new modelling technique for SEN pupils, teachers could develop a script of signs that can be associated with parts, mechanisms or forms of movement that occur in the mechanisms children encounter in Primary DT. These could come directly from BSL, or be adapted to suit the pupils' individual needs whilst maintaining cause and effect as well as spatial awareness from BSL. What you will then have is a visual, moving image that allows pupils to see a mechanism at work and to be in control of its movement.

Areas for Development

BSL is a language that can be quickly adapted to show different emotions, ideas and movements. It allows users to express ideas in a visual format that is very important for deaf pupils but would be another useful skill for pupils with SEN or English as a second language.

Within the international deaf community, there are over 100 distinct sign languages and there has never been full universality of signs. However, most deaf people can meet strangers, each having different languages, and yet find a way to communicate through the more literal/visual signs in their language. In the same way, if you focus on creating a clear image, placing objects with your hands and moving them to show motions, most people would be able to see the forces happening and connect them with a mechanism. Very often, children who find language challenging have a more visual experience of the world, as they must rely on visual clues to understand a situation, i.e. by copying the rest of the class.

My next step would be to find ways to link these gestural models to the technical vocabulary of design and technology, to enable those who wish to take their learning in the subject further to learn the necessary language. I would like to approach this with the specialist practitioners at the conference and share ideas about how to create visual resources for schools. Already, the idea of photographing pupils safely using tools etc. is widespread in design and technology in the primary school. Perhaps a series of videos or photos could support pupils' learning in the area of mechanisms.

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A Holistic View of Assessing Young Children's Designing

Primary Education Department of Canterbury Christ Church University College, Kent, England

Gill Hope, Senior Lecturer in Design and Technology – E-mail gh21@cant.ac.uk

Introduction

This paper combines gether three strands:

- ***Bridget Egan's research on children's understanding of the purpose of design drawing,***
- ***A model for assessment from Early Years research: a framework for defining and assessing quality in early childhood education, described by Pascal & Bertram (1991),***
- ***My own research into the way young children can be helped to use drawing to support development of design ideas.***

I have been aware for some time of Egan's work on children's understanding of the purpose of drawing for designing and agreed with her that this was important, but until the analysis of my research data was underway, I had not really considered this as the determining factor in how the children used drawing to support designing.

Adopting Pascal & Bertram's model enables a holistic, child-centred approach to the Design and Technology curriculum and demonstrates the interactivity of the dimensions of key skills within designing, making and evaluating that are central to young children's learning about designing.

As an assessment tool, it answered my need for an overall indicator of "novice-improver-expert" on which to base claims for enhanced capability amongst the children who received the teaching input in my research programme. The major part of this paper explains how the model fitted my analysis needs.

The paper concludes with an extrapolation from the model as an analysis tool and some thoughts on how this child-centred model could be applied to a way of viewing Design and Technology, which could enable the two-way sharing with other areas of the curriculum.

The Three Strands

1. Bridget Egan's Contribution

Egan's work (1995 – 1999) on children's perceptions of the function of drawing in the design process has been prodding me in the side ever since I began researching young children drawing for designing in 1998.

If the drawing had no practical function in the child's repertoire, then we were impeding their designing by asking them to do so. If, as I believed, drawing can support clarification of the problem, place-mark possible lines of enquiry, aid thinking through the design solution, make explicit the image in one's head so that it can be manipulated more easily, communicate ideas to others in a team, and so on – then it is a vital skill for children as learner-designers.

Egan's work caused me to realise that children's perception of the purpose of the drawing was central to the way in which they would use it.

2. Pascall & Bertram's Contribution

A child-centred framework (Figure 1) for defining and assessing quality in early childhood education is described by Pascal & Bertram (1991). Each segment represents an area of the child's development or competence. It is person-centric (not curriculum-centric) and emphasises that the child is central to any assessment process and that all dimensions of the child's learning are inter-related, not discrete or linear. This meshes with my view of the holistic nature of education for young children and with the importance of starting from the child's understanding of the activity, both for assessment and planning.

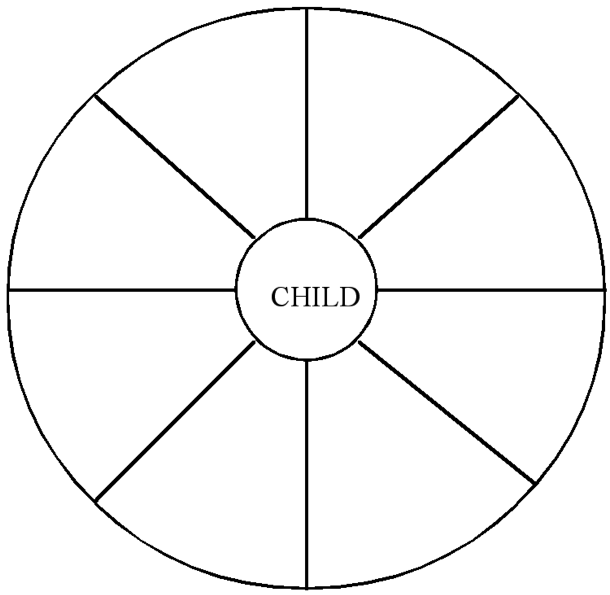

Figure 1

3. Combination for my Research

Not only does this model mesh with my view of the holistic nature of education for young children, but I could see potential in an adaptation of it to represent the child's view of design drawing (Figure 2, over page), the focus of my research, with Egan's understanding of purpose at the centre:

The arrows that I have added to Pascal and Bertram's model suggest development of the child's understanding. They could also suggest the development of the design, from first idea through to the realisation in a finished product. I called this a Dimensions Wheel, since Pascal & Bertram use the word "dimensions" to describe the contents of the segments.

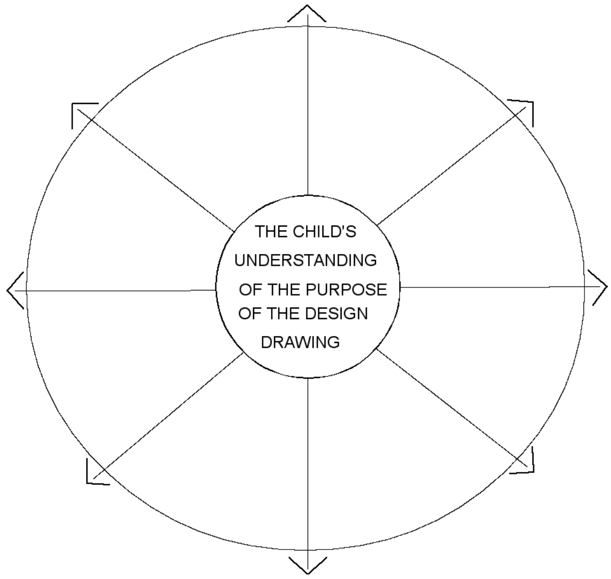

Figure 2

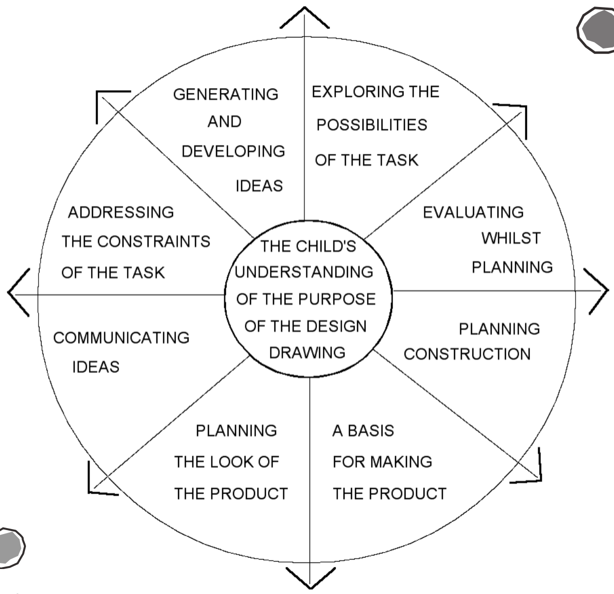

Figure 3

Developing Pascal & Bertram's Model into an Analysis Tool

Figure 3 (right) shows how, following Pascal & Bertram's model, the dimensions of design drawing (developed from the APU (1991) p.23), which I was examining in my research, would fit into each of the segments of the circle:

However, in order to display assessment results graphically (as radial plots generated by a spreadsheet), the dimensions needed to be placed on the lines rather than within the segments:

As can be seen in Figure 4 (below), this has the added advantage of eliminating the boundaries between the dimensions and suggests, even more strongly than Pascal and Bertrams's original model, the inter-connectedness of the dimensions.

The addition of concentric rings (Figure 5, right) demonstrates how the model was adapted to represent an evaluation tool, each ring relating to a level of understanding of the purpose of design drawing to the way in which children use drawing to support design thinking.

a) Imparting Understanding of Design Drawing to Children

This assessment model fitted so well with my research because I was aiming to impart to the children a holistic understanding of the role of drawing within designing, not teaching particular techniques or process order. The metaphor which I use to explain design drawing to children (Figure 6, right) is based on Lakoff & Johnson (1980) and I have explained this in more detail elsewhere (Hope (2000).

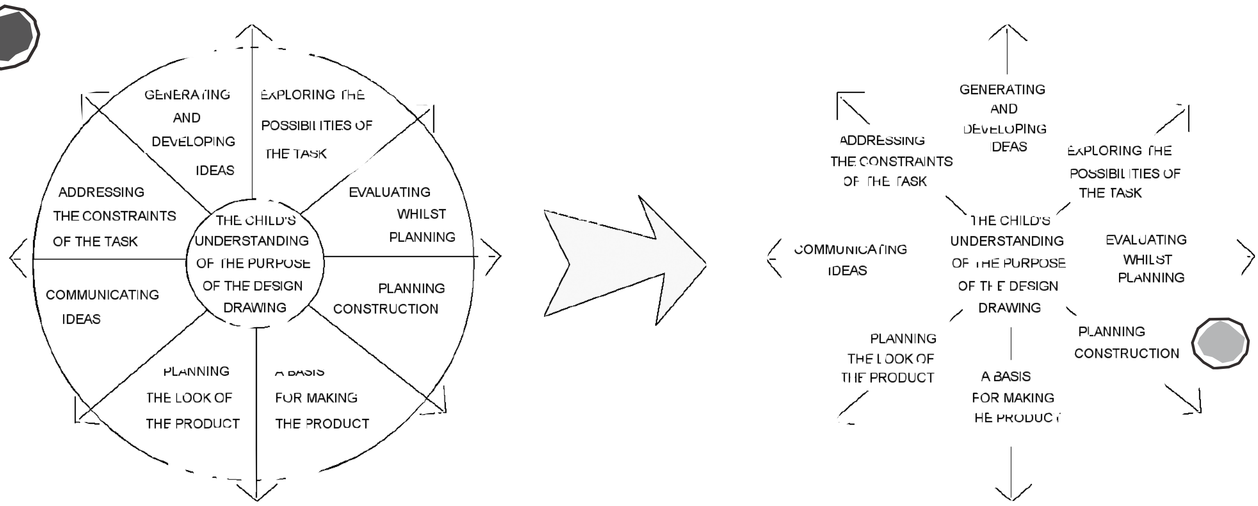

Figure 4

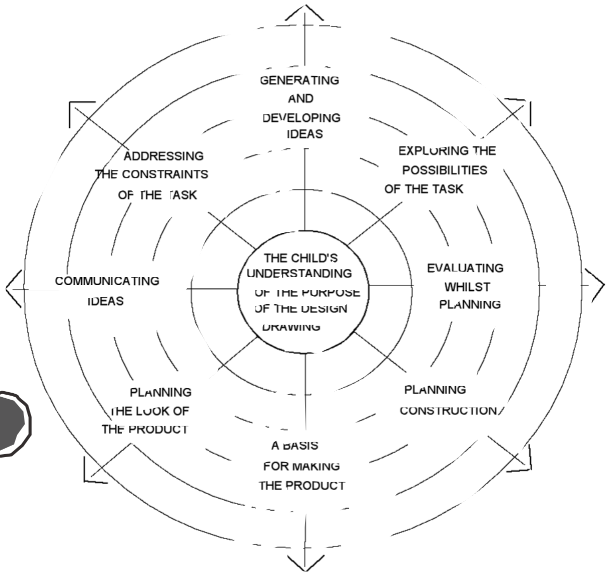

Figure 5

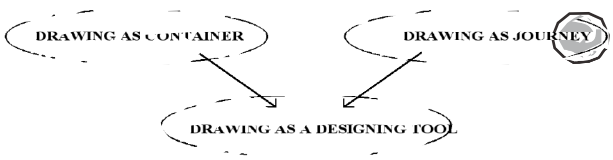

Figure 6

The children with whom I conducted my research were a Year 2 class in a rural school in England (average age approx. 7.0 yrs at start of study). The programme began in the second half of their first term in Year 2 (Oct.2000) and continued until the end of their first term in Year 3. The final assessment activity took place in Jan.2002. I called this my Focus Class.

The Comparison Class were a parallel class within the same school who did not receive my teaching input on the nature of design drawing. They were taught Design and Technology by their class teacher and broadly followed the QCA scheme of work. My Focus Class experienced similar practical activities but the way in which they were taught to use drawing to support their designing was very different. The Comparison Class teacher was not aware of my Container / Journey metaphor and so, although these children drew their ideas as part of their design experience, they were not given this overview of how drawing functioned with respect to supporting design thinking.

I explained the metaphor to the Focus Class children in March 2001, about a term into the programme. I felt they needed some knowledge and experience on which to base the big idea I was planning to impart. I believed that in order to absorb the idea, internalise it and make it their own, the children needed to be exposed to the idea in a range of contexts over a period of time. I did not want adoption of a drawing technique, I wanted understanding of how drawing could support design thinking.

The context for the introduction of the Container / Journey metaphor was a sequence of three lessons based on a character called Stan who has a variety of adventures, based around the book "Flat Stanley" by Jeff Brown, which their class teacher had read to them.

The children were shown two examples of design drawings and two in narrative genre. I discussed with the children the purpose of the drawings. One child asked "Was that one for something they were going to make?" I asked who thought the answer was yes, and why they thought so. This generated good responses and they had no difficulty identifying the other design drawing. I used the words "planning drawing" for design drawing and "picture" for the narrative drawing, as I thought these would be accessible terminology to the children.

I told them I was going to explain what design drawing (or "planning drawing") was like. I knew I would need to use the verb "contains" rather than the less familiar noun "container" in the first few sentences. Once the children were using the word "contains" in their answers, I felt I could say:

> *This drawing is a container for the person's ideas, but it isn't going anywhere, is it? They have put down all their ideas on the paper and once they finished drawing that was the job done. This drawing is like a journey. The ideas are going somewhere and they don't finish once the person finished drawing. The end of the journey isn't on the paper at all. It didn't finish until they finished making what they had planned.*

The Container / Journey metaphor was drawn on the flip chart and I explained that each of the little drawings on the planning drawing was a container for ideas at each point of the journey. The children were reminded of the "Flat Stanley" story and told that they would be making a puppet of Flat Stanley to go into an A5 envelope to help to tell the story.

Figure 7. Shows a fairly average example, by child who was debriefed after the lesson.

R I did that one and then I thought of that one.... and that one...erm....I got that one from C. Then I did that one. C. didn't like that one. He thought it looked like a crocodile (giggles). So he said why don't you do … Superman. So I did. But I did that one. *(Pointing to the first drawing in the second row)*

Me So that's the one you made?

R Yes.

Me So where's all the squiggly bits you drew on there?

R They're there. (He had drawn the pattern on the cut out puppet and then stuck coloured paper over it)

Me But you can't see it now!

R Yes you can, you just...look... (he peels back a corner of the sticky paper to show me)

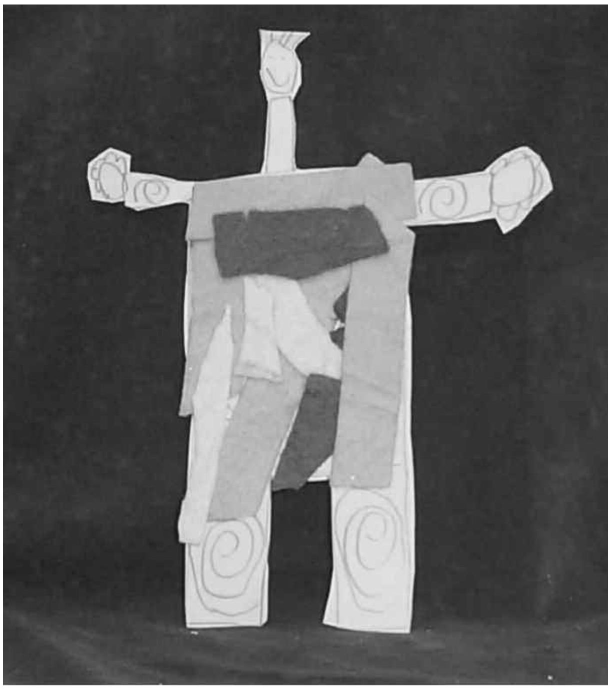

Figure 8. Shows R's finished puppet.

In the introduction to the two other lessons of my "Stan series", the Container/Journey metaphor diagram was re-presented to the children, to firmly establish the concept of a design journey, with drawings forming containers for ideas to be taken along on the journey, to be re-examined, played with, altered, stored away for future reference and so on. The metaphor was played out across the rest of the programme, regardless of context or medium. I was aiming to impart understanding of designing and the supporting role of drawing within designing, not run a drawing course, and so the metaphor was applied to a wide range of activities.

The programme's success was judged by a series of assessment tasks which were single lesson activities conducted with both my Focus Class and the Comparison Class, who had heard nothing about these containers for ideas going off on design journeys.

Effectiveness of Pascal & Bertram's Model as an Analysis Tool

I had, therefore, a holistic explanation of design drawing which seemed to work with small children and a holistic model of assessment to adapt and apply to the design drawings that I had collected from my assessment tasks. Choosing to display the number-crunching by spreadsheet in the form of radial plots, preserved my model through the analysis process.

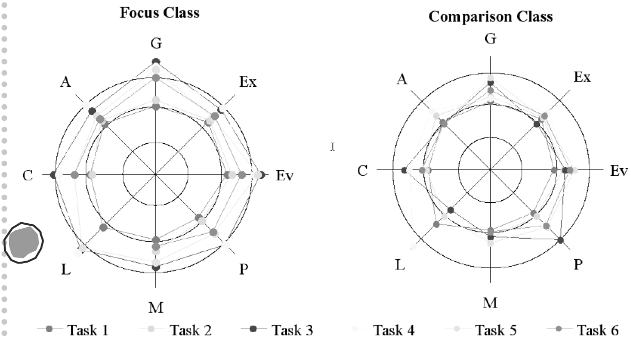

Figure 9. Dimensions of Design Drawing

Figure 9 shows an example of the model used as an analysis instrument: the average scores for each class for each dimension. Each of the dimensions were assessed using a 5-point scale based on my previous observations of children's capabilities across the 5-9 age range. Just the three inner rings are shown in Figure 9, as the average scores for both classes were mostly within this range.

The following abbreviations have been used for the dimensions:

G	Generating and Developing Ideas
Ex	Exploring the Possibilities of the Task
A	Addressing Tasks Constraints
L	Planning the Look of the Product
C	Communicating Ideas
P	Planning Construction
Ev	Evaluating Whilst Planning
M	Basis for Making the Product

Not all dimensions were considered for all tasks. Planning the Look of the Product was inapplicable to Tasks 2 & 6 (since these were problem-solving scenarios rather than product design tasks) and the children did not make the product for Task 4.

Some of the variations in the plots are related to the differences between the tasks. Tasks 1, 2, 3 & 5 were activities which I had used before in the exploratory phase of my research, when attempting to find out what children aged 5-9 could do, rather than, as here, attempting to improve it. Task 4 was conducted by Kay Stables and was one of the activities used in the Enriching Literacy Through Design and Technology project in Middlesbrough (2001). At the time, I regretted my choice of activity for Task 6, because the results for my Focus Class seemed so much poorer than the work they had been doing at the end of the programme. However, it gave me insights I would otherwise have missed: I discovered that children use drawing in a different way to support problem-solving than when designing a product.

The comparisons, therefore, should not be task-on-task but between Focus Class (who received the input) and the Comparison Class (who did not). The assessment tasks were activities that I knew were appropriate Design and Technology activities for children of this age, based on previous experience. They were not carefully graded. They were not evenly spaced chronologically. The discussion of them is outside the scope of this paper. However, the results were pleasing.

I was also pleased that an analysis tool which represented the way in which I viewed designing (and the importance of children understanding the reasons behind what they were being asked to do) worked as an analysis tool.

Postscript: Extrapolating Beyond the Boundaries of my Research

I also became excited about the potential of this holistic model as a way of viewing Design and Technology education, which meshes with my view of how education should be for the young child:

Foundation Stage (ages 3-5 yrs.) curriculum guidance now presents a more holistic view of children's learning and I believe that this should be extrapolated upwards into Key Stages 1 & 2. Design and Technology is, I believe, uniquely placed to contribute to each of the areas of children's development indicated in Figure 10.

As a starting point in that direction, I present the following:

- Physical: hand-eye co-ordination, hand skills, spatial awareness, properties of materials and their fitness to purpose
- Social: interaction with peers, sharing resources, responsibility etc., team work
- Moral: Considering needs and wants of third party (user / client), safety of others whilst working
- Spiritual: Appreciation of well-crafted artefacts, self-respect and giving respect to others, awareness of personal place in community and place of humanity within our planet and beyond
- Creative: Manipulating and combining materials, techniques and ideas to answer a problem in an appropriate, novel and pleasing way; making design choices
- Playful: Fun, personally satisfying activity, curiosity-driven experimentation
- Applicable: Activity and pedagogy appropriate for age, prior experience, skill base, knowledge etc.
- Informative: Telling children what they want / need to know in order to maximise their involvement in the learning process

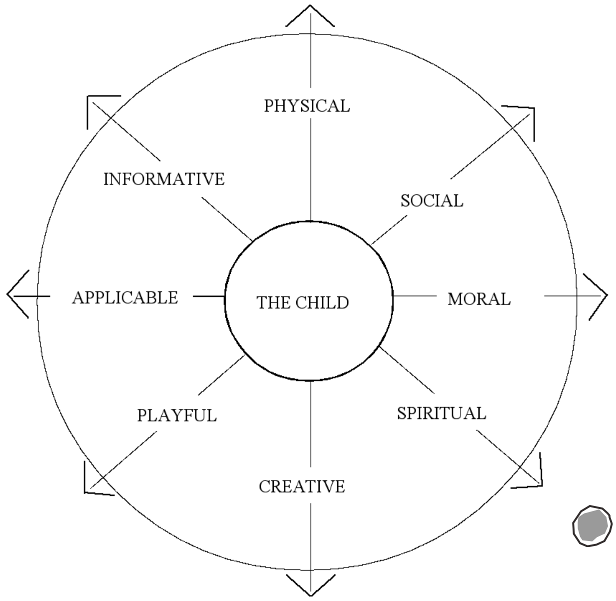

Figure 10

Such are my thoughts. A flight of fancy, based on a conveniently found assessment model which fits with a personal viewpoint? Perhaps. But I am not alone with my thoughts. Davies, Lowe & Ritchie (2002) see Design and Technology having a strong role in citizenship education, with a bold assertion of the contribution of Design and Technology to spiritual education. Yen-shun Wei (1999) defined the thinking mechanism of technology education as comprising creative thinking, social concern, cultural novelty, ecology environment and the human element.

So, with the new emphasis on creativity in recent government-funded documentation, perhaps we should dust down our copies of the Plowden Report (those of us old enough to remember reading it) and share a few gems about the child being at the centre of education. I certainly think it is time to stop being embarrassed about design and technology straddling the art/science divide and having a home nowhere and bravely step forward with the holistic perspective with which our multi-discipline subject provides us.

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Educational Reform and the Living Technology Curriculum in Taiwan's Primary Schools

National Taichung Teachers College (NTCTC), Taiwan. 140 Ming-Sheng Road, Taichung City, Taiwan

Chia-Sen Jimmy Huang, Professor of NTCTC – E-mail hcs@mail.ntctc.edu.tw

Chuen-Wen Liao, Professor of NTCTC – E-mail lcw@mail.ntctc.edu.tw

Introduction

Taiwan discontinued martial law in 1987, and since then has experienced rapid political, economic, social and cultural change and growth. In 1993, the Ministry of Education proposed a new curriculum standard for primary schools to prepare students to be futuristic, internationalized, integrated, life-oriented, humanized and flexible citizens in the 21st century (Ministry of Education, 1993). At present, the people in Taiwan are again paying attention to the curriculum reform for grades 1-9. The newly revised national curriculum, anticipated to be put into effect in 2001, emphasizes curricular coherence and integration as well as more school-based development and management Ministry of Education, 2001. All this indicates that Taiwan has been and continues to be involved in fundamental and significant educational reform.

The educational system and the concept of education in Taiwan were mainly influenced by the United States. When one traces it back in history, one discovers that U.S. technology education developed from craft education in Europe. Russian manual training and the Sloyd system of northern Europe were two important influences that had a major effect on the American handicraft education movement. In addition, Jackson Mill proposed a technology curriculum that sought to encompass an entire technology education system Tseng & Fang, 1999. Therefore, to make some conclusion on the nature and characteristics of technology education in Taiwan, we need to know more about how technology education developed in Europe. Owing to the fact that the England has made many contributions to the development of technology education in Europe, the experiences of the England will help us understand both the sources and the present status of the situation that exists in Taiwan. This study used some experiences of design and technology in the England for the support of implementing living technology in Taiwan.

Purposes of the Study

In order to conduct this study, the following purposes were analyzed:

- To explore primary technology education development in Taiwan.
- To explore primary technology education objectives in Taiwan.
- To explore primary technology education content in Taiwan.
- To explore primary technology education regarding instructional evaluation in Taiwan.
- To propose some suggestions for the concerned and involved administrators in Taiwan.

Primary Technology Education Development

In Taiwan, before 2001 all curriculum standards were regulated by the central government. All levels of instruction followed these curriculum standards. Teachers can only make choices on instructional methods and supplementary materials. Primary schools in Taiwan are divided into three levelslow 1st and 2nd grades, middle 3rd and 4th grades, and high 5th and 6th grades. Students' age is between six and twelve years old. At present, the new 2002 national curriculum syllabi were established. There are seven learning areas in the national curriculumlanguages, mathematics, science and living technology, arts and the humanities, social studies, health and physical education, and comprehensive activities. Also there are six learning topics which are suggested to integrate and connect the above seven learning areas: gender, environmental protection, computer science, home economics, human rights, and career development. The learning sessions are divided into area learning sessions and flexible learning sessions. The flexible learning sessions can be arranged according to the school-based development. Technology education in Taiwan is a new area that is called "Living Technology". Before the new 2002 national curriculum, technology education is usually integrated with fine arts and no technology is taught. Now technology education in Taiwan is expected to unify with science at the primary and secondary school levels. Also technology education in the lower grades in primary schools in Taiwan is called "Life" that is integrated with social studies, science and arts and the humanities. Taiwan's primary teachers also can make choices on instructional methods and supplementary materials. In addition, the primary teachers need to match and design the courses according to both school-based development and students' interest for their teaching.

Primary Technology Education Objectives

In 1968, Taiwan implemented its nine-year compulsory education plan. Its primary curriculum standard divided "Arts and Crafts" into three parts "work", "fine arts", and "crafts". In 1975, the Ministry of Education revised the primary curriculum standard and combined the above parts into one as "Arts and Crafts". In 1993, again the primary curriculum standard was revised and the course objectives and the course content were greatly changed. At this stage, the "Arts and Crafts" course has focused on the following three major areas of developmentthe presentation field, the appreciation field, and the life implementation field. This curriculum standard emphasized the application of materials and created as well as presentation abilities. In the "Arts and Crafts" course, students come to appreciate the arts through activities. They also were given the opportunity to discover the connection between art and both technology and the appreciation of beauty. The new 2002 national curriculum syllabi were set up five main goals as followsthe humanism, the integrated abilities, the democratic education, the lifelong learning, and international and local perspectives of culture. In response to the curriculum reform, the present primary curriculum syllabi emphasized curricular coherence and integration as well as more school-based development and more student-experienced. Therefore the Ministry of Education described ten basic learning abilities as followsthe individual potential, the creation and appreciation, the communication, the career planning, the concerning society, the international perspective, the organization, the technology, the exploration and research, and the problem-solving. Under the new 2002 curriculum syllabi, the goals of science and living technology SLT learning area is to assist students 1) to cultivate the enthusiasm and the interest of exploring science and to have a habit of active learning, 2) to learn the basic knowledge and the exploring ways of science and technology, and to be able to apply them to the daily lives, 3) to cultivate the attitudes of protecting environment, treasuring resources, and respecting life, 4) to cultivate the abilities of communicating, cooperating, and treating people harmoniously,) 5) to cultivate the potentials of independent thinking, problem-solving, and the creativity, and 6) to explore and observe the relationship between human beings and technology Ministry of Education (2001).

Design and technology in the England emphasizes the student's design and hands-on activities, as well as recognition abilities. It provides students with true learning-for-life skills. Therefore, students are ready for the world of work in the future Benson (1994). Living technology in Taiwan emphasizes an affective domain and the enhanced appraisal abilities. The new 2002 national curriculum specially emphasizes the application of daily lives for student's learning abilities. Of the two countries, it is the England that places the greatest amount of attention on technological design. It also stresses the accurate and effective completion of work. Taiwan, however, tries to put its emphasis on among student's learning abilities, the enjoyment of the process, and how to apply their abilities to daily lives.

Primary Technology Education Content

Science and living technology (SLT) course in Taiwan includes eight indicators of learning abilities and the total of 233 statements of attainment see Table 1 (over). Primary living technology course includes four indicators of learning abilities and the 45 statements of attainment as follows:

- The indicator of the skills of process – includes 5 sub-indicators such as observation, comparison and classification, organization and connection, induction and inference, and communication that has the total of 24 statements of attainment.
- The indicator of the knowledge of technology – includes 3 sub-indicators such as knowledge level, know the technological products to be used frequently, and know the technology to be seen frequently that has the total of 6 statements of attainment.
- The indicator of the development of technology – includes 2 sub-indicators such as essence of technology, and technology and society that has the total of 5 statements of attainment.
- The indicator of the knowledge and skills of thinking – includes 3 sub-indicators such as creative thinking, problem-solving, and critical thinking that has the total of 10 statements of attainment.

From Table 1, we know Taiwan's design and production regarding technology education starts from junior high schools. Taiwan views technology as having a tremendous impact on our daily lives. But in depth of content, Taiwan places more emphasis on life application, especially in the areas of creativity and beauty in fine arts. Now in Taiwan, many technology education researchers emphasize cultivating the abilities of creativity for students' learning in schools. It is a good challenge for primary school teachers to add the design process and to identify some strategies for their teaching in order to increase students' creativity in Taiwan.

Instructional Evaluation on Primary Technology Education

Technology education in the England includes many forms of evaluation. Its national standards are outlined in the level descriptions. The most important objectives are to develop students' understanding of knowledge development, making techniques, design methodology, quality assurance and safety habits. Each level of evaluation is based on design, processes of making, and the finished product. Evaluation is also based on written reports, oral presentations, questionnaires, and discussion. Furthermore, besides the instructor's evaluation, there can be both peer and self-evaluation SCAA & ACAC (1995).

Teachers play an important role in Taiwan's evaluation system. The process includes formative and summative evaluation. Besides the project itself, learning attitudes and cognitive abilities are important. The process of evaluation includes the following observation, interviews, grading, recording, testing, discussion, questionnaire, reports, answer questions, attitude measurement, and aesthetic judgment. The main purpose is to let instructional activities achieve the educational goals.

In the England summative evaluation is used to achieve certain educational levels. The Department of Education and Science DES, 1995 were struggling to develop an assessment instrument, such as the Assessment of Performance Unit and the National Curriculum Assessment, for 5 to 15 years old, and it also was seeking information about the success of this new curriculum discipline Kimbell (2001). The system values individual evaluation. Further, their design and technology course values formative assessment. The system in Taiwan puts less emphasis

Table 1. The Content of Science and Living Technology from Grades 1-9

Indicators	1. The Skills Process	2. The Knowledge of Science and Technology	3. The Essence of Science	4. The Developement of Technology	5. The Attitude of Science of Thinking	6. The Knowledge and Skills	7. The Application of Science	8. Design and Production
Statements of Attainment								
SI 1	Observation KS1(2).KS2(1) KS3(3).KS4(3)	Knowledge Level KS1(2).KS2(1) KS3(1).KS4(2)	KS1(2) KS2(3) KS3(5)	Essence of Technology KS1(0).KS2(2) KS3(2).KS4(3)	Like to explore KS1(2).KS2(0) KS3(0).KS4(0)	Creative thinking KS1(2).KS2(2) KS3(3).KS4(2)	KS1(2) KS2(3) KS3(4)	KS1(0) KS2(0) KS3(4)
SI 2	Comparison and classification KS1(2).KS2(4) KS3(3).KS4(3)	Know the animals and plants to be seen frequently KS1(1).KS2(0) KS3(0).KS4(0)	KS4(8)	Evolution of Technology KS1(0).KS2(0) KS3(4).KS4(3)	Discover the interest KS1(0).KS2(3) KS3(0).KS4(0)	Problem-solving KS1(3).KS2(2) KS3(2).KS4(2)	KS4(6)	KS4(6)
SI 3	Organization and connection KS1(2).KS2(3) KS3(3).KS4(2)	Phenomena and the observation of phenomenal change KS1(2).KS2(0) KS3(0).KS4(0)	KS3(1).KS4(5)	Technology and society KS1(0).KS2(3) KS3(3).KS4(0)	Deliberate and exact KS1(0).KS2(0) KS3(0).KS4(1)	Comprehensive Thinking KS1(0).KS2(0)		
SI 4	Induction and inference KS1(2).KS2(2) KS3(4).KS4(4)	Know the technological products to be used frequently KS1(1).KS2(0) KS3(0).KS4(0)			Seek for truth and exactness KS1(0).KS2(0) KS3(0).KS4(3)	Inferential thinking KS1(0).KS2(0) KS3(0).KS4(2)		
SI 5	Communication KS1(3).KS2(3) KS3(5).KS4(6)	Know the matter KS1(0).KS2(2) KS3(4).KS4(6)				Critical thinking KS1(0).KS2(1) KS3(1).KS4(1)		
SI 6		Know the environment KS1(0).KS2(2) KS3(4).KS4(4)						
SI 7		Know the interaction KS1(0).KS2(1) KS3(5).KS4(8)						
SI 8		Know the growth of animals and plants KS1(0).KS2(2) KS3(0).KS4(0)						

continued over/.

I. continued Table 1. The Content of Science and Living Technology from Grades 1-9

Indicators	1. The Skills Process	2. The Knowledge of Science and Technology	3. The Essence of Science	4. The Developement of Technology	5. The Attitude of Science of Thinking	6. The Knowledge and Skills	7. The Application of Science	8. Design and Production
Statements of Attainment								
SI 9		Know the technology to be seen frequently KS1(0).KS2(2) KS3(3).KS4(9)						
SI 10		Know the ecology of animals and plants KS1(0).KS2(0) KS3(4).KS4(0)						
SI 11		Know the physiology of animals and plants KS1(0).KS2(0) KS3(0).KS4(2)						
SI 12		The spectacles of energy KS1(0).KS2(0) KS3(0).KS4(1)						
SI 13		Reorganization and balance KS1(0).KS2(0) KS3(0).KS4(3)						

PS KS1 1st and 2nd grades ; KS2 3rd and 4th grades; KS3 5th and 6th grades; KS4 7th to 9th grades

on individual difference and as objectives are often vague, this encourages teachers to put more emphasis on summative evaluation rather than formative evaluation. The English system encourages students to be involved in project discussions. This provides more opportunities for creative thinking. Taiwan has been limited its small classroom spaces, overload of students, and has not been able to pay attention to individual difference. Thus, formative evaluation is more difficult for primary teachers to use in Taiwan.

Conclusions

After the Industrial Revolution, design becomes a very important factor in industrial production. This caused England to change its education and manufacturing systems. Curricular content also changed, such as the inclusion of design and technology and this is helping to maintain Britain's leading position in the industrial world. Taiwan's education is based on traditional Chinese culture, which relies heavily on literature, history and philosophy. Its educational system puts theoretical things first and practical things second. Therefore, at the primary level, the curriculum emphasizes mostly recognition and calculation. Fortunately, the new 2002 national curriculum in Taiwan puts the related technologies and applications into its curriculum objectives and content.

Compared to the technology education of the English system, Taiwan also has some features are listed below:

- Students are usually confined to an assembly project, so that they do not need to think deeply, and there are many restrictions that reduce their creativity.
- There are eight indicators of learning abilities and the total of 233 statements of attainment for students to achieve but also provide flexibility for teachers.
- Teachers can introduce different activities and forms of learning into their classes.

- There is no any national examination for living technology course.
- The inclusion of place, quality, health and safety are established as important content items.
- There are several professional publication companies to support the textbooks, websites, and the related instructional material.

Suggestions for the Future

Some suggestions for Taiwan's educational authorities can be drawn from the above conclusions as follows:

- The course content of "Living Technology" in Taiwan can be added the following categoriestechnology and life, information and communication, construction and manufacturing, and energy and transportation.
  - Clear objectives make the English technology education a successful story. Teachers can easily process their instruction through summative evaluation. There are many possible ways to improve technology education, and this research would like to suggest that administrators improve their curricular standards and implement more formative evaluation.
- Design abilities and problem-solving skills are important elements of the English. educational system. These kinds of experiences are those which Taiwan's primary students desperately need.
- Taiwan teachers colleges should provide a graduate level training course for living technology. Furthermore, it should be a required course for all primary teachers.
- At the primary level, living technology is only a small part of national curriculum in Taiwan. The best solution is to establish a national examination for Taiwan's administrators and parents to emphasize the instruction of "Living Technology".

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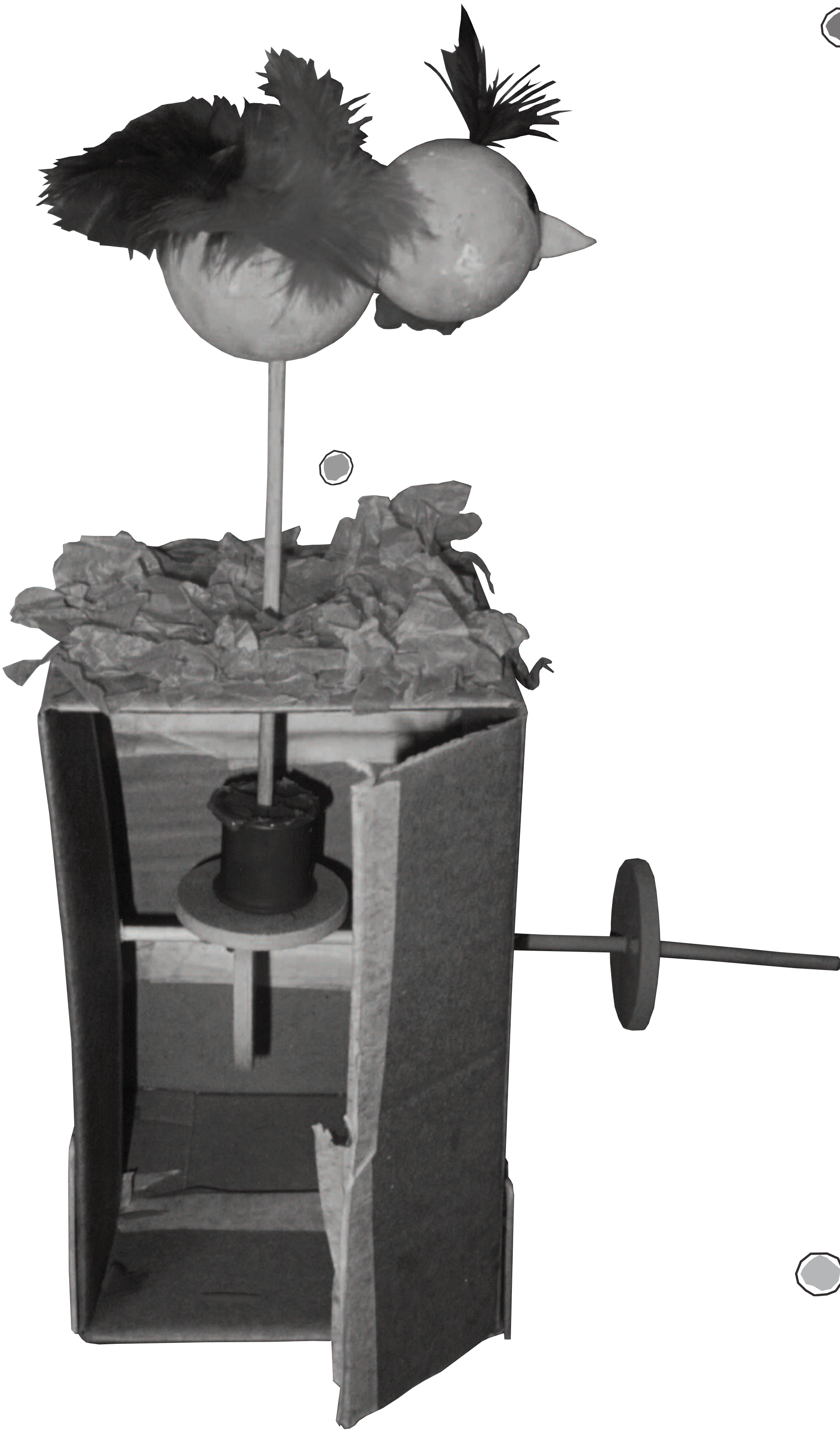

A Study of the Development of Children's Creative Ideas and the Research Development of New Products in Business

Department of Industrial Education, National Taiwan Normal University
Ming-Hsiung Wu, Professor and Research Chair – E-mail t07011@cc.ntnu.edu.tw
Department of Fine Arts and Technology Education, National Taichung Teachers' College in Taiwan
Chia-Sen Jimmy Huang, Professor and Research co-Chair – E-mail hcs@mail.ntctc.edu.tw

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Introduction

As businesses operating in a competitive society, where creativity and variation are in demand, where old technologies are being replaced by new ones, and where traits recognised as prestigious today may become disadvantageous tomorrow, the running of an enduring and flexible venture lies in the ability to absorb and innovate.

The Developmental Program for Knowledge Economy DPKE issued by the Ministry of Executive Yuan on Aug. 30, 2000 proposed 6 concrete measures, the first of which is to "set up mechanisms to encourage and foster new ventures." The ideal of implementing DPKE in the education system is, to be specific, to "develop students' ability of innovation and re-learning." Meanwhile, the DPKE defines the so-called "Knowledge-Based Economy" as one that is based on the creation, spread, and utilization of knowledge and information. The ability and efficiency of creating and utilizing knowledge will eventually prevail over the traditional components of manufacture, and will become the supporting force to push the economy forward (Executive Yuan, 2000). Indeed, innovation in itself is one of the processes of producing, applying, and spreading knowledge, while creativity is the spark for it. The cultivation of creativity or innovation is, not only the crux of elevating the quality of citizens, but also paves the way to developing a Knowledge-Based Economy. Hence, the idea of elevating an education of innovation becomes the emphasis in promoting future education. To further this, the white paper on Creativity Education proposed 6 preparatory programs:

- The cultivation of creative students;
- The growth of creative teachers;
- The overall construction of creative schools;
- The whole national proposal of creative life;
- On-line study on a creative database;
- The continuous cultivation of creative attainments Ministry of Education, 2001.The emphasis on innovation is thus self-evident.

All creative inventions consist of 3 components: people, managing techniques, and products Lin (1998). A product may be described as creative so long as it is novel, yet it also has to sell well. The elements that determine the life span of a product are manifold, the major 3 of which are:

- Competition
- The consumer the purchasing habit
- The technology revolution within enterprise itself Chen, 1988. The top priority in running an enterprise is not only to satisfy the demands from the customers, but also to create demands. It is important that innovative workers can come up with sufficient creativity within a short period of time; however, attaining "usable" creativity matters more. Creating these products may take longer to design and may need particular techniques; so long as they can win recognition from customers, and with the aid of product promotion, they are bound to enter and gain a foothold in the market.

The creativity of students at the stage of elementary education comes mostly from learning activities. Whether it is teaching conducted in the classroom or group activities, all contribute to stimulate inspiration. The implementation of different kinds of activities will function to inspire children's potentiality, to train the coordination between sensory abilities, to develop their ability to adapt to those things and environments that are unfamiliar and further, to cultivate curiosity and the drive to know their surroundings. Teacher can encourage children to explore, ponder, and solve problems through authentic activities, which leads to innovation. Creative ideas formed during this period, when properly infused with creative concepts, will construct newer and more original ideas, and will hence become usable or valuable resources Huang (1993).

Studies indicate that the creativity of children is more wide-ranging than that of middle-aged people Tu; Chen, 1997). The imagination of children is the least "polluted". They allow their imagination to go wild and do not hesitate to say what they think. Utterances like these may not qualify as design in the eyes of business, nor are they suitable to be discussed in public. However, ideas introduced through induction can provide wide-ranging innovations that provide designers with inspiration to expand possibilities, and finally contribute to better designing. In fact, there have already been successful examples of introducing children's creativity into merchandise.

Purposes

The Grade 1-9 Curriculum announced and implemented by the Ministry of Education (MOE) in 2000 has stated clearly the expectation of cultivating students' "ability to explore and research independently", and "ability to think and solve problems independently." Thus, the question here is how to elevate children's creative thinking. Still, the 21st century will see the fight between technology and human intelligence. Those who can take the lead and break traditional bounds and promote creativity-based research will eventually share the dominant position in the world. In this regard, the authors have set up the Creation and Invention Club CIC at Lung-An primary school selecting 28 students from the 5th and 6th grades as its members to conduct a one-year creative training program, with 4 enterprises cooperating and sponsoring this study. The purposes of this study are specifically as follows:

- Exploring the relationship between the creative ideas of children and the research and development of new products in the innovations of businesses.
- Exploring how the creative thinking training programs influence children's creative thinking abilities.
- Exploring how the creative thinking training programs influence children's problem-solving abilities.

Research Methods

This study puts its emphasis on quantitative investigation together with the incorporation of a qualitative approach to verify the research result.

1. Subject: Children

This study has set up the Creation and Invention Club CIC at Lung-An Primary School in the Ta-ann Zone of Taipei City. Members of the club came from about 30 volunteers among the 5th and 6th grade students, which belong to the experimental group. The students were given the creative training program for 2 semesters. The aim of the program is to further explore children's creativity, or develop other innovations so as to provide the 4 cooperating enterprises with concepts for product modification. The control group, on the other hand, was a group of 25 students selected from the 5th grade of the same school.

2. Cooperating enterprises

The businesses cooperating with this study are a stationary company, an electronic toy company, a food enterprise company, and a national network company.

3. Research Design

The independent variables, dependent variables and co-variables are as follows:

- Independent Variables include the implementation of the independent creative training teaching program in the experimental group.
- Dependent Variables include:
  – The post-test grade of the creative thinking test graphics, language edited by Dr. Chin-ji Wu.
  – The various grades of the post-test of the problem-solving test
  – The record of the students' reaction from classroom lessons, the video tapes from the classroom, interview with classroom advisors, students' final exam questionnaire, and discussion.
  – Co-variables include:
  i) The pre-test grade of the creative thinking test graphics, language edited by Dr. Chin-ji Wu
  ii) The various grades of the pre-test of the problem-solving test

4. Research Procedure

The research procedure comprised various steps including: setting up the CIC after the experimental teaching program was confirmed, confirming the students of the experimental and controlled group, implementing experimental teaching to the experimental group, processing the assessment, conducting data analysis, providing the creative concepts of the students and innovative ideas inspired by the club program to the superiors and the staff of the research department of the enterprises, evaluating the feasibility and practicality of the result and giving modification accordingly. The staff of the research department could give feedback to the students regarding the thinking logic and the direction to solve the problem related to the exploitation of creative product, meanwhile exchanging thoughts).

5. Experiment Management

The experimental teaching of this study is to develop the creative thinking of the students of the experimental group. The program consists of:

- The introduction of the patented invention and stories of invention. This is to show the students the current characteristics of invention and the mind-set of the inventors so as to motivate the students with creativity.
- The introduction of creative techniques. This is to get the students to familiarize themselves with various applications of creative techniques such as brainstorming, the listing of defects and merits, problem-solving techniques and steps in order to understand how students use their intelligence to apply all sorts of creative concepts.
- Brainstorming how the product the enterprises have provided can be bettered. Introduce to the students the current products of the cooperating enterprises. Encourage the students to provide tentative modification relating to the practicality, convenience, design and materials, in order to investigate if the creative ideas from the students can be effectively transferred into the modification of the products.

6. Research Tools

The assessment tools this study has applied include: the creative thinking test including graphics and language edited by Dr. Chin-ji Wu; the problem-solving test, the record of the students' reaction, lesson plans, teacher's observation and record, teaching journal and questionnaire by the students, and interview record.

7. Data Analysis

In respect of quantitative analysis, instruments include the Figure and Language Test of Creative thinking, the Test of Problem-solving, and one-way multivariate analysis of covariance. As for the qualitative analysis, documentations such as observations, interview, teaching journals, learning suggestion questionnaires were sorted preliminarily, then coded according to their categories, nature, filed according to the coding principle, giving the data titles, finally making the statistics of each and reaching a general conclusion.

Findings and Discussion

1 Relationship between creative thinking teaching and the students' creative thinking ability

- On graphic creative thinking ability:
  After receiving the creative thinking teaching, the performance of students of the experimental group, in the respect of "flexibility" of the graphic creative thinking ability, are superior to that of the control group.
- On language creative thinking ability:
  After receiving the creative thinking teaching, the performance of students of the experimental group, in the respect of "flexibility", "adaptability", and "originality" of the graphic creative thinking ability, are superior to that of the control group.
- On qualitative analysis:
  The study finds that after conducting the experimental teaching for 2 semesters, the students of the experimental group perform with more imagination, and the presentation of creative ideas is also more versatile when implementing the 'creative thinking' teaching. The control group, on the other hand, was provided with normal teaching. Being teacher-centered, this indicates the lack of interaction between students, and the work of the group is also more uniform. Meanwhile, unlike the control group, the responses to questioning in the experimental group has improved. The students are bolder in answering questions while the students in the control group are reluctant to give feedback for fear of making mistakes. The atmosphere in the experimental group presents a more picturesque and merrier situation, which probably is due to its club activity form, while the control group tends to be more ponderous. Though there seems to be less participation in the beginning in the experimental group, the willingness to take part in the group discussion has increased.

2 Competence impact of problem-solving

According to the results of the above, the score of the problem-solving test of the experimental group, after receiving the experimental management, has not evidently exceeded that of the control group, which indicates that the teaching program is not superior to the normal program.

On the qualitative analysis, the problem-solving ability of the experimental group was extremely versatile. Questions raised by the teacher were treated with great interests and were well thought out. The solutions the students proposed and the problem-solving suggested were beyond those of the conventional ones; some solutions were even very impressive. In addition, the creative ideas that were raised by most of the students of the experimental group were sometimes more than single concepts. There have been 4 or 5 concepts raised in the forming process.

3 Relationship between the creative ideas of children and the research and development of new products in the innovations of businesses

It can be inferred from this study that the creative thinking teaching has a divergent impact on students' thinking ability. The creative thinking teaching adopted by the experimental group has provided the students with versatile creativities and breadth if ideas. As to the performance on proposing product modification for the 4 enterprises sponsoring this research, the ideas raised were unrestrained and were superior in originality, while they were insufficient in practicality and delicacy. This could be due to the students lack of pre-knowledge and technology required for product modification. However, the concepts raised are still feasible with the incorporation of the research and development department of the enterprises.

4 Efficacy of teaching

- The results indicate that, within the experimental teaching of the 2 semesters, the implementation of the creative teaching has resulted in more frequent interactions between teachers and students, the atmosphere within the class was picturesque, and that switching off was rarely found.
- The students' ability to synthesize has been advanced and the ability to organise has also been improved.
- The implementation of the creative teaching has resulted in versatile creativities and innovations for the students.

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A Comparative Study on Assessment Criterion in Technology Education between Japan and England

Doctoral Program Graduate Student, Joint Graduate School in Science of School Education, Hyogo University of Teacher Education, Japan. Masataka Isobe – Email d02702j@cc.juen.ac.jp
Associate Professor, Department of Learning Support, Joetsu University of Education, Japan. Sadato Yamazaki – Email yamazaki@juen.ac.jp

Introduction

In Japan, it is questionable whether teachers can evaluate pupils' technological problem solving activities objectively and clearly with the current 'viewpoints of evaluation', that is: Interest, Will and Attitude, Device and Creativity, Skill and Knowledge and Understanding. In technology education in the UK, the General Certificate of Secondary Education (GCSE) has not only maintained high accountability but also managed to estimate pupils' ability objectively by the processes of marking and moderation by teachers and examiners. The purpose of this study is to compare assessment criteria between Design and Technology from AQA, OCR and Edexcel examination boards in England and technology in Japan. The following results were obtained: Japanese teachers concentrated on technological Knowledge and Understanding and Skill to evaluate objectively. English examination boards constructed assessment criteria for Design and Technology in accordance with a concept of designing. In addition, they stressed the evaluation of the design and technological processes through pupils products and portfolios. It suggests how to develop assessment criteria, such as designing to make pupils develop their technological problem solving capabilities relevant to their individual attainment levels in Japan.

This study explores the present situation and the problem of absolute evaluation that has been introduced since the 2002 Japanese school year. It is supposed that teachers should use absolute evaluation in all subjects. They should also have paid attention to intra-individual interpretation in helping children acquire essential knowledge, skills and mind towards a healthy social life as an individual as well as a member of the society / nation, based on an evaluation of: Interest, Will and Attitude, Device and Creativity, Skill and Knowledge and Understanding. The Japanese Ministry of Education has not introduced any national evaluation standards, though it has shown 'viewpoints of evaluation' without detailing the evaluation standards in all subjects. The Ministry has very much encouraged each school to develop school-based evaluation in line with national standards. Each Japanese School must develop criteria and standard of evaluation in accordance with their circumstances. Therefore, it is open to question whether teachers can evaluate pupils' technological problem solving activities using the 'viewpoints of evaluation' objectively and clearly (Yamazaki, Isobe and Itoh, 2003). It remains an unanswered question whether technological problem solving activities is different from problem solving activities in science, other subjects and the 'period for integrated study'. Although there have been some studies of the relation between scientific and technological activities (Layton, 1993; Fensham and Gardner, 1994), Japanese technology educators have no consensus about each characteristic of a problem solving process between technology, science, other subjects and the 'period for integrated study.' Nakamura and Sotokawa (2001) sent out a questionnaire of criteria and standard of evaluations in elementary schools all over and asked how teachers developed criteria and standards. Most of the schools have not developed evaluation criteria yet (Table 1).

Table 1 The Numbers and Percentages of Introduction About Schools-based Evaluation Criteria in 33 Elementary Schools
Schools have already developed and introduced evaluation criteria
3 schools (9%)
Schools have not developed and introduced evaluation criteria yet
29 schools (88%)

Nakamura and Sotokawa, 2001

Eighty-eight schools have not developed and introduced school-based evaluation criteria. This may reflect possible confusion for the Japanese teachers. In technology education in the UK, the GCSE has made an effort to keep high accountability. It has been possible to evaluate pupils' ability objectively by some teachers' and examiners' marking and moderation (Edexcel, 2001). And, many studies of assessment criteria and standard, including Kimbell (1997), have been undertaken since the 1980's. At this point, this study focused on the assessment criteria for Design and Technology in AQA, OCR and Edexcel examination boards and tried to compare between these assessment criteria of three examination boards and technology in Japan.

Method of Study

School-based evaluation criteria of 4 advanced lower secondary schools were studied. The schools were as follows: 'U municipal lower secondary school in Shinjyuku district (U school);' 'J municipal lower secondary school in Shinagawa district (J school);' 'J municipal lower secondary school in Joetsu City (JW school);' and 'national Lower Secondary School Attached to J University (JU school).' This study explored each characteristic of school-based evaluation in comparison with 4 lower secondary schools. It was also compared with assessment criteria for Design and Technology in AQA, OCR and Edexcel examination boards and evaluation in 4 Japanese lower secondary schools.

Results and Discussion

Technology Education in Japan

At first, the criteria of evaluation for technology education in JU school is shown in Table 2. Each viewpoint of evaluation was estimated by three common methods: Pupils' Worksheets, Notebooks and Presentation; Pupils' Products and Teachers' Observation; and Paper Tests. JU school made a paper test to evaluate all viewpoints of evaluation. The main method of evaluation was presented in Table 3.

Table 2. Criteria of Evaluation for Technology Education (JW municipal lower secondary school in Joetsu city, 2002)

Viewpoints of Evaluation	Methods of Evaluation	Standard of Evaluation
Interest, Will and Attitude	Worksheets, Notebooks and Presentation	A. Pupils can state their own goals properly and plan their goal for next classes by themselves. B. Pupils can state their own goals properly. C. Pupils can not state their own goals properly
	Products and Teachers' Observation	A. Pupils can find their subjects positively and use skills and knowledge to solve their subjects. B. Pupils can find their tasks and use skills and knowledge to solve their subjects. C. Pupils can not find their tasks positively and use skills and knowledge to solve their subjects.
	Paper Tests	A. More than 85% points B. More than 65% points C. Less than 64% points
Device and Creativity	Worksheets, Notebooks and Presentation	A. Pupils can arrange and device their studies properly. B. Pupils can arrange and device their studies. C. Pupils can not arrange and device their studies.
	Products and Teachers' Observation	A. Pupils can reconsider the relation between their life and technology and device skills to solve their subjects. B. Pupils can device skills to solve their problems. C. Pupils can not device skills to solve problems.
	Paper Tests	A. More than 85% points B. More than 65% points C. Less than 64% points
Skills	Worksheets, Notebooks and Presentation	A. Pupils can design their tasks and learning process in their worksheets properly. B. Pupils can design their tasks and learning process in their worksheets. C. Pupils can not design their tasks and learning process in their worksheets.
	Products and Teachers' Observation	A. Pupils have enough to skills to solve their subjects. B. Pupils have some skills to solve their subjects. C. Pupils don't have skills to solve their subjects.
	Paper Tests	A. More than 85% points B. More than 65% points C. Less than 64% points
Knowledge and Understanding	Worksheets, Notebooks and Presentation	A. Pupils understand their studies very much. B. Pupils understand their studies. C. Pupils don't understand their studies.
	Products and Teachers' Observation	A. Pupils understand materials, tools and media to solve their subjects very much. B. Pupils understand materials, tools and media to solve their subjects. A. Pupils don't understand materials, tools and media to solve their subjects.
	Paper Tests	A. More than 85% points B. More than 65% points C. Less than 64% points

Table 3. Main part of Evaluation Criteria of "Device and Creativity" (Lower Secondary School Attached to J University, 2002)		
Method of Evaluation	**Criteria of Evaluation***	**Grade**
Observation of Pupils' activities	– Pupils can plan their experiments and practices by themselves. And, they can investigate important information by using many methods (books, internet or interview etc.) to solve their problems.	Pupils are evaluated by 3 scales of A-C grades in accordance with their each study.
	– Pupils can produce with their clear prospects.	
Reports	– Pupils can generate and express original devices and ideas in their worksheets.	
	– Pupils can arrange their reports and materials by effective methods.	
Products	– Pupils can designate more than 2 original ideas and devices in pupils' products.	
Tests	– Pupils can get (more than 80% marks) more than 50% marks in problems of 'Device and Creativity.'	

** Gothic means pupils can do activities to get A grade. In order to get B grade, pupils should achieve to get each performance except gothic. If pupils can not achieve performance to get B grade, they are estimated as C grade.*

Table 4. The Method of Four Viewpoints of Evaluation (JS school, 2002)				
Methods	**Viewpoints of Evaluation**			
	Interest, Will and Attitude	Device and Creativity	Skill	Knowledge and Understanding
Rates	20%	25%	25%	30%
Total (400 points)	80	100	100	120
Paper Tests (two times)		10		120
Reports, Work Sheets	30	60		
Teachers' Observations	50	10		
Exercise Tests			50	
Products		20	50	

The viewpoint of Device and Creativity was evaluated by 4 methods: Pupils' Activities; Reports; Products; and Tests. Pupils were evaluated by 3 scales of grade A-C in accordance with each technological activity. This viewpoint was characterized by criteria of Pupils' Activities and Products. The point at which teachers required pupils to create many ideas is important for pupils, as can be seen in the following criteria: 'Pupils can plan their experiment and practice themselves. And, they can investigate important information by using many methods, for example, books, Internet or interview etc. to solve their tasks' and 'There are more than 2 original ideas and devices in pupils' products.'

The method of evaluation in JS school is shown in Table 4. Total 400 points were given in 4 viewpoints and the rate of 4 viewpoints was different. 'Paper Tests' was one of the most characteristic methods of evaluation. All viewpoints were evaluated by paper test in JW school, while only one viewpoint of Knowledge and Understanding was tested and evaluated in JS school. Though Skill was only evaluated by "pupils' products" and "Exercise Tests" in JS school, Skill was also evaluated by paper test and pupils' products in JW school.

The method of evaluation of U school is presented in Table 5. 'Pupils' Products' were an object of evaluation for Skill or Interest, Will and Attitude in JS school and JW school, while 'Pupils' Products' were only one object for Device and Creativity in U school. One possibility is to assume that teachers of U school stressed pupils' originality and individual character rather than pupils' skill and precision of products.

Technology Education in England

Assessment criteria and standard of AQA, OCR and Edexcel examination boards is shown in Table 6. They criteria were used to assess coursework. Pupils' coursework was assessed by two viewpoints of 'Designing' and 'Making' in AQA and OCR examination boards.

Each assessment criterion in AQA examination board was assessed by 7 grades, while assessment standard in OCR examination board set out 4 stages. The important point to note was that assessment criteria of AQA, OCR and Edexcel examination boards were focused on design process/designing. Pupils have always reviewed and reflected after completion during their projects.

Table 5. The Method of Four Viewpoints of Evaluation (U school, 2002)

Viewpoints of Evaluation	Materials	Total (200 points)	Rates (%)	The Standard of Attainment
Interest, Will and Attitude	– Observation of Pupils' Activities	70	35	63 – 70 points (A)
	– Check of Pupils' Notebooks Worksheets and Reports (Including pupils' self-assessment)			56 – 62 points (B) 0 – 55 points (C)
Device and Creativity	– Observation of Pupils' Activities	40	20	36 – 40 points (A)
	– Pupils' Presentation			32 – 35 points (B)
	– Check of Pupils' Notebooks Worksheets and Products (Including Pupils' Self-assessment)			0 – 31 points (C)
Skill	– Observation of Pupils' Activities	40	20	36 – 40 points (A)
	– Pupils' Presentation			32 – 35 points (B)
	– Check of Pupils' Notebooks, Worksheets and Reports (Including Pupils' Self-assessment)			0 – 31 points (C)
Knowledge and Understanding	– Analysis of Pupils' Answers	50	25	63 - 70 points (A)
	– Check of Pupils' Notebooks, Worksheets and Reports (Including Pupils' Self-assessment)			56 - 62 points (B) 0 - 55 points (C)
	– Tests			
	– Understanding of Regular Tests			

Discussion

Features of evaluation/assessment between England and Japan are shown in Table 7. In England, assessment criteria are focused on design process/designing. It is supposed that they have stressed to assess functional learning abilities of technological Communicating and Expressing with the design and technological process of pupils' performance such as pupils' products and portfolios. In Japan, teachers were concentrated on substantial scholastic of technological Knowledge and Understanding and Skill to evaluate objectively. It seems reasonable to suppose that Japanese teachers have encountered a lot of difficulties to evaluate 'Interest, Will and Attitude' and 'Device and Creativity' objectively. Therefore, methods of evaluation for Interest, Will and Attitude and Device and Creativity were very different and depended on each school and teacher. The evaluation criteria needs to be noted to make pupils develop their designing and portfolios. Japanese teachers were paying greater attention to portfolios in Japan (Table 8). Portfolio has been very used in 'Period for Integrated Study' in elementary school, Japan.

However, there have been a few studies on educational practice paying attention to pupils' portfolio of technology education in Japan (Sato, 1997; Nishioka, Umezawa and Miyamoto, 2001). It is supposed that it is worth using portfolio in technology education to make them reflect through all process continually. It is also suggested that technology education in Japan needs to develop viewpoints of assessment criteria as national assessment standards to make pupils develop their technological design process relevant to their individual attainment levels in Japan.

Table 7. Features of Evaluation/Assessment between Japan and England
Japan
• There were not a standardization of criteria and standard of evaluation. • Four viewpoints of evaluation: 'Interest, Will and Attitude,' 'Device and Creativity,' 'Skill' and 'Knowledge and Understanding' • A tendency attaches importance of scholastic abilities of technological 'Knowledge and Understanding' and 'Skill' to evaluate objectively
England
• There were a standardization of assessment criteria and standard. • Assessment criteria were focused on design process/designing • A tendency evaluates learning abilities of 'Communicating' and 'Expressing'

Table 6. Assessment Criteria of AQA, OCR and Edexcel Examination Boards			
Examination Board	Assessment Criteria		Points
	Designing	Making	
AQA	– Research – Analysis (of problem/task and research) – Specification – Generation of ideas – Development of solution – Planning of making – Evaluation, testing and modification – Use of communication, graphical and use of ICT skills – Social issues, Industrial practices and systems and control (including the use of CAD)	– Correction of working errors (where needed) including modifications – Use of appropriate equipment and processes (including the use of CAM) – Production and effectiveness of outcome – Level of accuracy and finish – Use of Quality Assurance (QA) and Quality Control (QC)	Each assessment criterion of "Designing" and "Making" have been assessed in 7 grades (A–G)
OCR	– Identification of a need or opportunity leading to a design brief		–
	– Research into design brief resulting in a specification		12
	– Generation of design proposals		12
	– Product development		12
	– Product planning and realisation		52
	– Evaluating and Testing		–
Edexcel	– Identify needs, use information sources to develop detailed specifications and criteria		–
	– Develop ideas from the specification, check, review and modify as necessary to develop a product		27
	– Use written and graphical techniques including ICT and computer aided design (CAD where appropriate) to generate, develop, model and communicate		–
	– Produce and use detailed working schedules, which includes a range of industrial applications as well as the concepts of systems and control. Simulate production and assembly lines using appropriate ICT		–
	– Select and use tools, equipment and processes effectively and safely to make single products and products in quantity. Use CAM appropriately		39
	– Device and work at critical control points. Ensure that their products are suitable quality for the intended use. Suggest modifications that would improve their performance		–

Table 8 Methods of Evaluation in "Period for Integrated Study"	
Teachers' Observation	88%
Pupils' Self-Assessment	85%
Portfolio	64%
Pupils' Mutual Assessment	6%
The Others 12%	

Nakamura and Sotokawa, 2001

Conclusion

Two main conclusions can be drawn. Firstly that 'viewpoints of evaluation' in Japan were four: Interest, Will and Attitude, Device and Creativity, Skill and Knowledge and Understanding. In England, assessment criteria of the AQA, OCR and Edexcel examination board corresponded to design process/designing. Secondly that Japanese teachers concentrated on substantial scholastic of technological Knowledge and Understanding and Skill to evaluate objectively. However, AQA, OCR and Edexcel examination boards have stressed to assess functional learning abilities of technological Communicating and Expressing with the design and technological process of pupils' performance by pupils' products and portfolios.

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Curriculum Design for Japanese Lower Secondary Technology Education and its Assessment of Pupils' Self-Reflective Thinking

Joint Graduate School in Science of School Education, Hyogo University of Teacher Education, Japan

Daisuke Itoh, Graduate Student, Joetsu University of Education, JAPAN

Sadato Yamazaki, Lecturer – E-mail yamazaki@juen.ac.jp

Abstract

The first purpose of this study is to design a school-based curriculum for Japanese lower secondary technology education focused on pupils' self-reflective learning activities. The second is to develop a system to support pupils' self-reflective learning activities and to associate them with curriculum improvement by using the wireless LAN system. In this case study, we focused on Grade 8 pupils in a compulsory technology and homemaking classroom in the Lower Secondary School attached to the Joetsu University of Education. After each coursework, pupils reflected on the work of this class and entered it by network-connected personal digital assistance. Then, the data entered by them was discussed with regard to how to plan the next class and how to improve teaching and learning process. This process was continued throughout the whole unit of work.

From this case study, we will show a 'process of curriculum design' from the following viewpoint.

1) Relation between 'planned curriculum' and 'performed curriculum'
2) Pupils' technological troubleshooting activity in this coursework

Introduction

As we have introduced the Period of Integrated Study since 2002, it has been important to design a school-based curriculum in Japan. It does not have common contents. However, there have been a few studies on curriculum design for Japanese technology education (Itoh & Yamasaki 2001) pointing out that the reason was as follows:

> *Many researchers and educators focused on the development of 'what pupils make' and 'what and how teaching tools technology researchers and teachers develop.' However, it seems that most of them did not have the viewpoint of 'context,' 'meaning,' and 'relationship' between 'curriculum,' 'learning contents,' 'making artefacts' and 'teaching tools.'* (Itoh & Yamazaki 2001 p.215)

On of the main reasons has been to make teachers not develop an authentic concept 'curriculum.' Many teachers and researchers in Japan have identified that the curriculum developer has been the Ministry of Education rather than the teacher.

In this study, we have the following two aims: The first aim is to design a school-based curriculum (Skilbeck 1975 p.104) for Japanese lower secondary technology education focused on pupils' self-reflective learning activities. The second is to develop a system to support pupils' self-reflective learning activities and to associate them with curriculum improvement by using the wireless LAN system.

There were some technology curriculum studies based on reflective thinking in U.K. (Orrell1998). Only a few studies such as Higichi (2003) and Sunaga (2003) with reflective activity have been reported in Japanese technology education.

Method

Approach to Curriculum Design

According to Hills (1983 p.121), Curriculum design' could be summarized as the 'setting of relationships in materials and learning'. The question now arises: how to design a curriculum. From the viewpoints of 'method' and 'composer', its approach may be divided into two types.

The Japan Ministry of Education introduced two approaches to curriculum development in 1975. One was the 'Technological Approach'; the other was the 'Rashomon Approach' (Atkin 1975 pp. 157-159). The 'Technological Approach' was a model based on educational engineering, and the 'Rashomon Approach' was a context-dependent model with interaction between pupils, materials and teacher.

Satoh (1996) reported that the 'Technological Approach' was concerned with 'Research-Development- diffusion (RDD)' model, and the 'Rashomon Approach' was related to the 'Practice-Remark-Design (PRD)' model (Satoh 1996: pp.32-38). In RDD model, curriculum developers were composers that arranged the 'National Curriculum Standard.' On the contrary, curriculum developers were schoolteachers in the PRD model.

Consequently we designed a useful approach for 'School-based Curriculum development' with the 'Rashomon Approach' and the PRD model (Figure 1).

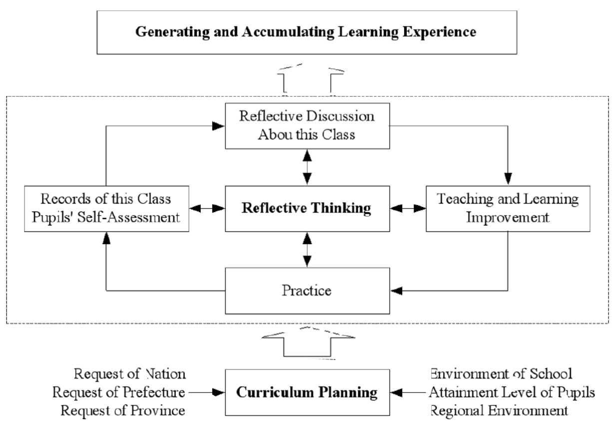

Figure 1. Approach of Curriculum Design in this Study

System Development

In a process of curriculum design, one of the most important things is pupils' and teachers' reflective thinking and the interaction between the two parties. After every class, teachers reflected on the 'performed curriculum' from pupils' notebook, worksheets, videotape recording of the class etc. at a department's staff meeting for teaching and learning improvement. The data of pupils' self-assessment information about the endeavours of a class was useful for the improvement of the teaching and learning process.

Yamada (2001) developed software based on web-services to associate pupils' self-reflective learning activities with curriculum improvement. Yamada's software, however, had problems that pupils and teacher could not use it without going to the computer room. Therefore we tried to improve Yamada's software using the wireless LAN system from the following viewpoints:

1) Solution of locally and temporal restriction
2) Efficiency of data collection and its analysis
3) Support for the development of pupils' self-assessment capabilities

Next, we would like to describe the outline of software developed in this study. The purpose of this software is to upload pupils' self-assessment information on the web service and to share it with pupils and teachers. This software could update the ODBC Database using 'Internet Database Connector', one of the functions of Internet Information Services 5.0. We used Microsoft Access 2000 as Database software. A conceptual diagram of this software is shown in Figure 1. Its function is indicated in Figure 2. The items of the questionnaire would provide the data required for teaching and learning improvement in the study is shown in Table 1.

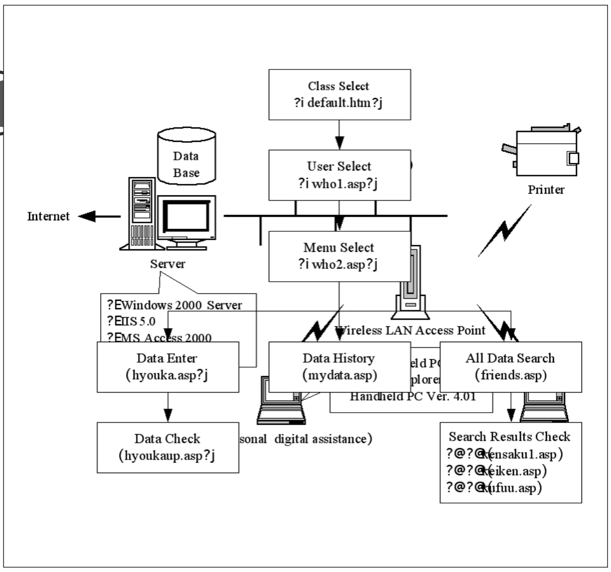

Figure 2. Function of the Curriculum Improvement Support System

Table 1 The Items of Questionnaire for Teaching and Learning Improvement
Please choose the appropriate entry
1) I could study with a perspective in this class.
2) I could act, having a motivation for this class. – absolutely non-applicable – non-applicable – not very applicable – applicable – well applicable – absolutely applicable
3) What is a transferable knowledge or skill within this learning for other subjects' study or daily life? (in writing)
4) What is a creative action or thinking for the learning in this class? (in writing)

Action Research

The Technology and Homemaking Department at the Lower Secondary School attached to the Joetsu University of Education cooperated in this action research from September – October, 2003. Participators were Grade 8 pupils in a compulsory technology and homemaking class. The analysis of data was based on technology classes in this school.

Curriculum and Modules

The curriculum and modules used within this study are shown in Table 2. This curriculum was composed from four modules to develop knowledge and skills for designing and making a communicating tool for 'telephone game'. The main target of each module was to:

Module 1: Understand and apply electric components to a circuit, e.g. resistors, diodes, batteries and LEDs etc. and those circuit symbols

Module 2: Understand, select and use a range of appropriate construction methods for easy electronic circuits

Module 3: Design and make a unique communicating tool, and continually evaluate the designing and making at whole technological processes

Module 4: Develop a web page on our own products and the efforts in this coursework.

Table 2 Curriculum and Modules

Module	Action
Module 1	What kind of communicative method do you know in daily life?
Module 2	Let's make a simple communications tool by LED.
Module 3	Let's make a unique communications tool and play 'telephone game.'
Module 4	Let's make a report by web page.

Results and Discussion

'Planned curriculum' and 'performed curriculum'

The 'planned curriculum' and the 'performed curriculum' in this research are summarised in Table 3. The key change in our practical research was in Module 2. In the 'planned curriculum', pupils should be able to understand, select and use a range of appropriate construction method thorough making an easy communicating tool using LEDs. After Module 1, however, there were many pupils worried about their capabilities for designing and making a unique communicating tool. For example, pupil A told about the class on 11th September, 2002.

Teacher said to us 'Let us design and make a communicating tool!' But I became anxious. Because I have little knowledge of electronics, and I am uncreative! I would like to leave the matter for the time being.

We changed Module 2 as shown in Table 2. The target of Module 2 was focussed on understanding and using a soldering technique through making a 'Battery Box.'

Table 2 Curriculum and Modules

Module	Action
Module 1	What kind of communicative method do you know in daily life?
Module 2	Let's make a simple communications tool by LED.
Module 3	Let's make a unique communications tool and play 'telephone game.'
Module 4	Let's make a report by web page.

Progress of Self-Assessment Score

The progress of self-assessment score on answers of Q1 and Q2 in the questionnaire is indicated in Figure 4. There were increases in each area on 20th September 2002. The learning contents of 11th September were composed of 'communication tool' and 'electric resistance.' Pupils generated and developed ideas for their products, or designed their specification in the class on 20th September. The score for Q1 rose to 4.44 on 30th September. Then it fluctuated between 3.94 and 4.75 till 24th October. On the other hand, the score of Q2 kept rising till 26th September, and remained at about 5.00 until 11th October. Although there was sudden drip, it rose to its peak on 24th October.

From pupils' reflective descriptions and the answers to Q3 and Q4, we suppose this transition were caused by the following factors:

1) There were increases on each score in the designing and making activity. Therefore it seems reasonable to suppose that pupils easily have 'perspective for their 'activity' or understand the 'target of learning' as a passive learning style rather than an active learning style. Since pupils have wanted to study in an active style (Itoh & Yamasaki 2002 p.21), they could play active roles in the designing and making activity.
2) A difficulty on making their product or the defective working of their product caused the decreasing of scores of Q1 on 8th and 16th October. The effect of the 'telephone game' on 24th October was to increase of each score.

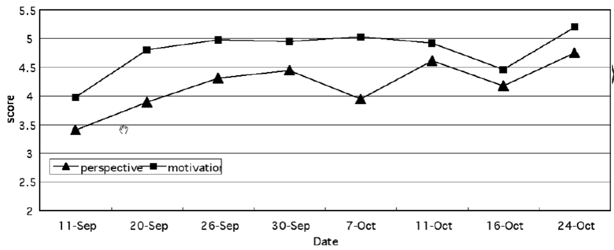

Figure 4. Progress of Self-Assessment Score

T-test Analysis

The results of T-test analysis of self-assessment score related to 'perspective for this class' are shown in Table 4 (over). The results of Table 4-3 and Table 4-5 were significantly greater. The pupils' activity on 11th October was the presentation of the outcome in the coursework. In the class on 8th October pupils received the information about the activity and its viewing on 11th October. And they began to understand the view of 'telephone game' from 16th October. It is important that pupils receive information about the activity in their next class to learn their views.

Incidentally, we may say that there was a significant decrease in Table 4-4, because their product was defective.

Next, the results of T-test analysis of the self-assessment score related to 'motivation of this class' is shown in Table 5 (over). The results of Table 5-1 and Table 5-3 were significantly increased. On the contrary, the results of Table 5-2 were significantly decreased. The reason might be the effect of an active learning style or the telephone game by using pupils' products. We think defective

Table 3 Curriculum Planning and Implementation

Module	Planning	Implementation
Module 1	What kind of communicative method do you know in daily life?	What kind of communicative method do you know in daily life?
Module 2	Let's make a simple communications tool by LED.	Let's make a 'battery box.'
Module 3	Let's make a unique communications tool and play 'telephone game.'	Let's make a unique communications tool and play 'telephone game.'
Module 4	Let's make a report by web page.	Let's make a report by web page.

Table 4 The Results of T-test Analysis in Self-assessment Score Related to 'perspective for this class'

Table 4-1

	11th Septempber	20th Septempber
Mean	3.37	3.83
SD	1.30	1.39
		t(29)=1.37 ns

Table 4-2

	30th September	7th October
Mean	4.43	3.94
SD	1.12	1.43
		t(34)= 1.58 ns

Table 4-3

	7th October	11th October
Mean	3.91	4.68
SD	1.44	1.04
		t(33)= 3.15**

Table 4-4

	11th October	16th October
Mean	4.68	4.17
SD	1.04	1.34
		t(33)= 2.31*

Table 4-5

	16th October	24th October
Mean	4.17	4.83
SD	1.34	1.15
		t(34)=3.78**
		+p < .05 **p < .01

Table 5 The Results of T-test Analysis in Self-assessment Score Related to 'motivation of this class'

Table 5-1

	11th September	20th September
Mean	3.97	4.77
SD	1.47	1.04
		t(29)=2.85**

Table 5-2

	11th October	16th October
Mean	4.94	4.47
SD	1.01	1.29
		t(33)=2.03+

Table 5-3

	16th October	24th October
Mean	4.46	5.20
SD	1.27	1.05
		t(34)=3.75**
		+p < .10 **p < .01

Note: Pupils' activity or learning contents at each date were composed as follows: Module 1 on 11th September: electronic components, Module 3 on 20th September design of a product, Module 3 on 7th October making, Module 3 on 11th October presentation of the product, Module 3 on 16th October maintenance of the product, Module 3 on 24th October telephone game.

working of their product would give rise to the significant decrease in Table 5-2.

Correlation Analysis

We have already discussed the transition of the self-assessment score in Q1 and Q2 a little earlier, and now focus on the relation between 'perspective' and 'motivation' in each score. The results of correlation analysis between 'perspective for this class' and 'motivation of this class' in the self-assessment score is shown in Table 6 (right). Its relation was not significant in generating ideas of a product on 20th September and before finishing a product on 8th October. Therefore, there was a range of correlation between their 'perspectives' and 'motivations' in their self-assessment scores. However, its relationship was dependent on its context of pupils' activities.

Pupils' Technological Troubleshooting Activity

In accordance with the above discussion, it is likely that trouble with soldering or the product had an effect on the transition of the pupils' self-assessment score. We must look carefully into how to troubleshoot and its process. Let us discuss the process of technological troubleshooting of Group E-1 from its members' description and the results of our participant observations.

Group E-1 made slow progress in the making of their product, because of the change to its specification. The circuit of their product was completed on 7th October. They found the error in the circuit, however, when they checked it in the coursework on 8th October. Unfortunately, it was too late because, they wound the insulating tape round the points of contact between the switch and the conducting wires to prevent a short circuit, from the idea of Pupil B, member of Group E-1. Pupil B reflected on the work sequence and wrote the following comments:

Do not use insulating tape in the circuit without a cable check! And we must not use packing tape as an insulating tape.

Afterwards, they removed the insulating tape from the circuit and tested it. There are many methods of checking cables in a circuit, and Pupil E checked it through lighting the LEDs by using a battery box and conducting wires. In addition, Pupil D troubleshot it by a tester, and found a 'disconnection' and 'bad electrical contact' as the reason fro the error in the circuit. When they identified the trouble spots in it, the coursework was completed. Pupil B reviewed the reasons for the error in the product, and wrote them as follows:

> *'In this class, we confirmed that our product was only marginally functioning as a communicating tool. But we are still a long way from being there because there are trouble spots caused by the insulating tape in our circuit. In short, the coppery cables were disrupted by removing the insulating tape!'*

Table 6 The Results of Correlation Analysis in Relation Between 'perspective for this class' and 'motivation of this class' in Self-assessment Score					
Date	Pupils' Activity or Learning Contents	r	df	t	Coefficient of Determination
11th September	Module 1: Electronic Components	0.68	31	5.02**	45.67
20th September	Module 3: Design of a product	0.17	34	0.99	2.91
26th September	Module 3: Making	0.65	35	5.04**	42.71
30th September	Module 3: Making	0.68	35	5.43**	46.45
7th October	Module 3: Making	0.07	34	0.41	0.50
11th October	Module 3: Presentation of the outcome	0.39	35	2.26+	15.00
16th October	Module 3: Maintenance of the product	0.75	34	6.50**	56.12
24th October	Module 3: Elephone game	0.78	34	7.27**	60.82

+ p < .10 **p < .01

After-school, each member of E-1 soldered the contact points between switch and conducting wires with care, and finished the circuit and verified it in working condition. There were insecure joints between the circuit board and the switches, and it was realized that it was a reason for inducing errors in the circuit on 9th October. Then they determined to fix the switches on the circuit board by a plastic board. They manufactured a plastic board, verified the product in working condition, and completed it.

From the above, we can see that pupils in Group E-1 found reasons for errors in the circuit, troubleshot it, and finished the product by themselves.

Comprehensive Discussion

Phases of Curriculum Designing and Its Improvement

We can point out that there were three phases of a curriculum designand its improvement in this study. The characteristic examples of each phase can be summarised as follows:

- In a Class
  It means that in a class, a teacher assesses the attainment level of pupils and makes changes to sequence of activities, teaching method, learning style etc. if appropriate. In this case, a curriculum design and its improvement depend in large measure upon teacher's practical ability.
- After a Class
  This means that after a class, a teacher reflects back on his/her practice and makes improvements to the 'planned curriculum' in accordance with pupils' descriptions or recorded images of the class. This case study accords with the change in Module 2.
- After a Unit
  This means that after a unit, a teacher discusses the 'performed curriculum' in accordance with descriptions of worksheets, notebook and pupils' products, and designs a curriculum for the next school year. In this study, it corresponds to the analysis of self-assessment score and descriptions above.

Curriculum design is polysemic, and there are various phases to it. Therefore, the viewpoints above may be useful when discussing the curriculum.

Pedagogical Implications

In this case study, the key point in the change of the 'planned curriculum' was pupils' worrying about their capabilities in designing and making a unique communicating tool. Pupils could finish their product, by the extension of Module 3 and detailed support for coursework, depending on the context of the classes. Therefore, identifying what is going on in a class is essential to curriculum improvement. In doing so, focusing on pupils' self-reflective activity to identify what is going on in class is very helpful in designing a school-based curriculum, and it might be the keyword for changing the view of the curriculum in Japan.

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Characteristics of Factory Pictures – Results of a Research Project at German Primary Schools

Carl von Ossietzky Universität Oldenburg, Germany

Astrid Kaiser – E-mail astrid.kaiser@uni-oldenburg.de

The Term of Learning Preconditions

In the theoretical concepts of didactics, the construct of the subjective 'entrance ways of the learners' has been applied since the time of Comenius as a – partially the – deciding size for "good" or successful instruction. For this construct, no uniform terminology has been developed in scientific discourse so far. Comenius described in the Didactica Magna this construct with nature categories of "enwrapped in the humans" property, which should be "peeled out in an educational way and unfolded" (Comenius 1904 (2), S. 40). Diesterweg demands a "knowledge of the point of view of pupils" (Diesterweg 1835) as the condition for successful education.

Later, terms (in each case accented differently) developed in the didactical discussion, such as previous knowledge, preconditions for learning, previous experience (Koch-Priewe 1995), previous understanding (Girg 1994) or anthropogene preconditions (Heimann, Otto, Schulz 1968). Thereby the entire of attitudes, knowledge, perceptions, valuations, value orientations, abilities and interests, which the pupils bring content-specifically and potentially into lessons, is meant. Here, they are taken as learning preconditions. Even some instruction theories, which are related explicitly to this subjective precondition structure of instruction, are formulated as "pupil-centered instruction" (Wagner u.a. 1976).

Despite the recognized relevance of the knowledge of preconditions for learning, there is a big deficit in the empirical state of research. The editorship of the *magazine for pedagogy* has therefore formulated in the theme magazine 7-8/1992 this problem as a question: "What do we know about our pupils?" This is also related to the internal structure problems of the category "learning preconditions".

Learning preconditions are pragmatic in the sense of categories specified to instruction. They are not bound to special, more exactly defined personality dimensions (e.g. motives, attitudes), but are to be understood as extensive, because children bring their whole person into the learning situation. Nevertheless, not all aspects are updated in every learning situation. To that extent, the preconditions for learning also depend on the specific content of the learning situation, which for example adresses only a certain knowledge or attitude. However learning preconditions are not restricted to the cognitive dimensions, even though the learning stimulation aims primarily at knowledge or wisdom. Learning preconditions always embrace cognitive, ethic, social and practical-handled dimensions (Kaiser 1995).

The construct "learning precondition" symbolizes (concretized to the subjective level) central social patterns, settings of norms and differentiations. Also the construction of the gender relationship can be clearly reconstructed to learning requirements and their gender-related differentiations.

There are actually no learning preconditions, but they become relevant in only in didactical contexts and there, they do not exist objectively, but as constructs of the people who are involved: teachers, children and researchers (Duit 1995). Simultaneously, they are relatively independent on the aim-dimensions. Aims could be developed, which strengthen or stabilize each learning condition or the ones, which they intend to transform.

Learning preconditions can be formulated in different width of the forms. They can be related to empiric isolatable attitudes, be extended to motor ability potentials and they can embrace a construct of attitudes, elements of preknowledge and already made acting experiences or they can contain cognitive contradictions as motivating preconditions for further learning.

Learning preconditions do not exist as conditions that can be understood individual-psychologically, but they are also social factors of learning in a class. So, didactically seen, a graded perception of differentiations within a group of learners can mean that there are educational starting points for relating dominating attitudes or perception patterns.

Preconditions for learning are in the long run only subjetive theories of the children, which are understood and considered in the didactical context, namely in the sense of one of the two term definitions by König, which are broadened by emotional and acting dimensions: "Cognitions of self- and worldview" (König 1995, S. 12).

Here, the learning preconditions are understood as cognitive, affective and behavior-referred personality dimensions of a learner or a group of learners, who are introduced to a new learning situation due to past experiences and then influence the new learning processes. Knowledge, terms, questions, situation interpretations, attitudes, expectations, behavior dispositions and behavior strategies are aspects of learning preconditions, which are actualizable in certain educational contexts.

Project for the Research of Learning Preconditions within the Range of Technology/Social

Duit (1992) has documented several thousand empiric studies in learning preconditions for scientific education. When we ask for the gender reference, we seldom find something. That is why I present my own empiric study that I have performed in 25 different primary schools in the region Bielefeld (Kaiser 1996b).

I want to document, with the help of a very extreme example of my research project – the project "dream factory" – in what way there are two "hidden curricula" for boys and girls in the lesson topic "factories", which seems at first to be matter-neutral.

The Character of the Project

The impulses of this lesson unit are very simple:

- Question of the teacher: "What factories do exist?"
- Question of the teacher: "Which factory would you like to build/choose for yourself?"
- Request to draw a factory after the own imaginations on a paperboard in groups, which were almost put together sexes-homogeneously.
- The presentation and explanation of the created factory pictures in front of the class is following.
- Impulse questions which are asked to the point ("Are the people who are working in your factory having fun?" – "Are they all german?" – "What do these people wish?")
- The steps 3 to 5 are executed analogously with the topic "factory in the year 2000" the following day.

At the end, the investigation for each class resulted in an extensive minute collection of the statements of the children in the group work and the class discussions and many colored pictures of factories. To interpret this material is not easy. Statements or pictures of pupils express in no way directly their knowledge or their consciousness. The factory pictures are not only structured by the knowledge of the children, but also by their aesthetical statement purposes and by special conditions for the drawing (e.g. seat order). But that what is painted and said and how it is painted and said can be interpreted as expression of personal applied and filtered perception. Not everything what the children think about factories and work is expressed there. But the given impulses lead obviously to the fact that the children – in the frame of their communicative situation – present many of their important imaginations of the working world.

Results

The result was very surprising for all involved adults: the pictures that were drawn in the groups of boys looked different than the ones drawn by girls. In the groups of boys, there were developed very complicated, often in several floors structured factories, in which already very technically mature machines fulfilled their functions in the work partial production process. Humans were only besides. The pictures of the girl looked much more colored, vivid and illustrative. Usually, the working life in a department (often packing department, tincture department or storage department) is presented very detailled and lively. The working people are big and clearly drawn. Their concrete working executions are obvious to identify.

When we have a closer look at the pictures, this impression is strengthened:

Every viewer of the factory pictures remarks that some pictures are outstanding because of their technical perfection and differentiation, while others give a very human impression because of the big and clearly drawn workers. Such differences occur in all classes between boys and girls. The pictures of the girls appear more colorful, the "factory rooms" appear to be comfortable. Clearly drawn workers can be recognized within their concrete working processes. On the contrary, the pictures of the boys look less kind: functional pipe systems, several floors of the factory, different part processes that are related to each other and different production departments, controlling desks and machines dominate the pictures. When we look at this impression in three (subjective) comparing criterions, namely presentation of humans, presentation of technical-functional relations and presentation of spatial structures, further differentiations of the differences between boys and gils arise from it.

The Humans in the Factory

The factory pictures of the girls look very vivid: many people, workers can be seen at their special work. Usually, they carry, pack, sort or color the products. They are painted big and clearly, their clothes are colorful and decorated with many details: Even patterns, ribbons, belts and buttons are recognizable. The humans have – as far as it is possible for pupils in primary schools to draw – expressive faces that are sometimes supplemented with speaking bubbles ("Pooh, this is hard").

On the contrary, the pictures drawn by the boys present no humans. If humans appear, they are usually drawn as little stick figures with a more male identity, who drive fork-lifts or heavy vehicles, conducting them and prosecute chef or custodianship functions.

Technical Aspects of the Factory

The factory pictures of the girls are rarely equipped with technical elements and machines. The machine arsenal is limited to conveyor belts and sometimes to black-box-machines. Technical details (e.g. cogwheel) usually stand functionless or isolated in the picture. On the contrary, the pictures of the boys contain complex technical systems, in which each function place is connected by canes, cables or electric pulse triggers. A variety of production-equitable machines (mix basins, press containers, installation ways, smelteries, switching boxes, control desks) can be seen and a deliberately differentiated pipe system, which seemed at first sight to be very complicated, complement the monotonous standard factory inventory of the boys. The production machines are complemented by transporting vehicles for material delivery, removing of products and inner-functional transports of products that are half done. Technical details like claw arms are drawn very detailed and differentiated.

The Spatial Structures of the Factory

There is also a difference in the spatial structures between boys and girls. The boys draw huge factories with several departments, usually with several floors. The girls usually portray only one department – often the packing, coloring or storage department of the finished product – and they depict here the "social details" (ventilator, security bonnet, speaking bubbles of the workers which present the exertion), as well as the product, which they had drawn with much care. They provide their pictures with many decorations, too. But also the way the boys and girls talk about their factories, what is important in their opinion, and how they react to the questions shows a clear gender-specific molding.

Girl talk, more than the boys, about the working people, they think of social problems, conditions at work (light, air, noise, demand) up to the question of family income in unemployment or lack of communication at work as a result of the inset of roboters.

Boys, on the contrary, talk more often about the fact if the drawn machines, connection canes and so on are technically functional. They think that professional work means money purchase.

For the characterization of the gender-specific differences, the following chart should serve as a survey. The single features do not occur in all pictures and there are also differences in some points.

Similar examinations were done later with this or a variant formulation of the question (e.g. to the topic working world, city planning or future) with similar results (Aissen-Crewett 1989; Kämpf-Jansen 1990; Appel 1990; Staudte 1991).

Results of the Lesson Conversation Analysis

Besides the pictuers of the factories, also the collection protocols were evaluated in the project working world. Firstly, the protocols were divided in diagnostic learning situations (DL) (e.g. the explanations of the pictures in front of the class, DL 5,

Table 1

Frequent features in the factory pictures of the girl group	Frequent features in the factory pictures of the boy group
The factories mostly consist of one room in side-view.	The factories are sketched often with several floors or in a bird s-eye perspective
Apart from the standard element of all factories, the conveyor belt, hardly any machinery processes are shown.	Technical elements and equipments are shown in their correct function. The equipments often show many different mechanical elements.
Even on the conveyor belts, there are placed a great variety of products and types of products (toy car, doll, ball, teddy,…).	The product is drawn as a standardized mass product.
They are often limited to the packing department or the coloring of the products.	The groups draw a widely extended production process often reaching from the delivery of raw material to the transport of the goods.
Manual working processes (putting chocolates in the refrigerator, painting garden dwarfs, putting sweet into boxes) outweigh.	Work is mostly mechanised, is confined to operating machines, controlling or supervising activities and driving of transport vehicles (fork lifts).
The production is – always in relation to the boys of the same class – nearer to private consumption: e.g. sweets, cuddling pets, chocolate, discs or toys factories.	The boys chose products which admit a greater emotional distance and are considered to be “harder”: plastics, helicopters, beverages, heavy vehicles, waste products recycling or destruction factories.
The people are drawn huge and detailled, many women work in the factories.	Less people – very small and hardly distinguishable – are shown. In classes having a high quote of foreigners, it is especially emphazised that women are not working in the factories.
The pictures contain not many references to hierarchical relations, but more cooperation between the workers.	The boss and his room (sometimes the room of the master) are often accentuated and placed in the top floor.
Decorative details like uniform working clothes with flower patterns, tablecloths on the packing tables, ribbons round the chocolate packs can be seen in many places.	Decoration is limited to the nameplate of the factory.
They emphazise “social” details like head-cloths for dust protection, toilets, cigarette automat for the breaks and they are drawn with big accuracy.	Social details can hardly be found.
	The profession of machine “controllers” is drawn very often.
The working process is presented very human vividly. The workers play an important role.	The picture of an alienated production without essential human intervention possiblities stand in foreground.
Female and male workers are drawn to be equally important for the production.	Female workers are usually overseen.

Source: Kaiser 1996(2)

Table 2 Conversation Analysis: Quantitative Data						
Sexes – Specific Distribution			Boys		Girls	
For DL 3/4/5 categories	Absolute frequency	% share of the categories with total number of the statements	Absolute	%	Absolute	%
Ma (draw-technical statements)	307	10	120	39	187	61
P (product mentionned)	509	17	230	45	279	55
E (non-technical furnishing objects)	227	9	123	54	104	46
MA (machines)	262	9	128	49	134	51
Te (technique)	242	8	177	73	65	27
PV (product supply)	293	10	145	49	148	51
Tp (parts of the product)	209	7	154	74	55	26
Me (humans)	145	5	40	28	105	72
Ar (workings of the humans)	131	4	45	34	86	66
Sch + Soz	134	5	31	23	103	77
VVM + Si + U	109	4	69	63	40	37

Source: Kaiser 1996(2)

answering to given questions, DL 6a, b, c, …). Within the diagnostic learning situations, all announcements of the children were assigned in categories.

During the drawing and explaining of the factory pictures, the expressions of the pupils (evaluation units) of the observed class in the primary school were recorded; these expressions are distributed to 21 different categories. For DL 3 (drawing), drawing-technical declarations occurred the most. The declarations, that were related to content aspects of factories, are presented in the following chart, where the categories that were quoted the most are introduced:

The variantful statements referred to the thing itself make at first clear that primary school pupils are in no way overstrained with the topic factory work, but they think about it with many aspects. The spectrum of their statements starts at the product, the technical and mechanical equipment for its production, the concrete work executions of the humans, their working burden und "social interests". Their statements stay – accoring to the task – referred mainly to the concrete single-operational level. But at the same time – like the text fragment analysis shows – the pupils hint, if possible, at relations that go far beyond it like origin of the production raw material or problems of the supporters of the unemployment insurance.

In the categories VVM, Si, Soz, U with a percentage portion of 6 % of all statements refer to thoughts that are detached of the immediate concrete point of view.

When we look at the decoding by gender at the chart, you can see that girls and boys clearly differ in certain categories. Statements of the girls outweight very clearly in the categories that are related to human works like Ar, Me, in the categories that deal with the improvement/ beautification of the working situation and the product like Sch and Soz, as well as in the direct description / nomination of the product (P).

The statements of the boys outweight especially in the categories Te and TP. That means that boys are much more concerned with technical elements and their analytic point of view of the production.

The results of the categorization for the lesson passages during drawing and explaining the factory in the year 2000 (DL 7,8 and 9) have a similar profile. At first, it is remarkable how aspect-rich the children work at such a task. Besides the known contents, questions for the alteration processes (Aut) are mentionned, which are due to automatization, technicalization, rationalization and effectiveness, which bring up the control of working processes and working tools (K), as well as roboter (R) as a symbol for childish future imaginations to discussion. The following chart shows the quantitative distribution of frequent mentionned categories or assembly categories for DL 7,8,9.

The categories K (control) and H (hierarchy) are not mentionned in this chart, because they are not frequent, although the boys dealt – more often than the girls – with the topic control of the products.

Concerning these results of "factories in the year 2000", it is very interesting that the differences between boys' and girls' statements are not as significant as with DL 3,4 and 5. The approach occurs in both ways. Both in the boy-typical (Te, TP) and the original girl-typical (Ar, Me) features, there is a more balanced distribution between the sexes, in TP there is even a total abolishment of gender-specific differences. For this development, there are two explanation variants: firstly, the impulse to draw a "factory in the year 2000" provokes a clearer molding of features that are technicalized. But this does not explain the approach of the sexes within the girl-specific features which are more related to persons. The thesis that girls and boys

Table 3 Factory in the Year 2000						
Sexes – Specific Distribution			Boys		Girls	
Categories	Absolute frequency	% share of the categories with total number of the statements	Absolute	%	Absolute	%
Social aspects (AB + Soz + Sch)	82	4	22	27	60	73
Working people (Ar + Me)	141	6	47	33	94	67
Technique and change (Te + R Aut)	430	19	244	57	186	43
P	340	15	172	51	168	49
Technique and machine (Te + Ma)	605	21	262	43	343	57
PV	190	8	82	43	108	57
TP	161	7	87	54	74	46

Source: Kaiser 1996(2)

influenced each other by their products and discussions about the "factory today" seems to be an appropriate explanation.

If this thesis is true – and there is some proof in the protocol texts which shows explicitely how boys and girls influence each other – this would be the proof for the effectiveness of co-educational breeding and for the content-balanced effect of shared discussions of boys and girls.

Culture-comparing Study in Indonesia

To proof the cultural conditionality and therefore also the variability of gender differences, I did a field-research-study at the "matrilinear Minangkabau" on Sumatra (Kaiser 1996), in an agricultural culture, in which even today the possession of house and ground lies in the hands of the women, the succession is in female line from mothers to daughters (matrilinearity) and the husband clearly has to live in the house of the wife and her mother (matrilocality). In the first half of this century there was the "Besuchsehe" (visit marriage), which means that the men worked and lived mainly in the own mother-house (Benda-Beckmann 1985). Further concrete clues for my questions were some exceptions which are clearly and noncontestably proven in the recent Minangkabau-research. So, there is agreement in the fact that the Minangkabau still emphazise the "adat" (their traditional right and norm system with emphasis on the high position of women) and that there are still adat meetings of the men in fundamental matters of public affairs like in the precolonial aera. The adat language of the men is explained by a strong traditional recourse to the common norm system (Doormann 1990), in which the speech acts do not produce or emphazise hierarchic relations between the participants, but strengthen the common ritually. This non-dominating way of communication is also presented as being related to the self-defense ability of the Minangkabau (Cordes 1990).

My research hypothesis in the culture-comparing context is that the other social gender relations of the Minangkabau is also verifiable in the imaginations of the children at drawing.

By means of the loading capacity of picture analysis for symbolic-cultural contents, I have done a comparing study to the studies, which are in hand in the german-language countries. The study of factory pictures and future imaginations was done in Magek, a village in the main part of the Minangkabau in West-Sumatra and it should examine, if the social central problems in the working world and the future are seen in the eyes of the Minangkabau children as gender-different as in Germany. Therefore, I have let made 250 pictures with two different topics of indonesian children in primary school. The first topic was to draw a factory after the own imagination, the second topic "future" had to be rephrased to "Magek in 100 years" for the village children of Magek who live in their traditional society.

The many daily observations of clear gender differentiation – from separate living and education places for growing girls (mother house) and boys (Surau) up to gender-separated weddings – make you expect also similar differences in the making of factory and future pictures of the children.

But at first sight, the pictures of the children in West-Sumatra appear to be irritating with regard to the local gender-different picture analysis: The Minangkabau boys draw the persons of the working as clearly as the girls here in Germany. Details of the clothes and the face gesture differ. Also the future vision of the boys are very nature-near, even though they try hard – like their female class buddies – to draw symbols for technical developments, like hotels, higher houses, cars or conveyor belts. It is very astonishing that the girls, too, draw these technical elements very often.

While the factory and future pictures from the german primary school classes can be clearly assigned to the gender of the drawing child, the pictures of the Minangkabau children appear to be very homogenous, in spite of the usually stiff gender separation and gender differentiation.

The results of the quantitative analysis also show different outcomes than the study in Bielefeld. There are – different than with the picture analysis in our culture – hardly significant differences between the gender in the quantitative analysis of the various counted and evaluated features of the pictures. For the topic "factory", different features were examined by means of a raster of 77 categories (e.g. number of people; size of the people; numer of the different clothes elements; frequency of manual production; technical elements like drive wheels, machines, conveyor belts, conveyor belt pillars and so on; number of fork-lifts and heavy vehicles) with the Chi-quadrat-test for significant differences. I have compared the pictures for the topic "future" with the help of 78 different categories (e.g. number and gender of the drawn people; clothes elements; living inventory; flower docoration; nature elements like trees, cloud, sun, plants, vulcanos, animals; means of transport; roads; traditonal symbols like the waved roof with several peaks or a Surau; national-public symbols like flags and flagstaffs).

In comparison to the study in Bielefeld, which showed a variety of significant differences between the pictures of the boys and girls, most of the checked categories of the pictures of the Minangkabau children showed no significant differences. The quantitative study showed significant differences only in some categories. These again showed mostly opposite tendencies in comparison to the study in Bielefeld, which are summarized in the following contrast result thesis:

- The german girls draw much more frequently humans in their factories, whose summed up seize, average seize, number of workers and number of recognizably drawn clothes were articulated much clearer than in the pictures of the boys.
  Concerning the pictures of the Minangkabau, the boys draw more frequently humans in their factory pictures than the girls did.
- The german boys draw more technical details and technical structure elements of the factory than the girls. The length of the pipe systems, the number of product raw material, product standardization and automatized steps were presented more clearer by the boys than by the girls.
  The Minangkabau boys and girls draw technical details nearly to the same extend, only the girls draw much more turning wheels.
- The girls of the two cultures both draw many female workers, while the boys of both cultures preferred to draw mostly male workers in their factory and future pictures.
- The same goes for the boy s predilection to draw heavy vehicles in their factory pictures and cars or street in their future pictures of both cultures.
- In the future pictures of the boys of the Minangkabau, there are much more animals than in the pictures of the girls.

The quantitative results proof the hypothesis of the cultural conditionality of the molding of gender differences.

The results indicate that also with regard to quantitative-formal data, like number auf drawn people, their size and details, number uaf drawn animals in the future pictures, the thesis of the lower person-orientation of the boys does not apply for the Minangkabau. It rather seems to be a tendency of the boys towards greater observance of persons. Also the thesis of the greater abstinence of technique in the pictures of the girls can not be proven with the available data for the Minangkabau children.

The stereotypical assignment of person-orientation towards the female gender and from technique-orientation towards the male gender can not be proven for the pictures of the Minangkabau children. Here, the gender relations seem to be in opposition to our stereotypes. All in all, you can neither speak of an inversion of the gender relation with the children of Minangkabau, nor of an assimilation. The picture of the missing distance between the two genders outweight: girls and boys both draw beautiful flowers and landscapes, conveyor belts and machines, tools and skyscrapers. In a few catergories, the Minangkabau boys match to the local boys. So, they also are interested in cars, streets and other motor vehicles.

Historical Evidence: Natural Science and Technique in the Interest Horizon of Girls

To see the technical distance of girls as historically changeable and not genetically defined, I have considered empiric studies from the 19th century to compare it with this study (Hartmann 1886).

The examination was done with no questions concerning gender thematics, but aimed at the acquisition of knowledge about learning preconditions of school beginners. The goal was to avoid paedagogical misjudgements, overextension and underextension of the children.

Especially, the Herbartian Berthold Hartmann (B. Hartmann 1913 (6)) was very successful, because he found out more about children with his empiric methods at the beginning of school.

At that time, some group and single conversations were done by a given keyword catalog of 100 terms of the current native content canon. These conversations were done openly and adapted to the children. The teachers categorized the answers by existing and not existing imaginations. The results were evaluated absolutly and percentaged, seperated for boys and girls.

The Annaberger research of Hartmann with the extensive keyword catalog brought forth further differences between boys and girls. The girls showed a 10%-superiority with objects that are not spacial near, but develop from the domestic living relation and closer contact to the mother like sky phaenomena (lightning, fog, starlit sky, moon phases) or family walk rooms (promenade, forest) and objects attributed to the female role (butterfly, religious contents, family feasts). The girls were also more competent in areas of the personal biography (christening, wedding, illness). In the pictures of the boys, there outweighted viewpoints of objects that were expirienced in autonomous (group) exploration like frog or ear field (B. Hartmann a.a.O, 78ff.) or objects that are related to hierarchy and comparison (name and position, coins). The following chart shows that not the spatial near-room, but the social experience room seems to be the suitable filter for the winning of "viewpoints".

The thesis of the stronger person-related socialization of the female gender can be proven for the former century. This emphasis has not influenced the technical natural science competences of the girls 100 years ago. None of the terms mentionned in the question catalog with technical natural science relevance (lightning, mine, rainbow, sunset, sundown, moon phases, starlit sky, clock, heaven regions, cube, ball, triangle) turned out to be domains of boys. The girls rather demonstrated a clear superiority in nearly all these question fields.

The quantitative differences that are extremely dominating in the Annaberger study should be presented in the following chart:

Table 4 Terms with Superiority of the Girls

	% Boys	% Girls
Butterfly	44	55
Cherry tree	13	21
Fungus	17	25
Lightning	55	65
Fog	28	38
Moon phases	22	34
Sunset	18	25
Starlit sky	53	71
Post (Annaberg)	45	53
Promenade (Annaberg)	35	45
Forrest	26	39
Cemetery	60	72
Frohnau (suburb)	25	35
Pond	66	75
Driving by train	45	53
Cube	32	45
Jesus	10	22
Christening	18	35
Wedding	11	35
Illness	54	62

Source: Berthold Hartmann: Annaberger Untersuchung 1880-1890

Table 5 Terms with Superiority of the Boys

	% Boys	% Girls
Frog	29	19
Rabbit	19	12
Ear field	28	17
Field works	38	28
Name and position	64	57
Coins	68	61

Source: Berthold Hartmann: Annaberger Untersuchung 1880-1890

In every other asked category, there were no or only a few differences between boys and girls in Hartmann s evaluation.

The myth, which is wide spread in the public, of the natural female technical competence fails when you regard these facts. Here, social explaining hypotheses are of greater plausibility. So it is possible that natural-scientific technical knowledge in the former century did not have the power-establishing meaning like today, so that parents did not see the importance to present such knowledge to their daughters as being un-communicatable. It is important to mention that gender specific socialization processes underlie obviously a strong historical change, so being changeable, too.

If girls at the beginning of school in the former century really were superior in technic natural-scientific contents to the boys, which were asked with the same methods, this would mean that girls are not abstinent per se towards these contents. To the contrary: it seems to be provable that girls can even be superior, if it is allowed socially. Because social expectations like "the gender is not important for children to be successful in natural science and technique" open processes that appear to be subtle and which can be fertile as a sophisticated paedagogical concept.

Problems of the Interpretation of Gender-Different Results

In the women movement and also in the women research, the category of the difference activated strong debates in the last 150 years. Up to today, there is no agreement between the claim of equality of rights with the help of similarity and the complaint about equivalence in spite of the contrasting of differences.

In recent scientific debates, declarations concerning the gender differences are criticized. With the argument that such a description would contribute to the construction of different gender relations, the designation of the same is criticized opposed. I think that this is connected with the difficulties in our society, namely to accept differences.

In a society, which labels itself democratic, the equality of all human is an important norm. In every-day-use, it is understood as opposition to the negatively connotated term inequality as hierarchic category. Accordingly, one reacts intensely to the designation of differences. In every-day-culture, one often tries – out of the defense of perception of social differences – to make the inequality undone in the sense of a mentality like hiding one's head in the sand by health-praying ("We are all germans in east and west." "All people have the same changes."). Also on the male side, the idea of gender differences meets with strong defense. Deborah Tannen, who worked out different speaking styles of men and women, met in her lectures to this topic with strong emotional defense of men, although she did not intend a critical attack. Men saw in the presentation of different speaking styles an attack of women, which they wanted to fend, while women interpreted the description of different speaking styles as a devaluation of women in the sense of the equality pattern (see D. Tannen 1991, 13). These men reacted so intensely, because they expected a loss of their patriarchally determined privileges.

But not only the defense plays an important role concerning the question of gender differences, but here you also have to differentiate clearly by the statements as regards content. Thereto some empirically proven theses:

- Ability differences (also in spacial understanding) between boys and girls can not be proven in their early childhood (see C. Hagemann-White 1984).
- The gender difference downgrade, which empirically rises with higher age (see C. Hagemann-White 1984), documents that the secret curriculum of the genetic distribution of work can be performed continuously, in spite of the education requirements that are poited to equality.
- Not the science constructs the gender differences, but the society and the living people who live in it. Children search for gender identity and develop a typical pattern which is expected by society.
- Even if our society is defined in the question of gender as being polar in the sense of a hermaphroditism (see Hagemann-White 1988; 1984), the individual people are not identical images in this scheme. Especially the variety offers tying possibilities. In fact, the inter-individual differences between people are more gravely than the genetic differences (C. Hartmann-White 1984). Different characteristics, that are assigned to the two contrary gender characteristics, can occur simultaneously with one person (Hagemann-White 1984) and there is, in spite of the stereo-typification and restriction by social structures, a relatively broad development setting for the sexes.
- Gender is not biological, but has to be seen as a social structure category that is defined stereotypically by the tradition of the last centuries. But this does also mean that the gender relation is seen as changeable. The rising number of teachers worldwide, who worry about gender relations in school, is an important signal. So, there are alteration possibilities and contradictions.

So, it is possible, accordantly, to accept a hermaphroditically differentiated social culture, but also to do some paedagogical changes in the goal level, namely towards the turn-away from gender stereotypes and gender polarities.

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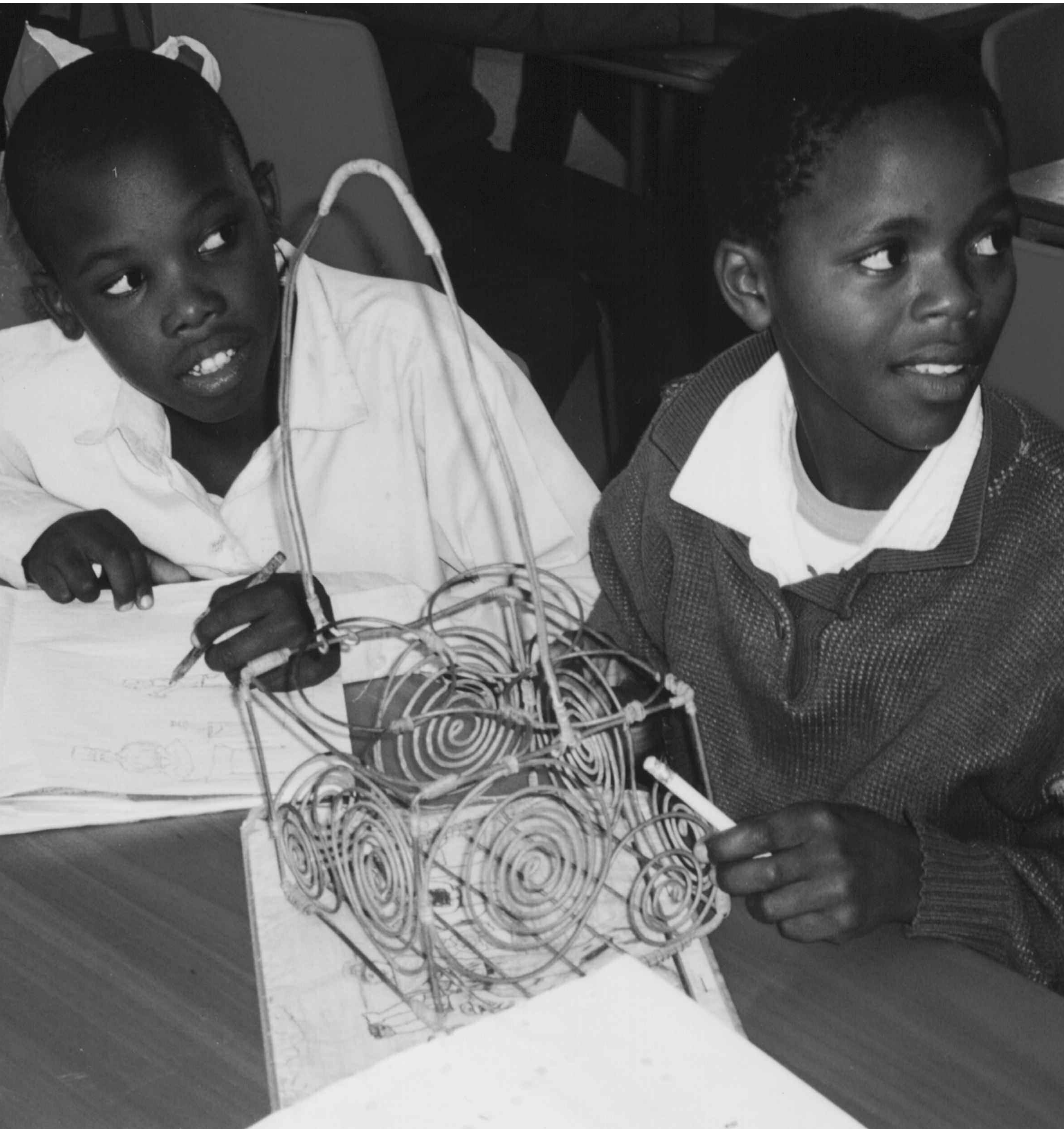

Looking Behind While Designing the Future: Can Practice Meet Theory in Primary D&T Curriculum?

Steve Keirl, Lecturer in Design and Technology Education, University of South Australia
E-mail steve.keirl@unisa.edu.au

Introduction

This paper explores the conference theme of 'Designing the Future' and what this might mean for primary Design and Technology (D&T) teachers and students.

As a device to develop appropriate perspectives, the notion of 'looking behind' is doubly engaged. The prime sense draws on a North American Indigenous poem of how the seven generations who follow us are our future. The less nuanced sense draws on past curricular and technological experiences to inform our understandings of 'designing the future'.

The paper discusses the notion of 'future' itself and how 'designing the future' must take into consideration choice-making, ethics and the will to bring about preferred futures. Also included are discussions of varying curriculum models and the relationships between policy, the profession and children in facilitating futures-orientated D&T practice. It is argued that, although the field of D&T may still have a long way to go in terms of developing both its theoretical and practical bases, it is nevertheless very well placed to serve any curriculum serious about 'designing the future'.

The Future, the Future and Futures

Without getting too metaphysical, it is safe to say that the future is that aspect of time which lies ahead of us and may be contrasted with the present and the past. But the term is used differently when we talk of the Future (big 'F') as it articulates as a whole – not just of something ahead of now but a whole way of being, of living, or relating, of travelling, of knowing, and so on. The Future in this amorphous sense is not only unknown but can seemingly only be envisaged by each of us in differing ways. While each of us will have our own views of what the future can or will hold, this does not make looking at the future pointless. Rather, it begs the questions of how it will come about and who will have enacted it. If an amorphous Future is both a reality and beyond our individual control, it is more helpful to explore futures in the plural. There are multiple possible personal and communal futures and these may materialise in all kinds of different social, technological and political ways. Whatever they are, when they are combined, they become our shared future.

Clearly all possible (imaginable) futures cannot happen concurrently – at least not in the wish-list sense. However, much as we coexist now, multiple personal futures will be able to coexist. Hopefully individual and cultural (and peaceful) coexistence will be aspects of the Future. Thus, questions of tolerance, acceptance and diversity arise. How we might coexist is very much an ethical matter – as it is now. So, it is argued, any discussion of a desirable and defensible future warrants engagement with ethics – with questions of how we should *be,* and *act,* with and towards one another. Further, can we actually set about creating the future we desire? Is such a gaol plausible?

Choice and Action for the Future

To assume we can create or adopt *any* kind of future (rather than just let it happen to us) begs understanding of two senses of choosing to do so. First we must have the *ability to choose* such a future and, secondly, we must have the *will to choose* it (Keirl, 2002). To be able to choose (or design) the future one must have some degree of freedom and power to do so – and this requires certain social and political conditions, usually embodied in what we call democracy (ethically defensible politics). A key to maintaining democracy is an education in, and for, democracy (White, 1973). Thus, if a democratic future is desirable then an appropriate education will be needed. In turn, such an education teaches the value of participating in, and contributing to, democratic practice – that is, in exercising *will.* To offer a simplistic political example, it is one thing to have a right to vote but it is another to use that vote.

If we entertain the idea of designing the future then we might reflect on the kinds and qualities of technologies which we have today and how we see the technological future. The same choice issues can apply. *Are we able* to choose our technologies and, if so, *have we the will* to exercise that ability? Of the myriad technologies with which we interact daily, in how many cases did we have any say in their development or desirability? The fact is that we are presented with technologies as *fait accompli* (a thing done and no longer worth arguing against). The question of whether we can even 'choose' in the first sense (as prerequisite of the second) when it comes to our technologies is an issue. It can be said that 'good' technologies need not be questioned but this claim is problematic too. For example: the term 'good' is value-laden; all technologies have a downside; who determines 'good' may be essentially undemocratic (e.g. technical 'experts'); and, technologies, in solving one problem, often create others.

When it is extremely difficult individually, even collectively, to influence any social, technological or political current then feelings of helplessness, pointlessness and apathy emerge. Such circumstances mirror determinism (the doctrine that all events are consequences of former events and contributors to future events). The determinist view that we have no free will throws up serious questions for educators, designers and politicians alike. If we believe that we have the power to choose, to act in particular ways and to bring about change, then we contest determinism. It is also important to remember that determinism is disputed by moral philosophers (Frankena, 1973; Warnock, 1996;1998) who point out that we exercise our will when we choose to live and act in particular ways.

From what has been said so far, it can be seen that to 'design the future' is problematic. It may be seen as both complex and challenging and none of design, technology, education or politics stands disconnected from understandings of 'future'. However when we look at these shapers of the future it is technology that catches the popular imagination and which, for the extreme pessimists, offers scenarios of technological disaster and calls for a return to less technologically-sophisticated times. Very deep concerns legitimately exist for our technologically mediated futures – pollution, nuclear issues, obsolescence, surveillance, trans-species contamination, and the grey-goo phenomenon offered by nanotechnologies are all examples of major and unresolved matters for our planetary coexistence.

Design for Now and for the Future

That we find ourselves in such a situation begs interrogation of the nature of the designing that lead to such a technological existence. A few design basics must be recalled. First, there is an immensely important issue of 'why design' this or that technology at the outset? Since no technology is neutral nor is it universally good, concerns can be expressed as well as questions asked. Thus, the *intention* prefacing the act of designing matters. Second, 'to design' means to bring about change – the act of designing is to change one set of circumstances into another. Third, given that design is about weighing up competing variables, it must be remembered that at least some of those variables will be value-laden. Fourth, and reflecting the first three, design is about choice-making in many senses.

Sadly, our own participation – socially, politically or educationally – in the design intention or practice of new technologies remains almost non-existent. We can criticise in hindsight many technologies we have adopted or accepted. It would seem that either we are ill-equipped to interrogate technological intention or design or, we are content to leave the conceptualisation and introduction of new technologies to 'experts' and capitalism. As Layton (1994) pointed out in regard to the competing stakeholder claims to technology curriculum, two key protagonists are the economic instrumentalists and the defenders of participatory democracy (Layton, 1994). The latter are concerned that technological decision-making rarely takes into account public opinion and that the lack of detailed information about technologies precludes any meaningful debate. Given the life- and behaviour-shaping nature of technologies, this is both an ethical and a political matter. Indeed, our seeming passivity and oblivion towards technological innovation has been likened by one author to living with a 'temperamental elephant' in our lounge room yet never speaking about it nor disturbing it as the consequences don't bear consideration (Sclove, 1995).

The major problem here is that we have neither a culture of deep design intelligence and thinking nor do we have a culture of criticism towards technologies *before* they are brought into being. The absence of such cultures is one of the contributory factors to our blind acceptance of technologies or, at least, to our feeling of inadequacy in resisting them. A healthy design culture could engender critical interrogations and facilitate 'designing the future' on ethical and democratic principles rather than being lead by markets and exploitation. This is where education has a fundamental role to play as it can foster such cultures.

Children and Our Very Own Education Acts

Two statements drawn from different countries introduce the important notion of intergenerational responsibility. As one Norwegian adage has it 'Children are always the only future the human race has … teach them well'. Meanwhile, Leon Shenandoah, an Onondagan Elder, (native North American), offers reflection on 'seven generations' saying:

> *Look behind you. See your sons and your daughters. They are your future. Look farther and see your sons' and daughters' children and their children's children even unto the seventh generation. That's the way we were taught. Think about it – you yourself are a seventh generation.* (Shenandoah in Schaef, 1995, np)

If we put the responsibilities we have towards children alongside the enormity and complexity of technological development, one of the easiest things to do is to throw one's hands up and say 'its all too hard'. This has been offered as one of a group of 'orthodoxies' (accepted and rarely-questioned popular understandings) of technology – the orthodoxy of technology-as-incomprehensible (Keirl, 1999). Yet this is surely the challenge of education and the duty of a democratic society – to unpick the incomprehensible and help make sense of it. Like the elephant, the fact that such an uncomfortable and risky challenge is there is not a reason not to engage with it.

Undoubtedly, curriculum policy has a role to play in the quality of D&T education and such policy can take many forms. So long as technology education is seen in a narrow and instrumental way, that is, having a focus on skilling, making, and developing technical vocabulary and concepts, it will not contribute to an enlightened education for the future. It will certainly not serve any capacities for 'designing the future' in ways that are ethically and democratically defensible. It will serve ways of reinforcing the technological status quo. However, a design-rich technology curriculum offers students and teachers significant opportunities to explore the contestable and problematic nature of technological development.

Curriculum policy, no matter how well theorised, is often a victim of that very theorisation. Teachers may criticise the perceived 'top-down' development of curriculum often arguing that the developers are 'out of touch' with the classroom. Teachers are often denied opportunities to contribute to the curriculum development when, if they had been, they would not only have some sense of ownership but they would have had opportunities to both contribute knowledge and experience, and debate their own practice against the theory. Most importantly, the gap between theory and practice is rarely bridged because of inadequate provision of time and funding for quality professional development.

These critiques of policy and development noted, something must be said to illustrate some curriculum potential for 'designing the future'. One recent curriculum development offers a few future-orientated possibilities (DETE, 2001). Firstly, this policy was constructed as a framework, that is, it is not a prescription of content for teachers to follow. This immediately offers teachers professional leeway – even some liberation in these chaste times – to consider the diversity and circumstances of their students and tailor projects accordingly.

Further possibilities emerge from the organization of the framework. There are eight Learning Areas which are subsequently articulated through strands. The Design and Technology Learning Area has three strands – Critiquing, Designing and Making. The Designing strand provides for much of what has been discussed above but is complemented by the innovative strand of Critiquing. While design is well established in *some* jurisdictions across the world and provides for imagination, creativity and future-sight, critiquing develops the very important practices of analysis, interrogation and hindsight. In an elementary sense, designing is about bringing into being while critiquing is about questioning that which exists. Clearly the two intertwine especially where the learning from critiquing informs new designing (and, again, the intentions behind it).

Another future-orientated possibility in this curriculum development is also one of the framework's organisers. Interwoven across the Learning Areas are five Essential Learnings and one of these is Futures.

> *Learners develop a sense of optimism about their ability to actively contribute to shaping preferred futures and capabilities to critically reflect on, and take action in, shaping preferred futures.*
>
> *Curriculum developed from this Framework provides opportunities and skills for learners to critically examine future possibilities and challenge commonly held assumptions about the past, present and future. Through such analysis learners understand that the future has connections with the present and the past, and that social, political, economic and physical environments are constantly changing and can be improved. Thus the major theme of this learning is creating sustainable natural environments, and just and sustainable human environments.* (DETE: General Introduction, 2001)

There are some comments to make concerning this last possibility for 'designing the future'. First, it is there – explicitly stated as an integral part of teaching and learning, that there be a futures component *throughout* the curriculum. This is a huge step forward (admittedly at policy level – if not yet in practice) as it has both validated the pioneering work of those primary teachers already embracing futures perspectives and provided guidance for others to adopt them. Second, the cynic might argue the very optimism of a curriculum purporting to 'develop a sense of optimism' in children. But this is about efficacy and the curriculum is neither 'futures' alone nor naïve optimism alone. It is futures and optimism when *combined with design* that empowers students to 'shape preferred futures'. Thirdly, such 'preference' returns to the issues of choice, ethically defensible futures and having some sort of knowledge base to explain what one might prefer and what one might not. Such a knowledge base comes from the Critiquing, the act of which teaches about intentions behind designs and technologies, resources used, social and cultural impacts and comparative alternatives.

This curriculum framework has been developed for 'Birth to Year 12' (approx. age 18 years) and is one possible way forward in tackling varying aspects of the educational challenge of 'designing the future'. It does so in the faith of constructivist learning theory and that all concepts and methodologies, no matter how complex, can have legitimate beginnings from early childhood onward. The beginnings of reasoning, understanding fair play, happiness, sadness, making things better and empathy (Identity and Interdependence are two other Essential Learnings) all find their place in the early and primary years and are the foundations for value-rich Design and Technology education that is capable of empowering students to believe they can 'design the future'. Capacities to *act* are well modelled through quality D&T practice and this can serve individual and community alike.

Towards the Future…

In their own ways, children draw on imagination, develop strategies and model possible solutions to tangible and less tangible design problems. Part of such an education teaches children to question the very problem, that is, to determine whether it is the 'problem' that needs solving or the problem's origin. All of these strategies and scenarios inevitably engage values issues – which are the raw material of developing ethical sensibility in children. When children come together in early childhood centres or primary schools they bring with them rich values frameworks from their families, culture, religion and communities. Such frameworks are assets equally to developing ethical sensibility and to sensitive D&T teaching. A further asset, simple yet often neglected in curriculum policy development, is the rich awareness children have from their own being-with technologies. There is a danger in overlooking the often sophisticated awareness children hold of their own and their media-influenced environments.

There is a big 'F' Future ahead and when enough pessimistic scenarios are assembled 'scary' is the bland adjective often used. Any scenario will be indisputably and inseparably technologically situated. Education can, and has an arguable duty to, help students imagine futures, rationalise and ethically justify preferred futures and then to collectively create them. This will most certainly warrant a quality Design and Technology education – one which uses the holism of designing, critiquing and creating as architectural tools for an equitable life for all who share the planet – human and non-human species alike. It is a truism for the teaching profession that it is teachers themselves who operate between the policy and the children, the theory and the practice, and the present and the future. This is an enormous responsibility and is the kind of reason why non-educators fail to see why there is no finer profession than teaching.

D&T today has a highly defensible role in both future-orientated curriculum policy and in future-orientated classrooms but our innovative curriculum area continues to need deep, and more interactive, theorising and practice. Discourse amongst all in the field can provide much-needed knowledge and professional synergies. So equipped, when we feel that the seventh generation behind us seems impossibly remote, we can be more confident in accepting that the starting point is always with the children we serve today.

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The Implications of Knowledge Management for Technology Education in Primary Schools

Graduate Institute of Elementary Education, National Taichung Teachers' College, 140 Ming-Sheng Road, Taichung City, Taiwan
Chuen-Wen Liao, Professor – E-mail lcw@mail.ntctc.edu.tw
Dept. of Fine Arts and Technology Education, National Taichung Teachers' College, Taiwan
Chia-Sen Jimmy Huang, Professor – E-mail hcs@mail.ntctc.edu.tw

Introduction

Knowledge management involves gathering, sharing, structuring, storing and accessing information to build knowledge. Therefore, how to transfer collected data into information, information into knowledge, and knowledge into intelligence through critical heritage, creative transformation and dialectic synthesis is very important.

Technology education plays an important role in the 21st century. It takes the responsibility for accelerating technological changes.

As we know, human civilization is undergoing fundamental changes, facilitated by the revolution in information and communication technology. In other words, we are experiencing a transition in which intellectual capital-brain power is replacing financial capital and land as the key to our strength, prosperity, and social well-being.

The main purpose of this paper is to explore the conceptual framework of knowledge management, and its implications for technology education in the primary school. In the paper, we not only illustrate the significance of knowledge management in the economic sphere, but also introduce the main concepts of knowledge management for the primary school. Some implications on primary school technology education will also be presented.

The Significance of Knowledge Management in the Era of the Knowledge-based Economy

No one can escape the transforming fire of technology. No one can doubt that we are now experiencing the era of the knowledge-based economy. Facing this new economic challenge, the capability of knowledge management becomes very important. This section will review the significance of some global changes focusing on technology education in the primary school.

The Coming of Globalization

During the last few decades, with rapid technology advances, a key force for change in the globalization era has been the expansion of information, communication, and transportation networks. Because an unanticipated consequence of this information revolution is that consumers are beginning to define the meaning of quality education globally, many educational policy makers (and parents) view it as important to prepare students to be (Hallinger, 2000):

- Lifelong learners;
- Cable communicators in both their own and an international language;
- Technologically skilled for the workplace and daily living;
- Cognitively prepared for complex tasks, problem-solving, and the creation of knowledge;
- Socially, politically and culturally responsible citizens.

Without a doubt, facing rapid global competitive change, technology education in the primary school is under increasing pressure to attain the global educational ideal.

The globalization system, unlike the cold war system, is not frozen, but a dynamic ongoing process (Friedman, 2000). Although globalization has its own dominant culture, defining technologies, demographic patterns and defining structures, today it has became a mega trend, whatever opinions are held..

The Emergence of Information Technology

With the progress of new and hi-tech technology, the way we communicate with one another has changed dramatically. Friedman (2000) called this change "the democratization of technology". The democratization of technology is the result of several innovations that came together in the 1980s involving computerization, telecommunications, miniaturization, compression technology and digitization.

Technological innovation and development is having a broad impact on modern political, social, cultural, educational and economic systems. School organization is a subsystem of whole social systems, so when these systems produce changes school systems will inevitably be influenced. In order to meet the challenge of technology innovation, primary schools should bring new technology into the classroom so that all students have the opportunity to learn how to use it at an early age. In fact, it is also the main goal of technology education.

Development of the Knowledge-based Economy

According to Mazarr (1999), the greatest clue to the progress of modern economics over the next decade is that the nature of economic activity is changing. In its most important and fundamental sense, this means a shift to what many economic and social commentators have called an "information" or "knowledge" economy. However, Mazarr used the term "human resources economy" because in this era, as never before, people are the basic source of economic strength and growth – not land and natural resources.

In other words, the knowledge-based economy not only involves the development, exploration, storage, interpretation, and application of knowledge, but also represents the emergence of human beings as the ultimate source of economic value.

Emphasis on Learning Competences Cultivation

In a knowledge-based economy era of rapid change, learning is the keystone to successful adoption of change, not only for individuals but also for organizations. Generally speaking, successful organizations tap the knowledge that exists in the workforce and among customers. Leaders in successful organizations create shared knowledge and apply this learning to adapt to a rapidly changing environment. (Hallinger, 2000; Stewart, 1997) Therefore, transforming the school organization into the learning organization must be the most important task in the knowledge-based economy era. Senge (1994) described five disciplines that together constitute the key ingredients for a learning organization:

- System thinking
- Personal mastery
- Mental models
- Shared vision
- Team learning

There is no such thing as a bad time to enhance organizational learning. Successful knowledge management requires four learning competences to manage the knowledge flow in an organization: absorption of knowledge from outside, diffusion of knowledge within, generation of knowledge within, and exploitation of knowledge in products and services.

Thoughts on Organizational Change

Today, without doubt, we live in an "information age" or "knowledge era". Toffler (1981) said that information "is the basic raw material" of the period (the "third wave" of human society). Bell (1972) indicated that whereas industrial society involved "the coordination of machines and men for the production of goods", post-industrial society will be organized around knowledge, for the purpose of social control and the directing of innovation and change. Just as Gates (2000) said, if the 1980s were about quality and the 1990s were about re-engineering, then the 2000s will be about velocity. It shows that the key to future competitive advantage is velocity. Organization is going to change more in the next ten years than it has in the last fifty. In sunnary, we should understand that the only thing constant in organizations is change. It is why continuous improvement programs are sprouting up all over as organizations strive to better themselves and gain an edge.

The Basic Concepts Framework of the Knowledge Management Model

Basic Concepts Framework of SBKM

If we want to understand the main contents of knowledge management, firstly we should understand what the basic concept framework of school-based knowledge management is. Figure 1 illustrates the elements of the SBKM model in technology education in the primary school. This concepts framework has four dimensions: main processes, influential factors, enablers and practical strategies. In the main processes dimension, it contains five processes: knowledge gathering, knowledge storing, knowledge sharing, knowledge creation, knowledge application. In the influential factors dimension, it includes six factors: knowledge-based economy, organizational change, technology progress, education reform, life long learning, globalization. It involves six elements: ideas and concepts (share), leadership style (style), school culture (structure), information technology (skill), performance assessment (system), organizational structure (strategy). In terms of practical strategies, it provides six strategies: assignment of CKO, building a practical community, shaping learning organization, sketching knowledge geography, data house building, developing a knowledge sharing platform.

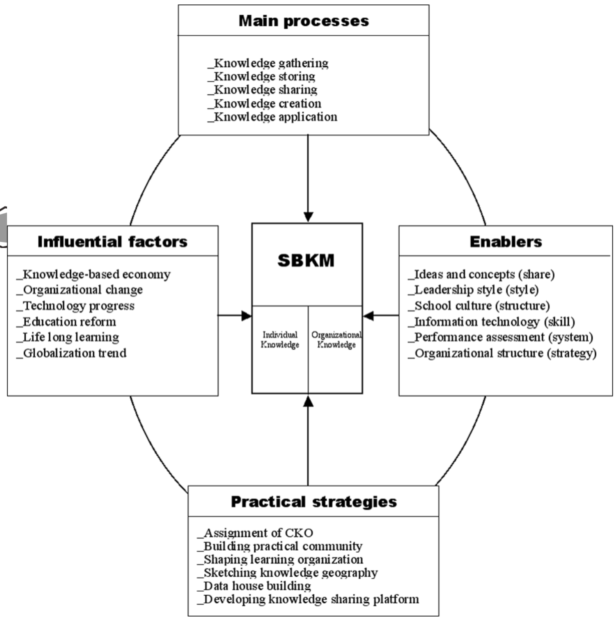

Figure 1. Basic Concepts Framework of School-based Knowledge Management

As we all know, knowledge management is a dynamic development process. From knowledge gathering, storing, sharing, creating to applying, members in a school organization should understand the importance of knowledge management in a knowledge-based economy. After realizing the factors influencing school-based knowledge management, how to promote SBKM is a very important mission. In order to achieve the effect of SBKM, some concrete practical action strategies are necessary. In other words, in this model, we analyze and explain, in four parts: influential factors, main processes, enablers and practical strategies.

The Transformation Process of Knowledge Management

In order to investigate the deep structure of knowledge management, we need to understand the transformation process between individual knowledge and organizational knowledge. The following section will provide two different perspectives on the transformation process.

The Spiral of Knowledge

Nonaka (1998) cited Ikuko Tanaka and Michael Polanyi's concepts, distinguishing two types of knowledge: tacit and explicit. According to descriptions of the knowledge – creating organization, Nonaka (1994) provides a useful starting point for theorizing about how an individual's personal knowledge can be transformed into organizational knowledge that is valuable to the organization. Meanwhile, he also argues that organizational knowledge can be created through interactions between tacit knowledge and explicit knowledge. This interaction can be divided into four basic patterns for creating knowledge in any organization: (see Figure 2)

- From Tacit to Tacit. One individual shares tacit knowledge directly with another through observation, imitation, and practice. This process may be called socialization.
- From Explicit to Explicit. An individual can also combine discrete pieces of explicit knowledge into a new whole. Maybe we can call this process combination.
- From Tacit to Explicit. When some people are able to articulate the foundation of one's tacit knowledge of bread making, one converts it into explicit. This is the so called externalization process.
- From Explicit to Tacit. What's more, as new explicit knowledge is shared throughout an organization, other members begin to internalize it – that is, they use it to broaden, extend, and reframe their own tacit knowledge. Perhaps this process can be called internalization.

These four distinct interaction modes shape the spiral of knowledge creation. What we want to emphasize is that externalization (converting tacit knowledge into explicit knowledge) and internalization (using that explicit knowledge base) are the critical steps in this spiral of knowledge. According to Nanaka's statements, the reason is that both require the active involvement of the self – that is, personal commitment.

From \ To	Tacit knowledge	Explicit knowledge
Tacit knowledge	(Socialization) **Sympathized Knowledge**	(Externalization) **Conceptual Knowledge**
Explicit knowledge	(Internalization) **Operational Knowledge**	(Combination) **Systemic Knowledge**

Figure 2. Contents of Knowledge created by Four Models (Nonaka and Kakeuchi, 1995)

The Process of Knowledge Transformation

Before explaining the process of knowledge transformation, we should identify what are data, information and knowledge. According to Davenport & Prusak (2000), data is a set of discrete, objective facts about events. Like many researchers who have studied information, they describe it as a message, usually in the form of a document or an audible or visible communication. As with any message, it has a sender and receiver. Information is meant to change the way the receiver perceives something, to have an impact on his judgment and behavior. However, most people have an intuitive sense that knowledge is broader, deeper, and richer than data or information. Davenport & Prusak (2000) define knowledge as a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. In other words, knowledge is a mixture of various elements; it is fluid as well as formally structured, it is intuitive and therefore hard to capture in words or understand completely in logical terms. In short, we can clearly conclude that knowledge derives from information as information derives from data. If we want to make data become information or information become knowledge, or even knowledge become intelligence, some transformation processes are needed. (see Figure 3)

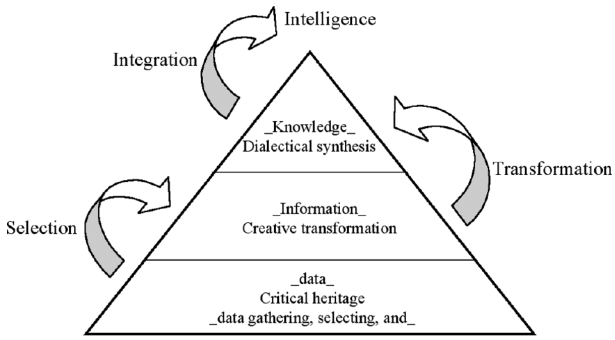

Figure 3. The Process of Knowledge

1. From Data to Information

Data is a set of objective facts about events. More data is not always better than less, if we don't need too much. At the same time, gathering enough data is useless, if we don not make a selection process. Hence, in order to avoid data becoming garbage, we should transform data into information through the critical heritage approach when we gather and select data. Only when data becomes information is it useful. That is the reason why we call this transformation the critical heritage process.

2. From Information to Knowledge

As mentioned earlier, information derives from data. Unlike data, information has meaning. Data becomes information when its creator adds meaning. If we cannot transform data into information through critical heritage, or transform information into knowledge through creative transformation, and let knowledge become a useful concept framework in our everyday life, information is meaningless.

3. From Knowledge to Intelligence

As Davenport & Prusak (2000) stated, knowledge is a mixture of various elements; it is fluid as well as formally structured; it is intuitive and therefore hard to capture in words or understand completely in logical terms. Strictly speaking, knowledge is delivered through structured media such as books and documents, and person to person contacts ranging from conversations to apprenticeships. We obtain knowledge from individuals, groups or organizations in various ways. When we store abundant knowledge, we can use it to make wiser decisions about daily working, living and learning. In other words, knowledge is not a rigid structure; it can deal with complexity in a complex way. All these values of knowledge should be based on the interaction process that people need to transform knowledge into intelligence through dialectic synthesis, or otherwise knowledge will become dead knowledge.

The Implications of the SBKM Model on Technology Education in the Primary School

What constitutes success in knowledge management? Davenport & Prusak (2000) argued that the indications of success in knowledge management are no different from the criteria companies use to measure success in other types of business change projects. According to their points of view, the primary attributes we use to define success in knowledge management include: a knowledge-oriented culture, technical and organizational infrastructure, senior management support, a link to economics or industry values, a modicum of process orientation, clarity of vision and language, nontrivial motivational aids, some level of knowledge structure, and multiple channels for knowledge transfer.

Although Davenport & Prusak defined successful factors in knowledge management from a business perspective, the above attributes could still provide us with some ideas. Indeed, the indicators described above tell us whether a project is successful or not, but not what makes it that way. However, what kind of strategies should we adopt that can lead to school-based knowledge management success? Here are some concrete action strategies for promoting effective SBKM:

Building a Shared Vision of School Organization

Vision helps each member see what the future holds as a rational extension of the present. A vision for a school is a target at which the principal directs the organization's energy and resources. School-based knowledge management is not just a concept framework; the most important thing is how to put it into practice. Therefore, when school members understand the principal's vision, they understand what the organization is trying to accomplish and what it stands for. If we want to promote a school-based knowledge management project, the first step is building a shared vision of school organizations.

Creating a Knowledge-oriented Culture

Knowledge management consists of knowledge gathering, knowledge storing, knowledge sharing, knowledge creating, and knowledge application. All the processes are not only interactive, but also complicated. Therefore, how to create a knowledge-oriented culture in a school organization is very important. A knowledge-friendly culture was clearly one of the most important conditions leading to the success of SBKM. In the knowledge-based economy era, building a positive knowledge culture is critical. What the so called "knowledge-oriented culture" means is that members in a school organization are willing and free to explore, and their knowledge-creating is given credence by executives.

Enhancing Technical and Organizational Infrastructure

School-based knowledge management is more likely to succeed when it can take advantage of a broader infrastructure of both technology and organization. Technological infrastructure is the easier of the two to put in place. The technology infrastructure of knowledge management is a uniform set of technologies for desktop computing and communications. At the simplest level, this means a networked PC on every desk or in every briefcase. As to organizational infrastructure, this refers to establishing a healthy rewards system that encourages school members to share their information or knowledge. Let school become a learning organization where members can share individual information or knowledge. That is the core of school-based knowledge management.

Obtaining Senior Management Support

Like almost every other type of change program, knowledge management projects benefit from senior management support. According to Prusak & Davenport (2000) study, strong support from executives was critical for transformational knowledge but less necessary in efforts to use knowledge for improving individual functions or processes. Whether school-based knowledge management is implemented effectively or not, obtaining senior management support is very important, because the senior manager or leader has the power to control financial budgets and necessary resources.

Appointing the Chief Knowledge Officer

The role of chief knowledge officer is to lead the knowledge management charge that involves both the management of knowledge and the facilitation of organizational learning. Generally speaking, the chief knowledge officer in an organization must enforce the important role of knowledge in the knowledge-based economy era. Meanwhile, the CKO should build a shared platform that school members could use to obtain the information or knowledge that they want. In addition, the CKO has the responsibility to design and implement the school's knowledge infrastructure: knowledge bases, libraries, human and computer networks, research centers and knowledge organizational structure. Therefore, choosing a good CKO is the keystone of school-based knowledge management.

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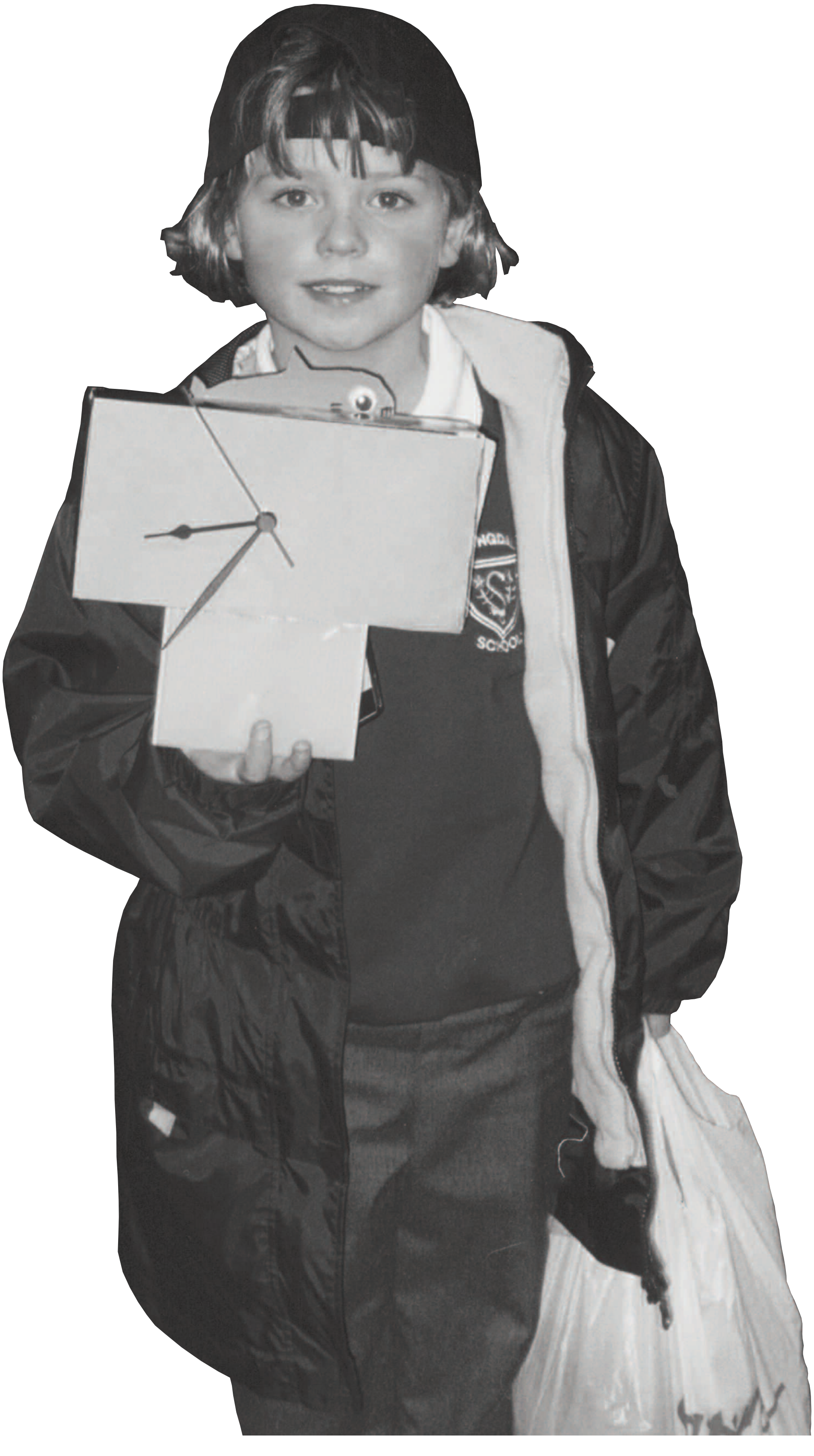

Product Evaluation in Pedagogical Context

University of Oulu, Department of Educational Sciences and Teacher Education

Eila Lindfors, Senior Lecturer – E-mail eila.linfors@oulu.fi

Introduction

We all, as consumers, live surrounded by products. We make choices concerning a very wide area of products: what products to buy, what products to use, how to use them and how to take care of them. People do not have to make everything by themselves as they used to do for about 100 years ago. It is possible to buy and to use whatever one can afford. Advertising wakes up different kinds of needs to consume even if it is good for people or not. In future this will lead to a situation where there is a shortage of raw materials and there is already too much waste. In this situation we have to ask if is it possible and how would it be possible to learn critical attitude on products.

A Product and its Technological Properties

A product is a thing what we use for different purposes. It can be a cloth, a chair, a car or whatever a thing we can use. It has a relationship to a user and an environment where it is used. The product is appropriate in its task if it has such properties which are suitable from the end-use and from the user point of view. We can speak about technological properties of products. Lindfors has created a classification of the technological properties of textiles (Lindfors 2002a). On the common level the classification of technological properties can be introduced with five classes as shown in Figure 1.

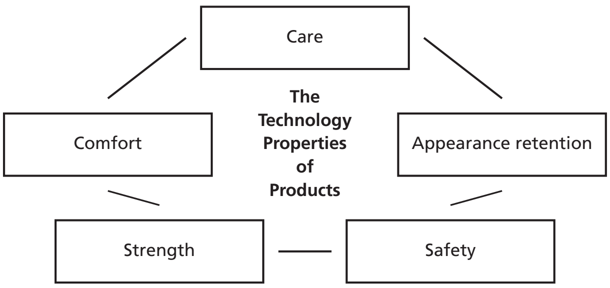

Figure 1. The technological properties of a product

The classification gives us support of what kind of dimensions one should have in mind while evaluating a product from a functional point of view. Care means how the product can be in use again after cleaning and repairing. Comfort means how the close connection of product and user works out. Appearance retention means how the product will preserve its out look or loose it. Strength of the product means if it is strong enough to work properly or is it too weak to be broken quickly. Safety means that the product does not cause danger or is harmful for the user, e.g. the product is not too flammable or does not release harmful chemicals.

The product has to have certain technological properties to fulfil its task. The task is a consequence of the consumer's problems, needs, wishes and end-use situation (Figure 2). The same product can fulfil its task perfectly or poorly depending the user and/or the environment. The task can be evaluated in co-operation of a consumer, a product and a concrete end-use environment.

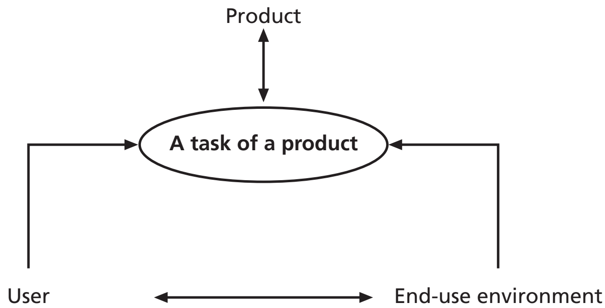

Figure 2. A task in the middle of a user, an end-use environment and a product.

The user has an idea what kind of a product would satisfy his/her needs. If the product is ready made one must ask for what task it is made in the first hand. If user, e.g. a student at school, is due to design it he can decide what properties are suitable. Finally the end use environment defines if the product has optimal properties or not for the use. These three aspects in mind we have to ask does the product work. Is it functioning? The function means that the technological properties are optimal for the end use. The product can not fulfil its task if it is used in wrong environment, if it does not fit for the user or if the product does not fit for users needs. The product which does not have suitable properties will be a waste very soon. This does not fit for the idea of sustainability.

It depends of the product and the user how important the technological properties are. (e.g. Torrens 2000) We point out different dimensions if the product is e.g. a toy or a car. If we consider the life-cycle of a product it is important to use it as long as possible. This means that the technological properties of the product should be in balance compared to the task. If e.g. the appearance retention is not good the product will be abandoned earlier than what the strength would suggest.

Design, Technology, Education and Product Properties

End use and opinions of users have become an important part of innovation and design when designers have the life-cycle and the sustainability of product in mind. This means that the properties of new products are seen from the user point of view. Kaulio (1998) has presented different types of methods for how to take the user and the user point of view as a part of design process. Margolin (1997) has presented ideas on how to get to know users and the milieu where the product is supposed to use. Erol et. al. (1998) and McDonagh-Philip & Denton (1998) have introduced case studies on how to use the consumer point of view in evaluation of existing products and in accessing user worlds. Buurman (1997) has considered advantages of user-centred design.

At school technology education offers situations to evaluate products and their properties in concrete end-use environments. As we think products from perspectives of end-use and user we can see them as technological problems. Technological problem solving as a combination of scientific research, thinking and understanding, making and evaluation as a practical actual learning with products and systems (Lindfors 2002b) gives us possibilities to learn critical attitude on products. This means analyzing, testing, evaluating and defining the product properties and finally applying the created information in concrete situations.

It is quite typical for a student to study the function of a technological system, e.g. a work of some kind of automatic machine in technology education. Materials of systems and products are not so often in the focus. If we consider technology education as a problem based and future oriented actual learning we can ask how a teacher would apply the idea of technological product properties and user-centred design to offer students opportunities to learn about materials and products and to gain critical attitude towards them. The case of a kettle-holder gives one example.

Designing a Kettle-Holder as a Case

Kettle-holders are in use at homes all over the world. Their task is to prevent the heat not to burn hands when cooking. We all have experiences how they do function. We can ask ourselves how satisfied we are to technological properties of kettle-holders. They are usually quite aesthetic ones. But is this enough? We have to ask how do they really work. Do they fulfil their task? The answer is that kettle-holders work quite badly! They are too small and therefore we burn our hands often. Their thermal resistance is too low. Their dirty resistance is low and it is difficult to wash them properly. They are not safe because of the flammability! How is it possible that the world is full of unfunctional kettle-holders in this time of technology!

This daily technological problem gave us an idea to make a small research on the proper function of the kettle-holder with 11 and 12 years old students. The goal was to learn evaluate products critically according to their task and technological properties.

Students worked in groups of three and four. The project started with a homework. Students clarified which kind of kettle-holders they had at their homes. They also interviewed parents about a function and problems of kettle-holders.

The first step at school was to discuss the findings. Every student brought one kettle-holder from home (Figure 3). The second task was to test the kettle-holders in real situation (Figure 4). The third step was to study the materials (Figure 5) Students cut kettle-holders and did some burning tests to the materials to find out which one would be not flammable. After all this students had a negotiation where they defined optimal criteria for a proper kettle-holder (Figure 6 and 7.) They were very interested to design a functional product. And they were surprised that people can use so dangerous kettle-holders as they do.


Figure 3


Figure 4


Figure 5


Figure 6

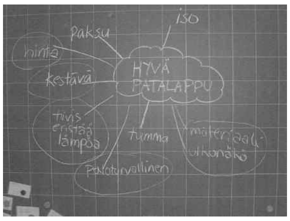

Figure 7

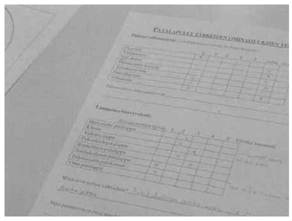
Figure 8

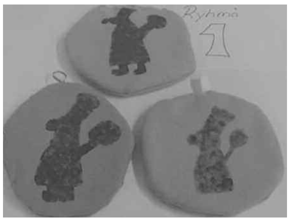

Figure 9

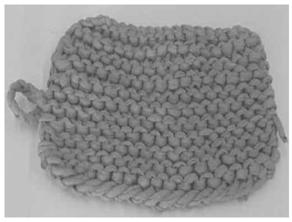
Figure 10

Figure 11

Students tested some new materials to find out the best possible solutions and noticed that they were doing important and innovative work. After had chosen the materials they started the making process of their functional kettle-holder. And some results are in the Figures 9-11. Students noticed that it is not easy to choose what properties are the most important ones. If you choose some properties it is not evident that all the properties will be optional. Students discussed with each other what kind of a role the technological properties have in the function of a product. They noticed that properties change if the user or end-use situation alters (Figure 1).

After the kettle-holders were ready they were tested in a real situation with pots and the oven. The students did deep product evaluation and wrote feed-back and gave points for each of them. The evaluation criteria was agreed together as the Figure 7 shows: care, safety, comfort, strength and appearance retention. The more the kettle-holder got points the more innovative it was compared to ordinary kettle-holders you can by from a store. Important part of the process was that students invented also ideas how to develop the products in the future.

This process showed very clearly one ordinary problem in daily life. It made the everyday use of a kettle-holder as one technological problem. It was an example of evaluating a product in relationship to a user and an end-use environment. The students really wondered how it is possible that almost all homes in the world are satisfied to un-functional kettle-holders with bad technological properties.

Product Evaluation in Daily Life

The case of the kettle-holder presents one concrete example how to apply the classification of the technological product properties in technology education. It shows how students go on from step to step to design a product which will have optimal properties in use from the user and end-use point of view. It also tells the about evaluation of product properties in educational context. From the pedagogical point of view it considers the products which will be designed and made at school as well as industry made products which will can be evaluated at school. In the last phase it is a question to learn to evaluate products critically as well as learn to understand how do they function and make them last as long as possible.

When being critical on the products the first phase is to analyze the user of a product. As important is to consider the end-use environment. By this the students can define the preconditions of the product and its technological properties. Second phase is to decide in which way to evaluate the properties. In pedagogical context a teacher can suggest the tests but students can design the tests also. By analyzing the use they can invent interesting ways to test the technological properties.

When testing different materials and products it is important to make careful notes and compare the results. This shows to the students that there is never one solution to a problem. By comparing the test results students can learn to evaluate different possibilities instead of taking the first one. This is important from the critical point of view. As you notice on the basis of your actual work in technology education that there are many possibilities in designing and evaluating products you can use this information in your daily life also. If we consider the user centred design used more in industry, we can expect better products to our daily life. The question is how to choose the best ones. From sustainable point of view it seems that a product with good technological properties is a good choice for the future. This means that the classification of technological product properties gives students a tool to act critically when considering products all a round daily life.

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Teachers' Perceptions of Purposes for Writing Tasks in Design and Technology at Key Stage 2

University of Central England in Birmingham

Julie Mantell – E-mail jemantell@aol.com

Introduction

Much of children's activity in design and technology consists of handling products, discussing, drawing, and working with materials and tools. However, it is also common practice for teachers to engage children in tasks which involve writing. Why is this? What purposes do these writing tasks serve? Do they have specific pedagogic purposes or is their role to provide tangible evidence of practical activity? Are children encouraged to take part in writing tasks in order to learn particular ways of writing and communicating in design and technology that initiate them into the cultural practices of designers and technologists? Or are teachers using design and technology as a lively and interesting context in which to develop children's literacy skills?

These were some of the questions on my mind when I carried out some classroom research as a participant observer in three classrooms between 2000 and 2001. The timing is significant in that English primary schools at this time were focused on implementing the National Literacy and Numeracy Strategies. The intense focus on these two national intervention programmes had a negative impact upon non-core subjects such as design and technology, reducing curriculum time and limiting the resources available for the development of the subject in schools (OFSTED, 2002). Members of the design and technology community attempted to counter the threat posed to the subject by promoting it as a motivating context for developing literacy and numeracy skills (e.g. DATA, 1999; NAAIDT, 1999).

My research into writing in design and technology is set in this context. This paper focuses upon one aspect of my research study: teachers' perceptions of the purposes for writing tasks.

What are 'Writing Tasks' in Design and Technology?

I am using the term 'writing task' to refer to any activity initiated by the teacher that requires pupils to write. In design and technology, children often use writing in conjunction with other forms of expression, such as discussion, drawing and working with materials. The texts they produce are usually short and take a variety of forms such as lists, notes in a table, annotations, storyboards and mind-maps.

Method

The data used for this analysis is a sub-set of data from three case studies. Data was gathered in each school through participant observation, interviews with teachers and children, and a questionnaire to children. Teachers' planning and children's writing outcomes were also analysed. Each teacher taught a unit of work from the national exemplar scheme of work (QCA, 1998): Bread, Cam Toys and Slippers.

In order to develop categories of teacher purposes for writing tasks, the data was analysed for incidents where teachers articulated purposes for specific writing tasks or for writing tasks in general. Categories were developed from this analysis and from the literature using the constant comparative method: working definitions of the categories were continually refined in a process of iteration between the data, the literature and the categories.

The data analysis has revealed eight categories of purpose for writing tasks articulated by these three teachers. These categories have been separated out for the purposes of definition and description, but in practice one writing task might serve a number of purposes.

Categories of Teachers' Purposes for Writing Tasks in Design and Technology

'Remember this'

> *"I want you to memorise this, to make a record you can refer back to, to look back and recall this."*

Writing involves a complex interaction of motor and cognitive skills and can take great effort. This degree of concentration, the time spent engaged with the subject and the fact that writing is a visual form of representation contribute to its effectiveness as a tool for memorising. Some of the writing tasks in this study provided opportunities for children to reinforce their understanding of specific aspects of subject knowledge, e.g. using the correct technical vocabulary when labelling diagrams of cam toys.

Children were also encouraged to use writing to make records to refer back to, e.g. lists of tools and materials needed and criteria for their designs. Planning sheets were used by two of the teachers to prompt the children to record their stages of designing and making. Both teachers and children were very aware of this purpose for writing, although in practice the children rarely referred back to their planning sheets. The opportunity for children to have their own lasting record of their experience of design and technology was also recognised as important by teachers, either as a personal souvenir or as a reminder of what had been learnt for future reference.

'Think about this'

> *"I want you to pay attention to these things, to think creatively and critically, to clarify your thoughts, to specify, to think things through."*

The teachers believed that many of the writing tasks they planned were designed to direct children's attention to specific issues that they needed to think about. The photocopied sheets included questions and prompts for the children to respond to. When children used blank paper, they were asked verbally to focus on specific issues, but on these occasions they also had to consider the layout of their texts.

Sometimes writing for this purpose involved children in making quick notes to capture ideas and thoughts. The teacher in the cam toys project encouraged the children to use their planning sheet as a 'working document' and attributed value to children's 'rough' writing. The laying out of thoughts on paper is one form of modelling ideas, an activity central to design and technology (Kimbell et al, 1996). This purpose for writing was regarded as important by the teachers.

> *'…this business of thinking things through … because I think it's only when you commit it to paper that you can see the loopholes really.'*

'Take it Step by Step'

> *"I want you to be methodical and not rush ahead and make mistakes; I want to be in control of how fast you go."*

All the teachers planned their units of work by thinking about what the children needed to achieve and working back from that, identifying a sequence of steps. Each step had its own related writing task(s), except for the main making activity. The teachers thought that mapping out a clear sequence of steps was a useful strategy for managing challenging practical activities. In two of the cases it also seemed to be a way of managing the children through the process of designing and making, reining them in, so that they did not rush through the activities in their desire to get on with making their products. One potential danger of this approach is that the writing tasks can become a series of hoops for children to jump through in a linear design process. This can limit the learning potential of designing and making assignments and can have a negative impact upon children's motivation (Stables et al, 2000).

'Put your Heads Together'

> *"I want you to spark ideas off each other, to discuss and think through something together, to share your expertise, to compare your thoughts and ideas with other people's."*

Writing tasks were sometimes undertaken in groups to encourage children to discuss their work and to think about issues in more depth. Group writing tasks involved working as a group with a single scribe or working as a group and recording individually. Group recording took place in activities such as brainstorming, investigating products, investigating materials, designing and evaluating. The teacher in the bread project found that drafting and revising text on the computer was particularly effective when undertaken as a group activity as the screen was visible to all and changes could be made easily. In this project, the children and teacher also shared outcomes of individual writing as a way of expanding their own range of ideas and developing a greater awareness of other people's thoughts and opinions.

'Show me, Tell me'

> *"I want you to show me what you know and what you can do, what you have done and what you plan to do. I want you to tell me what you think, what you feel, what you want."*

The teachers recognised that writing tasks could provide feedback about individual children's level of understanding, their progress in a project and their design plans. There was, in practice, however, little dialogue between teachers and children using children's written outcomes as a starting point. This was possibly due to time constraints.

This type of recording was also used by the teachers for information about children's resource needs in terms of materials, equipment, skills and time.

'Write for Others'

> *"I want you to practise and develop your literacy skills and create texts appropriate for audience and purpose."*

In the bread project the teacher planned two tasks which placed an emphasis on creating texts for others. This type of writing task has strong links with literacy as the children are encouraged to consider audience, purpose, style and genre and to use correct English. The children were involved in designing and making posters to inform younger children of how to work safely and hygienically with food. They also drafted, revised and published recipes for their bread products to publish in a class recipe book. The teacher used this opportunity to teach specific learning objectives from the National Literacy Strategy (DFEE, 1998) related to instructional writing. Some of this work took place in the literacy hour. This was possible in this school as the teacher taught all the children for both design and technology and literacy. In the other two cases, children were streamed for literacy which made it difficult for the teachers to make meaningful links between the two subjects.

'Keep Yourselves Busy!'

> *"I want you to keep busy and not disturb me or other children in the class."*

There were several instances in the case studies where children were asked to write independently while they were waiting for help or for resources or when they had finished their work and were waiting for the next activity. In the bread project, the teacher planned a writing task to occupy half the class while the other half was making bread. It was a worthwhile and enjoyable activity for the children but the teacher was almost reluctant to admit to her real purpose for the activity. The teachers in the other schools did not mention this category of purpose, although in practice they did use writing to occupy children as a strategy for managing practical activity in the classroom.

'Let's Prove It!'

"I want you to produce written work so that I can prove to other people that we have been working hard and doing things properly."

In the current climate of accountability in schools, I was anticipating that some teachers might feel pressure to produce written evidence of design and technology as a way of proving that they had been covering the statutory curriculum requirements, especially when much of the work in design and technology is practical and children tend to take models home – or eat them! None of the teachers admitted to feeling this pressure themselves. However, in one school there was evidence of pressure from OFSTED inspectors and from the teacher herself in her role as subject leader as she perceived the need to collect tangible evidence of children's work from her colleagues.

Discussion

The teachers in this study articulated a range of purposes for writing tasks in design and technology which responded to their needs in relation to teaching and learning, classroom management and accountability issues. However, they were reluctant to admit to purposes for writing tasks that were not directly linked to children's learning, although they all used writing tasks for these purposes. There was also sometimes a mismatch between teachers' perceived purposes for writing tasks and the reality as experienced by the children. For example, children rarely returned to their own writing to reflect upon their thinking or learning.

Developing specific literacy skills through writing tasks in design and technology occurred in just one of the three cases, although another teacher was intending to develop literacy links in her school. In the two schools where children were streamed for literacy it was difficult for teachers to make meaningful links for children between literacy and design and technology, beyond general reinforcement of spellings, vocabulary and punctuation, as they did not teach the same children for both subjects. They were also unable to use literacy lessons to work on literacy activities related to their design and technology units of work. This would appear to be a missed opportunity as other studies have shown that design and technology can be used to increase motivation and raise standards of achievement in literacy (Spendlove and Stone, 2000; Stables et al, 2000).

Time for design and technology was an issue that impacted upon the practice of all the teachers in the study: time for planning and curriculum time. There is evidence that this situation is improving now but the question remains, if there is limited time for children to experience design and technology, where should the emphasis lie? The teachers in this study were concerned that there should not be too much writing in design and technology and that it should not be too onerous. They viewed design and technology as an important contrast to other subjects – in content and teaching and learning style.

The eight categories for purposes for writing tasks identified from the data could be supplemented by two other relevant purposes not articulated by the teachers in the study:

'Find Out'

"I want you to ask questions of people, texts and products to find out information that will be useful to you."

There are opportunities in design and technology for children to find out as part of their research, e.g. developing questionnaires, carrying out surveys, asking questions and writing letters requesting information.

'Try These Ways of Writing'

"I want you to learn about genres used by design and technologists so that you can try them for yourselves."

Although much of design and technology involves practical activity, there are particular genres which might be seen as being significant forms of expression and communication in this field of activity. More research needs to be carried out on this, but I would suggest genres might include annotated sketches, specifications, brainstorms, comparison charts, mind maps, lists and storyboards. These types of writing do not currently figure in the literacy objectives for this age group in the National Literacy Strategy.

Conclusion

The evidence from these case studies suggests that primary design and technology has evolved a tradition of practice that includes writing tasks as an integral feature of teaching and learning. The teachers articulated a number of purposes for writing tasks but these were not always evident in practice or in children's perceptions of the writing tasks they experience in design and technology. There is further work to be done on identifying 'authentic' writing tasks, i.e. writing tasks which have meaning for children in thinking and learning in design and technology that might also serve the purposes of teachers managing an exciting but challenging subject in the primary classroom.

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Designing the Future by Including Indigenous Knowledge

Technology for All, P.O. Box 735, Kloof, Durban, South Africa

Kate Ter-Morshuizen, Director – E-mail kimali@mweb.co.za

Introduction

In Africa, one cannot be involved with Designing the Future without including indigenous knowledge as a relevant and essential part of the technology curriculum. One of the major shortcomings of our curriculum in the past has been an overemphasis on formal scientific knowledge and an almost complete neglect of indigenous knowledge. Achievement in science, maths and technology of South African children in general, and black children in particular, is a cause for concern. The problem is usually related to deficit theories of underachievement e.g. the problem being located within the black child and the home environment. To compound the problem, the education system prior to our new democracy did not encourage black learners to engage in these subjects. Thus the poor quality teaching in these subjects results largely from poorly trained teachers due to their own inadequate training

Engaging with technology develops children's capacity for innovation, enterprise and invention. It stimulates curiosity and leads children to ask scientific questions and apply mathematical skills. By engaging with technology the positive effects are felt in science and mathematics. Our challenge is to promote the public understanding of technology, to promote equal opportunities and to challenge the culture of technology to include Indigenous Knowledge Systems, so that the pupils operate from a position of ownership and pride, rather than from a deficit position. One of the ways of achieving this is the inclusion of Indigenous Technology in the curriculum.

According to Dr. Wally Serote.

> *"There is a power, there is a strength, there is a wealth, there is a past, a present, a future, there is everything in the indigenous knowledge."*

This paper attempts to highlight the vast reservoir of indigenous knowledge that is available. It examines aspects of the processing of materials such as grains and clay and investigates earliest iron working sites as well as a range of structures that support, protect and contain. Early indigenous handmade and idiosyncratic traditional design skills are included as part of the knowledge and skills that can be taken forward. The point of departure is based on the premise that technology is a human response to a human need. Over the years, in different places, with different cultures, the needs remain the same but the responses differ.

In addition, this paper attempts to offer ways of using indigenous technology to examine opportunities to address the basic needs of:

- Food
- Shelter
- Clothing and adornment
- Health

The Need for Obtaining and Preserving Food

In Africa, grain is used extensively as a staple foodstuff and to make a fermented drink. This has been practised for hundreds of years. At the Shongweni south cave, just west of Durban, pottery shards dating to the end of the second century A.D. were found with preserved remains of the cereal millet.

Several hundred years ago, journalists on the south Eastern seaboard of Africa wrote…

> *"They cultivate millet which is white and the size of peppercorns – it is the fruit of a plant of the size and appearance of a seed. Of this millet, ground between two stones or in wooden mortars, they make flour and of this they make cakes which they cook among the embers. Of the same grain they make wine, mixing it with a quantity of water which, when fermented in a vessel of clay, and has cooled and turned sour, they drink with great enjoyment."*

This account reinforces the fact that processing of food was occurring many hundreds of years ago.

The Nguni grain pits illustrate a very effective technology for preserving grain for several years. Maize was reaped after the cobs had been dried in the sun. Grain was stripped from the cobs and stored in the grain pits. These was usually dug in the centre of the cattle kraal and lined with a mixture of cow dung and clay. The base was covered with small stones and clay. Then the pit was dried by the sun and when dry, it was filled with grain. A lid of roots and sticks, covered with clay, was placed on top and covered with a heavy stone. The grain in the cool dark pit was kept fresh because a little grain on the edges fermented and gave off carbon dioxide that suffocated any pests which might eat it. This is a good example of indigenous technology where the indigenous people knew that carbon dioxide gas preserves grain long before they knew how it preserved grain. In this case technology preceded science.

The food of the indigenous people was crushed, combined, and preserved by dehydration and fermentation. There are endless opportunities for food technology lessons that are relevant and most importantly dispel the myth of apartheid education that at the time when Jan van Riebeck arrived at the Cape in 1654, the people were simple hunters and gatherers.

The Need for Containment and Storage of Food

Linked to the need for obtaining food is the need for containment and storage of liquids and food. The processing of clay and fibres has been perfected in indigenous cultures.

The technology involved in making pottery is one of the oldest arts of man. In the Sahara there is pottery dating to the eighth millennium B.C. People need to contain liquids and allow the direct application of heat to food. The introduction of pottery was therefore a significant technological event. In addition, pottery style plays an important role in different societies. Style relates to different shapes and motifs in the design. Society transmits it social norms and values though cooking and serving dishes.

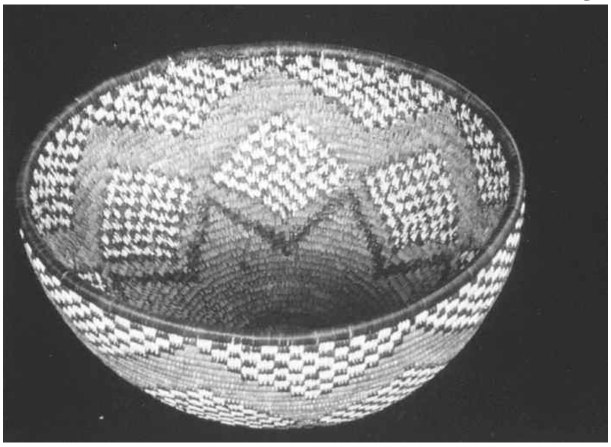
General Techniques of Potting

- The simple raw materials are earth and water. Tools are minimal, the single most important factor being the human hand.
- Lumps and stones are removed, dried and pulverised.
- Clay may be puddled by the addition of water so coarse material falls to the bottom.
- Pounding and kneading removes trapped air otherwise this would expand on firing and burst the pot.
- Straw, dung, ash and sand could be added to reduce the water content. This prevents cracking during drying and firing. African pots are usually fired at fairly low temperatures so that they can be put directly onto coals when cooking. One method of firing is to stack dry grass around the pots and set it alight. Another method is to dig a pit, bury the pots in there and make a fire on top of the soil.
- Many African clays contain iron oxides which turn from red to black. They are burnished with a smooth stone and a little water until glossy.

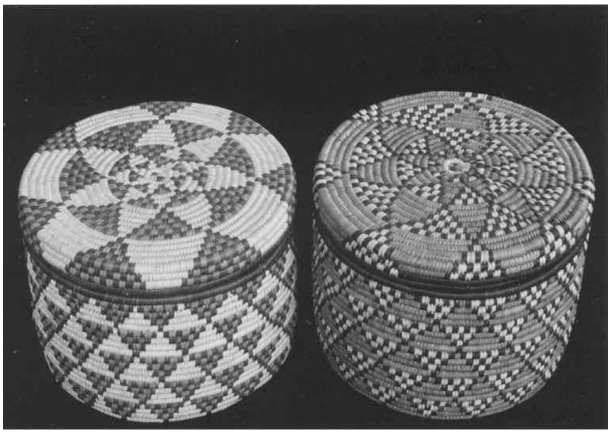
Suggested Design and Technology Tasks

- Use the example of one of our famous potters, Nesta Nala, as a case study. She has been described as "a remarkable and resourceful artist, who has negotiated the boundaries of the environment, technology and culture with deft skill and artistic vision."
- Identify a potter in the community to demonstrate the making of pots.
- Design and make coil pots using clay as a gift for a member of your family.
- Identify different styles of pots from different cultures e.g. African, Chinese, American Indian or Egyptian. Note that cultures transmit their oral traditions and beliefs through pottery. Find out about Hindu clay lamps and Diwali.
- Evaluate four different pottery coffee mugs using the criteria of size, shape, handle and design (colour and decoration). Give a mark out of five for each criterion resulting in a score out of twenty. Each member of the group must cooperate, compromise and reach consensus to rank order them.

The processing of fibres has a long and proud history in Africa. In our curriculum we cover both basketry and textiles. The processing of fibres covers a wide range of articles. In basket work the shape is rarely ornamental and is mostly dictated by the use to which the object is to be put. This is an excellent opportunity to relate form and function. Fibres can be woven close enough to hold liquids and open enough to strain liquids e.g. beer strainer. There is the almost flat winnowing tray to separate the chaff from the grain. Garden baskets for gathering are usually flared at the top with a small concave base to balance on the head. There are open and lidded storage baskets including wicker granaries big enough to take the season's harvest. Other containers are used for a variety of household uses e.g. the containment of seeds, flour, sorghum and other household items. The grinding stone is placed on a tightly woven mat of palm or grass fibres to collect the meal.



Wooden bowl



Wooden baskets

Suggested Design and Technology Tasks

- Design and make a coiled mat that will protect a surface from a hot pot.
- Examine a range of baskets and describe how the form fits the function

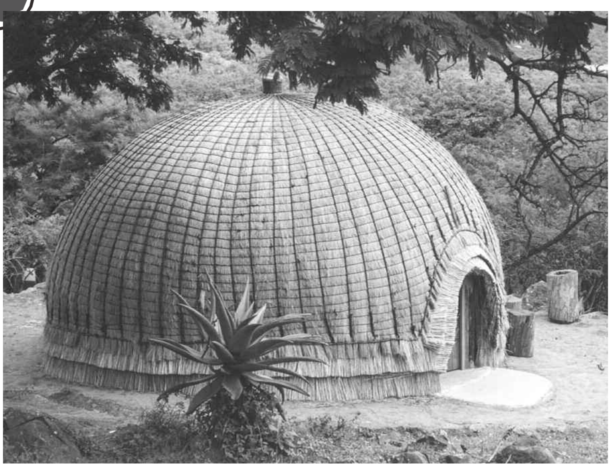
The Need for Shelter

The beautiful grass huts of the amaNgwane of KwaZulu are one of the most successful architectural designs. They rank amongst on of the finest indigenous dwellings in Africa. The people live in the foothills of the Drakensberg in grassland pastures.

What was the Need?

- The need was to build a shelter with readily available material. These huts were built entirely of grass and saplings. No nails, wire, bricks or planks were used.
- The hut needed to have both good ventilation and good insulation.
- There was a need for soil conservation so topsoil was not used for bricks. The indigenous people lived close to the land an were aware of environmental issues. In this regard, the cutting of certain reeds from wetlands was controlled by means of a cutting race on only one day of the year. This ensured that there was no environmental degradation. The construction of the domed hut meets all the needs for functional efficiency, constructional economy and exploitation of the nature of the materials.

Grass hut frame



Finished grass hut

Suggested Design and Technology Tasks

- There are endless opportunities to explore frame and shell structures, cone on cylinder which is so typical of Africa, and the change from cylindrical structures to rectangular shapes.
- One can investigate the problems of the Ndebele which resulted in huts which are striking, colourful and vibrant. These features were the result of enormous social and political changes when the Ndzunza royal family was nearly wiped out, and they developed this distinctive decorative form as a means of cultural identity.
- Pupils can design and make an Ndebele frieze for their classroom.

The Need for Clothing and Adornment

The processing of hides was formerly essential to the Nguni economy. They made extensive use of hides from game and livestock for clothing, ornaments and utensils. The leopard and primates furnished both sexes with clothing and ornaments which were also used to indicate rank and status,

What was the Need?

The skin – working technology enabled the Nguni (Zulus, Xhosa and Swazis) to meet their needs in the following ways

- Soft hides were needed by the mother as a cloak or imbeleko for carrying the baby
- Leopard skin loin cloth for Zulus
- Monkey tail loin cloth for Swazis
- Skin skirt with pleated effect for women
- Cloak with leopard skin trim for Xhosa Paramount Chief
- Sandals

Suggested Design and Technology Tasks

- Different cultures traditionally use different fur for ceremonial dress. Find out what fur is used for
  - Zulu king
  - Swazi warrior
  - The coronation robe of the British royal family
  - British busby
- Obtain some leather off-cuts from a local shoe factory or other outlet. Design and make a simple article such as a purse.
- Discuss the values and attitudes we need to consider when
  - Designing and making fur fashion items
  - Wearing fake fur
  - Culling animals

The Need for Adornment

Beads are the most common items dug out of middens and graves of ancient civilisations. The earliest civilisations in present day Africa traded ivory, gold and other products in exchange for beads. Early diary records from Henry Francis Fynn in 1824 record how he earned the right to live on the shores of the bay of Natal (Durban) by bartering beads with King Shaka.

Beads were used traditionally to transmit messages. Love, amongst the Zulus, is a very private matter. A typical, traditional woman will never say "I love you," and so bead messages were sent. The colours are significant but there is more meaning than just the colours.

- Pink – even though you are poor, I still love you
- Yellow – she loves the boy like sugar
- Turquoise – her love is clean and pure like the sea
- Green – young, but old enough to marry
- Red – ready for marriage

Suggested Design and Technology Tasks

- Make a collection of beads. Note the different materials used for beads today
- Design and make a necklace of papier machè beads. Think about who you will give it to and then decide on the size, shape, colour and design.
- Draw the design of a love letter that you will send someone.
- Design and make a game for preschool children using beads made from clay or papier machè. It should give practice in eye-hand coordination, matching colours and counting, using repetitive designs

NOTE: It should be recorded that beaded dolls are not only exquisitely made and collectors items, but often had symbolic meaning attached to them. e.g. the Tsonga doll consists of male and female elements – the cylinder being the male and the skirt the female element. The dolls traditionally have no limbs and no facial features. The doll is called m'wana or child and this links the doll to fertility where the real child replaces the doll. After initiation, the girl takes the doll to her husband's home. After the birth of her first daughter, the beads of the doll would be sewn onto the child's skirt.

Suggested Design and Technology Tasks

- Bring a doll from home. Look carefully at the way it is constructed then answer the following questions.
  - What material is used?
  - Is the material breakable? Or washable?
  - If the limbs can move, how do they articulate?
- Look carefully at the pictures of beaded dolls and then make a doll using indigenous technology. Your doll should be made from beads, textiles and anything else and be based on the simple cone shape.

The Need for Health Through Traditional Medicines

One of the earliest records of Zulu traditional medicines was by Dr A T Bryant who arrived in Natal from Britain in 1883 and was engaged in missionary, educational and literary work. He kept accurate notes of how the medicine man was trained, his healing methods and the medicines he used. He discovered that the Zulus were on the one hand using curative herbs and plants long before the Western medical world learned about these and yet on the other hand he found them using worthless and even dangerous methods and medicines.

From a processing point of view, he records

- Cold infusions (isiChonco) – a certain amount of cold water poured on a certain amount of powdered or chopped bark or root
- Hot infusions (Ifudumezelo) – prepared like tea, where the plant material is steeped in hot or boiling water
- Decoctions (imPeko) – simmered and / or boiled
- Powders – air dried and roasted, pulverised and even burned into ashes. Powdered medicines were also often rubbed into incisions made on the spot.
- Poultices – made by bruised vegetable substances and applied warm or cold, and
- Lotions in which the liquid extract of the medicine is used for dropping into, or pouring onto, the affected part.

There are many thousands of plants which are used but I shall use three beautiful and easily recognisable flowering plants.

- Agapanthus africanus – (Zulu – ubani)
  The Zulu medical usage is for chest troubles and as an emetic for expectorant coughs. Hot root infusions are taken daily as emetics for heart diseases. Hot root infusions are taken as love charm emetics and as emetics by people who are afraid of thunderstorms as they are used as protective sprinkling charms against thunder. Roots are sometimes taken during the last three months of pregnancy to ensure healthy children and in more concentrated forms to induce labour. Other uses are a lotion from crushed roots to bathe newly born babies to make them strong.
- Gloriosa superba – Flame Lily – Ihlamvu
  The powdered corms are taken by men for impotency or mixed with food to be taken by husband and wife for barrenness or to ensure the desired gender of the child. Corms are selected according to their resemblance to male or female organs. They are also taken as aphrodisiacs and sometimes taken as an emetic charm by a young man to cause an indifferent girl to return his affections. They are used to kill lice, for skin eruptions, tick infections and for screw worms on cattle. In Ayeuvedic medicine, a paste is made from corms, fried in butter and mixed with oil and applied for rheumatism and gout. Corms are actually toxic and the extract colchine may cause foetal abnormalities.
- Aloe arborescence – inhlaba encane
  Leaf decoctions are used in childbirth. Cold water leaf infusions are used for stomach aches. Powdered leaf infusions are used for sprinkling protective charms against storms. Leaves have purgative properties and sap relieves sunburn.

Commercially, extracts from leaves have been widely investigated and shown significant wound healing, anti bacterial, anti ulcer, anti inflammatory, anticarcinogenic and hypoglycaemic properties.

The polysaccharide aloemannan, shows anti tumour activity against implanted sarcoma S – 180 in mice. Aloe lectin is thought to be the active component in wound healing.

Aloe vera gel has therapeutic effects. This is confirmed in animal and human subjects. It has analgesic, anti – inflammatory, tissue penetration and capillary dilatory effects. Topical applications produce healing without tissue loss in burn and frost bite patients and reversal of tissue necrosis in intra-arterial drug abuse patients. Topically applied extracts have also been shown to stimulate the synthesis of collagen and elastin fibres. Diets containing leaves produced marked decreases in serum total cholestrol, serum triglycerides and blood glucose levels in patients with diabetic atherosclerotic heart disease. Reduction in blood glucose levels was found in patients treated with leaf extracts.

Suggested Design and Technology Tasks

NOTE: Pupils are to be warned not to try and make their own health remedies!

- Make a cup of tea as an example of a hot infusion
- Use coffee beans to dry, roast, crush or pulverise to grains to simulate making powders.

Conclusion

We need to shift from creating job seekers to job creators and entrepreneurs; to integrate theoretical aspects of the curriculum with practical realities and pride in the rural environment. We need to develop economic enterprises using our indigenous knowledge and skills, accumulated over centuries of living in rural communities where of necessity people have to solve problems, and design and make solutions to everyday needs and problems. We need to preserve technologies that are rapidly being lost and prevent cultural practices from fading with Westernisation. Giving indigenous technology its rightful place in the curriculum will help us to design the future, building on the past.

Technology Exemplars and the Matrix a Hollywood Fantasy Epic or Useful Classroom Tool

Department of Technology, Science and Mathematics Education (TSaME)
Massey University College of Education, Massey University, New Zealand.
Gary O'Sullivan, Senior Lecturer – E-mail g.c.osullivan@massey.ac.nz

Introduction

Morpheus: What you know you can't explain, but you feel it. You've felt it your entire life, that there's something wrong with the world. You don't know what it is, but it's there, like a splinter in your mind, driving you mad. **(The Matrix, 1999)**

The technology curriculum statement (TINZC) was published in 1995 however it was not until February 1999 that the New Zealand Ministry of Education gazetted it, i.e. made it mandatory in state schools. This meant that Primary schools years 1-6, Intermediate schools years 7-8 and Secondary schools years 9-10 were required to deliver programmes designed to implement this curriculum.

According to the technology curriculum statement the aim of technology education in New Zealand is to develop students' technological literacy. This is to be achieved through the development of: technological knowledge and understanding, technology capability and understanding and awareness of the relationship between technology and society. (Ministry of Education, 1995, p. 8)

It is the improvement of programme offerings through a greater understanding of progression and assessment via the development of technology exemplars and the matrix that is the focus of this paper.

Background

Since the publication of the curriculum statement in 1995 a significant amount of funding has been made available by the Ministry of Education to develop teachers understanding of technology education. However, research carried out shortly after national facilitation programmes for teachers by (Compton and Harwood, 1999) suggested that success has been limited. In particular, teachers are finding it difficult to create programmes that move beyond separate one off activities therefore limiting progression for their students.

Between 1998 and 2001, the Ministry of Education funded research projects to be carried out by Massey University, Auckland College of Education and Waikato University. The focus of these research projects was to describe student learning, assessment practices and progression in technology education (Moreland, 2001). The results from these research projects were later to be used to inform a national exemplar project.

In August 2000, the Minister of Education, announced the National Exemplar Project which was part of the governments overall assessment strategy.

> *An exemplar is an authentic example of student work annotated to illustrate **learning, achievement,** and **quality** in relation to the levels described in the relevant national curriculum statement. Each exemplar highlights significant features of that work and important aspects of students' learning.* (Ministry of Education, 2002)

In 2002, a contract was given to the Auckland College of Education to administer the national programme for technology. This meant the appointment of a National

Coordinator and selection of members for three groups who would be involved in the 2002 technology exemplar development model. The three groups were to be compiled of people with curriculum and assessment expertise from a range of institutions throughout New Zealand.

The Development Group: A team of people contracted to work as facilitators with the classroom teachers and help with the identification and production of the exemplars.

The Quality Assurance Group: A team of people contracted to develop quality assurance criteria for the selection of exemplars. Additionally they were given the brief to develop a learning matrix for technology education.

The Advisory Group: A Ministry of Education group to review the decision making process.

The author of this paper served on the Quality Assurance Group and as a liaison person to the advisory group. This paper is a personal commentary of what and how it was achieved.

The Exemplars

During 2001, exemplar teams of experienced subject specialists and teachers in English and Maori worked with schools throughout New Zealand to develop the first draft exemplars. These draft exemplars were developed from authentic classroom teaching, learning, and assessment activities (Chamberlain, 2002).

In a background paper the Assessment Manager at the Ministry of Education cited above explains the purpose of the exemplar project:

> *The government's aim is to reduce inequities in students' achievement and to raise achievement levels for all students.* (Chamberlain, 2001 p. 1)

For technology education, this proved to be a particularly difficult undertaking. Given all the stakeholder interest groups and differing perceptions of technology education that abounds in New Zealand. The initial meetings of the Quality Assurance Group were focused on the review of the draft exemplars and the formation of selection criteria. However, it became quite clear that the chosen technology exemplars and the proposed matrix were going to need careful development as the link between the two became more complex. Initial reviews of the draft exemplars were less than favourable. Many were deemed little more than craft projects, which could have been undertaken twenty years earlier and displayed little relevance to the current curriculum statement.

In the background paper from the Ministry of Education highlighted above, a concern was raised that the exemplars of student work could become a de facto curriculum. For technology, the Quality Assurance Group soon realized the exemplars could totally undermine the curriculum. Although achievement objectives from the curriculum were being highlighted in the early exemplars, the essence of the curriculum was not. These initial observations were to drive the whole direction of the contract. It became clear that feedback given by the Quality Assurance Group to the Development Group and ultimately to the teachers and students in technology education was to have a profound effect. The matrix took on an even greater significance and urgency in the process.

Sessions were held where the exemplars were critiqued by individuals, small groups and finally by the whole Quality Assurance Group. Decisions were taken after hours of debate which exemplars were to go on to the next phase and which were not. Additionally as one might expect with a relatively new curriculum some technological areas from the curriculum were under represented, as were some age groups. The exemplars and matrix were to cover curriculum levels 1-5, years 1-10 and also to indicate access for early childhood and lead in to the new school qualifications NCEA. Each of the draft exemplars was returned to the Development Group with annotations from the Quality Assurance Group along with the latest version of the draft matrix. Improvements in the exemplars that were still being developed were quite noticeable. (Some early exemplars can be viewed here) http://www.tki.org.nz/r/assessment/exemplars/tech/index_e.php

The more the Quality Assurance Group refined the Matrix the better the exemplars became. Teachers and the Development Group were reporting that overall the Matrix and the recommendations of the group were being received positively. The matrix was not changing the work per se. Nevertheless, it was helping to change the parties' involved perceptions of technology and what to look for in terms of assessment and progression.

The Matrix

> *Morpheus: Unfortunately, no one can be told what the Matrix is. You have to see it for yourself.* (The Matrix, 1999)

Morpheus's expression of what the matrix is in the movie is very similar to viewpoints expressed by the Quality Assurance Group. Creating a matrix is a very difficult undertaking. However, there is a rationale for attempting such a task.

> *"The area of progression is one of the least understood areas, yet this is crucial for designing curriculum and enhancing student achievement".* (Carr, McGee, Jones et al., 2000, p. 60).

If one could take current practice that was deemed to be of some quality and replicate it, improvements would be made with those who struggle to reach that level. However, those who currently exemplify quality practice may not be extended. The Quality Assurance Group saw the matrix as an opportunity to review research in the area of assessment in technology, take quality practice and try to push it forward. The exemplars on there own give a valid picture of good practice but the exemplars need the matrix to help with overall progression and the striving for overall improvement.

As with any discussions of assessment personal positions as to the purposes, intentions and validity of assessment techniques were hotly debated. Discussions along the lines of atomistic and holistic notions of technology assessment (see Kimbell, 1997) were to the fore. Earlier research projects carried out by teams from Waikato University, Massey University and Auckland College of Education in New Zealand had attempted creating matrices. These formed the starting point for the Quality Assurance Group's work.

In fact, numerous attempts were made to create something that could be of use as an aide-mémoire for teachers and students of technology education. It seems that every group that has been involved with this project has attempted at least one different matrix. There was an obligation as part of the contract to create a matrix so a consensus and in some cases a compromise had to be reached. According to Black and Wiliam (1998), students needs would be best met by teachers who adjust their teaching to take account of the results of assessment, therefore teachers need to know about progression and students' learning needs. According to Chamberlain, exemplars and the Matrix together would assist teachers in making quality decisions.

The Quality Assurance Group were adamant that the exemplars and the matrix should be used in conjunction with each other, so much so that this statement was included in the final draft.

> *The matrix is one way of providing a basis for describing the 'big picture' progression of student learning in technology with the statements describing the richness, and the increasing depth and complexity of this learning. The matrix should not be read in isolation, but should be used alongside the exemplars to enhance teaching and learning in technology.* (Quality Assurance Group, 2002)

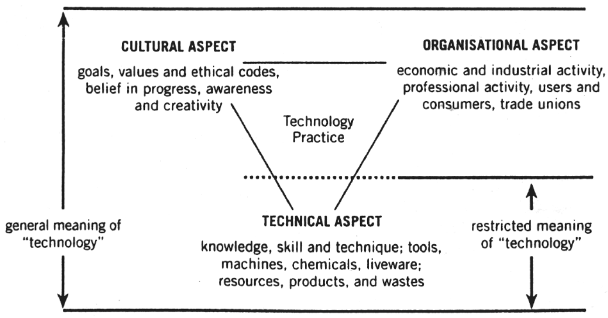
The matrix consists of six tables each readable in landscape format on one A4 page. The use of bullet points was avoided where possible in an attempt to encourage the reader to read across, as well as down. Some tables have no separate levels but signify important facets of technology education that run across levels. Other tables have grouped levels that are indicative rather than descriptive or prescriptive. The headings and introductory statements of each table resulted from many constructive discussions. These form components or characteristics of technological practice, which are important for developing technological literacy. The matrix needs to be seen as a work in progress, remain flexible to accommodate other characteristics as and when the need arises.

The headings of each table signify the key characteristics of learning in technology they are:

- Overall Statement of Learning;
- Being Innovative, Creative and a Risk Taker;
- Developing and Using Technological Knowledge;
- Communication and Modelling;
- Decision-making and Discernment;
- Developing and Achieving Solutions.

Overall Statement of Learning

The debates surrounding the notion of atomistic and holistic assessment in technology education led to compromises by all the members of the Quality Assurance Group. This manifested itself with the matrix having one introductory table, which tries to signify the importance of holistic assessment in technology education. It encompasses the key characteristics from each of the other tables and helps to form an overall statement of learning in technology. There were some concerns expressed at a late stage in the process that some strands of the technology curriculum statement (TINZC) were receiving too much emphasis. To ensure a balanced viewpoint of technology was being expressed level statements from all the tables were mapped against the headings identified by Pacey's (1983) diagrammatic model of technology and technological practice.



Diagrammatic Definitions of "Technonology" and "Technology Practice". (Pacey, 1983)

The level statements from each table were grouped under Pacey's aspects and overall there was found to be a reasonable balance of Pacey's general meaning of technology.

Being Innovative, Creative and a Risk Taker

This key characteristic would be impossible to level. Initial dissatisfaction with the exemplars as they were presented stemmed primarily from a lack of this key characteristic. It was not necessarily that is was not occurring but the teachers were not looking for or highlighting it. The Quality Assurance Group felt that by having this key characteristic unlevelled but clearly identified. The Matrix would encourage teachers and students to be more focused in this area. The group identified that innovation; creativity and risk taking may take the form of outcomes, processes ideas or approaches to a technological solution.

> *The opportunity for children to grow creatively in classrooms would appear to depend critically upon how support (scaffolding) is maximized.* (Davies, 2002p.118)

The technology curriculum encourages the notion of risk taking the Quality Assurance Group used the tem 'being brave'. It was hoped that by including this key characteristic that teachers and students would feel validated (supported) and encouraged.

Developing and Using Technologocal Knowledge

This key characteristic has also been widely debated both in New Zealand and Internationally (see McCormick, 1997). The Quality Assurance Group decided to support the view of some New Zealand research by Compton and Harwood (2001) that specific technological knowledge is contextually based. Individual levelling of bullet points within this key characteristic would be unhelpful. In fact would end up as an incomplete list that would run contrary to the philosophy of the Technology in the New Zealand Curriculum statement. However to omit technological knowledge from the matrix would be to devalue the importance of this key characteristic. This characteristic was used to support the notion that technological knowledge can be acquired from within ones own practice but also from without.

Communication and Modelling

This characteristic contains statements about technological language and its use for communicating. Communication between teaching staff according to Bowen (2002) is a key skill of technology education and should be one determinant of teaching and learning in the subject. The Quality Assurance Group widened that view to include everyone involved with the technological activities undertaken. Language is described in the matrix as incorporating words images, plans photos storyboards simulations prototyping etc. Modelling is discussed in its broadest sense i.e. rather than specific types of 2D, 3D etc the purposes of modelling are identified. Making use of modelling techniques to consult, develop, verify, evaluate and present. Again, holistic statements are used as indicators of student performance rather than a checklist.

Decision Making and Discernment

This key characteristic derived from debates concerning a lack of evidence of broad technological literacy. Initial exemplars fell clearly into Pacey's restricted meaning highlighted in Figure 1. There were exemplars that contained some evidence of functional literacy as well as notions of critical literacy. However, the Quality Assurance Group felt that this key characteristic should encourage teachers and students to consider multiple variables and increasingly evidence of both reflecting and forecasting becoming more a part of their practice.

Developing and Achieving Solutions

Acknowledgement of the importance of developing a tangible, viable outcome was the pre-cursor to this key characteristic being developed. Clear links were made in this characteristic to the three strands of the curriculum document in New Zealand and to the holistic nature of technology education. The application of skills, techniques, knowledge and understanding, including that of Pacey's organizational aspect. Within an overall awareness of the relationship between technology and society is emphasized.

Conclusion

The intention of this paper was to introduce some of the background to the development of the Technology Exemplars and Matrix. Too often policy decisions are taken at a government level and little clarity is given as too the thinking behind the direction which teachers are asked to follow. The Quality Assurance Group, Development Group and Advisory Group worked in a collaborative supportive and open manner. What has been produced thus far is a product of that collaboration and openness.

Whether Technology Exemplars and the Matrix is a Hollywood fantasy epic or useful classroom tool is yet to be decided. They are due for release mid to late 2003, time will tell. The Matrix as a movie has been reported by Paul LePetit of the Sunday Telegraph as "one of the best ten science fiction films of the century" The reception for the Technology Exemplars and their Matrix is uncertain but the intention isn't:

> *The matrix is one way of providing a basis for describing the 'big picture' progression of learning in technology. Ideally this will assist teachers to progress student learning from unit to unit.* (Quality Assurance Group, p.1, 2002)

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2-Days Lessons Are...

Using a Collapsed Timetable Strategy to Teach D&T in Primary Schools

Victoria Park Primary School, Sandwell

Chris Perry, Subject Leader, school manager of the DATA Leading School initiative; DATA Subject Leader Award winner in April 2003

E-mail chrisperry@cwperry.freeserve.co.uk

Introduction

As an NQT I recall a particularly dreadful Autumn term when I was asked to construct wooden toys that used CAMs. The Science Co-Ordinator, who was also 'asked' to look after D&T, gave me some 8mm strips of timber and the advice that a CAM was an off-centre wheel. "Make them from card," Carol said cheerfully. Resplendent in my newly-found knowledge and 'extensive training' (lasting all of five minutes) I duly went away. I discovered immediately that Year 6 had never used wood before. Indeed, card seemed to be a miraculous new discovery as well. In fact, they had done no D&T since Year 4. "Time pressures on the curriculum," the Headteacher said.

Year 6 and I tried. Two wooden frames later, our six lessons were finished. To this day, the children probably still have no conception of a CAM. We did no research, created no designs and had nothing to evaluate. The models fell apart after a week when someone sat on them. The Headteacher thought they were excellent and told me I was a good teacher. I left that school shortly afterwards.

What I have just described may sound like a scene from a Mary Shelley gothic novel, but it is the reality of many schools in Britain. Teachers lacking guidance and confidence leading children down blindfolded alleys. All of them lacking basic skills, like how to measure accurately or use a saw. They spend all their time desperately trying to create a few models that the Headteacher can show OFSTED (inspection) as some form of evidence. All that is required is a magic lamp and a Fairy Godmother and the pantomime will be complete.

Rob Johnsey (1998) argues, "that D&T is about improvement in the made world and cannot proceed without identifying the fact that something needs improvement." Only through a series of informed choices, steered through skilful teaching, can technology be understood, analysed, used for benefit and put in its place – essential for modern living, but used not at a cost of broken, human relationships living within a displaced sense of community. Within a context of human emotional and spiritual understanding, the role of technology in education can never be over-emphasised.

Skilful Teaching begins with Confidence. "I can do this, because I know what I am doing." Without that confidence, the Easter assembly becomes a great excuse to miss out large chunks of the curriculum.

Structure of a Typical Lesson	
Structure of a Typical Lesson	Time allocated (60mins max)
Putting out materials & Introduction	15mins
Main Task	25mins
Plenary & Tidying Away	20mins

Within a typical one-hour lesson, ten minutes will be a recap of previous learning with a further ten minutes to either take out resources or clear away the mess. Across a six week project that's two hours from an allocation of six spent on 'dead time'. There is a mere four hours left for teaching.

Structure of a Typical Day in a Primary School	
National Literacy Strategy lesson	First lesson
National Numeracy Strategy lesson	Second lesson
Core subject – Science, RE or PE	Third lesson
Foundation subject	Fourth lesson*

* *Struggling to compete with making Mother's Day cards, the visit by the local Fire Service, FLS, numeracy booster classes, Standard Assessment tasks (SATS) revision and a hundred other add-on activities that primary schools fight to fit in their timetables.*

At Victoria Park Primary School, core subjects take priority. We have five afternoons to teach ICT, History, Geography, Modern Foreign Languages, You Can Do It, PSHE and Music. The analogy of a juggler is very apt. Bemused visitors often glance at our timetable and politely enquire, "Do you teach D&T and Art at your school?" We reply that, until 2002, Art was taught on a weekly basis. Now it has followed D&T into the format of being taught in three-day blocked units achieved by collapsing the normal school timetable.

Design & Technology Curriculum Map 2002-2003

	Autumn 1	*Autumn 2*	*Spring 1*	*Spring 2*	*Summer 1*	*Summer 2*
Foundation	Ourselves Construction toys; Play dough	Build and construct: basic kits	Junk modelling	Design of a miniature garden	Design in the local environment	Design and make clay models and a farm
Year 1	Cutting skills	Eat More Fruit and Vegetables Unit	Moving Pictures	Mothers Day clay flowers	Vehicles	Fabric skills
Year 2	Food tools: Hygiene and equipment	As Autumn 1 Cookie Challenge	Puppets	Winding Mechanisms	EBP Link: Dudley College Skill Sampling Day	Puppets
Year 3	Photograph	Frames	Money Or: Bright Sparks	Containers Challenge	Sandwich	Snacks
Year 4	Structures -	Packaging	Pneumatic EBP Link	Systems	Cam Moving	Mechanisms: Toys
Year 5	Textiles -	Slippers	Control Storybooks	Mechanisms	Control Torches	Mechanisms Electrical
Year 6	Control Fairground rides	Mechanisms ICT/Electrical	Structures -	Buildings	Bread	Production

Design and Technology Curriculum Map at Victoria Park Primary School

In 1998, our school was criticised during its OFSTED inspection for "weaknesses in the design process, particularly in Years 3-4". Within five years the school's approach to D&T has been transformed. In a 2003 staff survey amongst Sandwell schools, teachers highlighted D&T, PSHE and Music as subjects they feared most. Staff at Victoria Park wrote the opposite – every teacher said they felt confident teaching D&T. Furthermore, a visit by HMI in March 2003 confirmed our belief that the last five years have been a remarkable success story.

In April 1999 the Headteacher agreed to let the normal school timetable be changed to create 'D&T Days'. This development was fully supported by all the senior management and teaching staff. Rob Johnsey began advocating this flexibility of approach many years ago, highlighting that D&T worked at its best when freed from tight timetabling restrictions.

Joint collaboration

As subject leader, I was keen to exploit some perceived advantages:

- Greater teaching time could be devoted to subject-specific work and less to clearing away and putting out materials. Initially, two days were allocated to each QCA Unit of Work, equating to approximately ten hours of solid teaching time.
- The whole process of D&T could now be taught:
  – Situation-Problem-Research-Design-the Prototype Stage-Testing-Evaluation.
- Assessment of the subject would be easier. Evidence could be collated of all aspects of the D&T process. There would be no opportunity for other subjects or events to interfere with the whole process. If part of the process was omitted, then it would be clearly evident and easily correctable later.
- The subject could be monitored easily through the use of photography, informal lesson observations and visits by senior managers/other professionals.
- Outside agencies such as the Sandwell Education Business Partnership would find it easier to block book their activities in school, instead of trying to find a spare hour each week of the term.
- Greater parental support was now possible, either in collating resources to a given deadline, or visiting the school to help with practical activities.
- For the duration of the days, LSPs and classroom assistants could be re-organised either to work on small SEN-based projects or provide day-to-day support in classrooms. After agreement with the SENCO, LSPs were shared around the school with a minimum of one assistant per classroom.
- A full risk assessment could be conducted before each project and managed more easily. There was no longer a need for a class to keep a box of saws or glue guns in their room for a whole term.

Overall, the status of D&T had been raised in the eyes of pupils and staff. This was a 'quality' subject deserving special treatment. The pupils saw the days as a welcome break from Literacy and Numeracy and relished the challenge to get busy. In reality, they used all their Literacy and Numeracy skills to great effect, but the context was more appealing to them, of course.

The initiative offered many advantages, but also some drawbacks:

- The cleaners, initially, were very irate until they realised that the mess was restricted to a couple of days instead of mess every single day.
- Were there enough resources to go around the school simultaneously? The long term curriculum map of the school had to be adjusted so that year groups worked on projects requiring different materials at different times of the year. For example, while Year 6 was woodworking, Year 5 was using electrics and Year 4 was sewing.
- Was two days sufficient to fit in all the stages of the D&T process? Clearly, it was not and by 2002 we had started to use three-day blocks instead.
- Could the school afford the cost of this initiative? Considerable grovelling to local companies and charities gained us some extra cash, but most of the finance came from my decision that work would be dismantled after construction unless the children were prepared to pay for the materials used.
- Medium and short term planning had to be re-written to meet the specific restrictions of our daily timetable. (We teach four sixty-minute lessons and a thirty-minute slot.) In some cases, year groups were teaching new units and these needed to be re-planned from scratch.

Creating structures

Food technology

A venture of this nature will only work effectively if staff feel confident teaching a project. By focussing attention and expectations in this blocked-approach, the staff and pupils were under pressure to 'deliver the goods'.

It was a very nervous and unsure staff that received the news in April 1999 that D&T Days would arrive in September. Suddenly, my role became crucial. I led a vital INSET session discussing the process of D&T and the new expectations for the subject. This was followed by several twilight sessions where the staff were given the chance to write their new medium and short-term plans. There was also an opportunity for staff to use any resources they were unfamiliar with. It transpired that corriflute was a material made of plastic, and not a musical instrument! In retrospect, I can see now that the staff were being asked to make a huge change in working practices and they wanted as much of my help as possible. Yet here I was facilitating change and offering support, but still forcing them to write their own planning. That year my name was spelt M U D!

J. Smith from Gladstone Park Primary School, London felt that "A model does not have to fulfil the brief for the task to be a success. Children can learn a lot from 'failure'. However, be careful to manage the level of failure. A child can take just so much!"

This belief in the value of failure applies to teachers as well. Would the staff have learnt anything if I'd done it all for them? Within a supportive framework of mutual learning in a confidential and calm atmosphere, I allowed the staff to face their personal demons about the subject, and then I led them safely through the minefield. The learning process went both ways. I learnt a lot that year and I admitted it.

Andy Breckon (1997) commented that:

> *"For many years practical activities took place in schools. Some were craft-based, while others involved cooking and needlework. Much … was artistically orientated and little was scientifically or design-based."*

One vital question remains:
Since 1998 has pupils' attainment risen? Year 6 in 2002-2003 are the first year group to experience D&T Days across the four-year period (until September 2002 we were a Junior School and had no Key Stage One). Using levels of attainment extracted from National Curriculum and QCA documents, in March 2003, the school had 61% of Year 6 working at Level 4 or higher. Not bad for a school that shows as an E* nationally on its PANDA rating. Five years ago no such data was even collected. By 2003-2004 a baseline assessment of children will take place at Foundation level making comparisons easier for future years.

Victoria Park Primary School is now one of DATA's Leading Primary Schools for Design & Technology. We welcome researchers, students or visitors who wish to come to the school.

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Exploring Education for Sustainable Development through Design and Technology Education

Department of Educational Studies, Goldsmith's, University of London, London SE14 6NW

Maggie Rogers, Senior Lecturer in Design and Technology Education – E-mail m.rogers@gold.ac.uk

Introduction

Design and technology in the Foundation Stage and Primary Education in England is at a critical stage of its development. The Teacher Training Agency (TTA), which regulates teacher training in England, has relegated design and technology, alongside three other National Curriculum foundation subjects, to the place of options in the recent revision of standards for newly qualified teachers. Whether Initial Teacher Training providers will be able to sustain sufficiently challenging courses within such a framework, supporting student teachers to explore issues, develop skills and reflect on their experiences is crucial to the development of a responsible design ethic. This paper describes research carried out at Goldsmiths', University of London, England as a joint project with South Bank University, London, England and funded by the WWF Initiative 'Partners in Change'. Through this project, student and newly qualified teachers have explored Education for Sustainable Development (ESD), using design and technology projects as the focus.

Research outlined in this paper describes work with primary student teachers in their efforts to explore the designing and making of products within a social context. This paper aims to demonstrate how, in supporting student teachers to analyze and question their own values and dispositions, subsequent work in school is better informed and implemented.

Changes to the TTA Standards for ITT

To be compliant with the TTA Standards for ITT Institutions of Higher Education in England have had to make choices about the amount of time given (if any) to these four subjects: art, design and technology, geography and history. Unfortunately, making D&T optional with art may confuse student teachers with the idea that the two areas are inter-changeable.

> *"Art and design, and design and technology are grouped because they both involve practical work with tools and materials, sometimes with specialised equipment."* (TTA 2002 p16)

The evidence for student teachers to demonstrate that they have met this standard is equally confusing.

> *"In art and design or design and technology, trainees might teach pupils to select and use a variety of materials, use tools and resources safely, and evaluate their own and others' work."* (TTA 2002 p41)

The expectation is that the student teacher will be able to teach "with advice from an experienced colleague where necessary" across a range of subjects (ibid p16). Yet, one of the main findings of the 2001/2002 Office for Standards in Education report on design and technology in primary schools, indicates that generally that

> *"The quality of teaching of D&T is adversely affected by substantial shortcomings in teachers' knowledge and understanding."* (Ofsted 2003 p 3)

Challenging Courses in ITT

The WWF Partners in Change project at South Bank and Goldsmiths' College has been concerned with "developing ways of further embedding Sustainable Development Education (SDE) within Initial Teacher Training (ITT) programmes" (Inman 2002 p8). After identifying the appropriate knowledge, skills and values/dispositions required of new teachers in relation to SDE the project team explored what an appropriate learning entitlement might look for students during their initial teacher training. Findings from this initial study highlighted the importance of giving student teachers the opportunity to explore their own values and dispositions when learning about design and technology education (Rogers 2002). Whether Initial Teacher Training providers will be able to sustain sufficiently challenging courses within the new standards for ITT, courses supporting student teachers to explore issues, develop skills and reflect on their experiences, is crucial to the development of a responsible design ethic.

Since the completion of the original 'Partners in Change' project in July 2001 the design and technology courses at Goldsmiths' have changed considerably. In making the undergraduate programme compliant with the revised standards for ITT design and technology, as with all the foundation subjects, has been reorganized to three two-hour introductory sessions followed by optional courses thereafter set against art. What was a nine-hour input on education for sustainable development the second year course has been reduced to a two-hour seminar. However, previously this experience was only open to the half of the BA (Ed) cohort who opted for design and technology as a second year option. With the changes in the undergraduate and postgraduate programmes, a one-hour session has been introduced into the first year introductory course and the postgraduate primary design and technology course. Although minimal, the input will be universal across the primary programmes. Whether it will be as challenging in relation to the issues is explored through feedback from student teachers who are currently following the design and technology curriculum course.

Background to the Project 'Partners in Change'

Research carried out through this joint project demonstrates the development of student teacher awareness of issues through design and technology education. Evidence gathered through monitoring inclusion of issues in assignments in 2001 showed that over 75% of the students had addressed values and attitudes to technology well with "more than half of the group demonstrating a very good to excellent understanding of issues of sustainable development education, making the connections between design and technology activities in school and wider development issues" (Rogers 2003). As these students completed the course contact was maintained with subject specialists into their first year of teaching as part of an extension project. This has resulted in a longitudinal study tracking student teachers into their first year of teaching, demonstrating the importance of well-developed values and dispositions in the delivery of design and technology schemes of work.

The second study analyses the experiences of four recent graduates from the BA (Ed) course as they take their design and technology specialist knowledge of design and technology into their first teaching posts. This is one aspect of the 'Partners in Change' Extension project where the aim is to track what happens when this knowledge and understanding is taken into school, particularly at a time when design and technology education is supported by the QCA scheme of work, DATA Help sheets and more recently, lesson plans. The challenge, at the start of their first year of teaching, for the teachers was to embed education for sustainable development into the units of work.

Case Study – PGCE Course 2003 College Based Work

This course was selected as a case study because of the changes in the postgraduate primary programme this year. In previous years the postgraduate students had two three-hour sessions exploring design and technology education. Under the new programme structure they now have five two-hour sessions. This increase in time has made time for a one-hour input on education for sustainable development through product analysis.

The postgraduate primary student teachers follow their foundation subject courses on their return to college after their second school experience placement. Some will have already observed, if not taught design and technology and this focuses the first, introductory session, on experience in the classroom. The session is introduced through introducing the issues followed by an analysis of several products, including food items, looking for questions to ask rather than trying to find answers. This is followed by a food-based investigation and design and make task.

The following week the students were given a short questionnaire to fill in which included the following questions:

- What was your understanding of 'sustainability' before the session last week?
- How has your understanding changed?
- Which aspects of the session did you feel that you could use in your classroom practice?
- Have you seen 'handling collections' being used and/ or product analysis being used in your school during your placement?
- Were you aware of education for sustainable development taking place in your placement schools?

The responses were necessarily brief due to time constraints but, nevertheless, they give some insights into the student experience. Figure 1: The level of understanding of 'sustainability' before the session, as demonstrated by the students' responses, show that this group had at least a limited understanding sustainability. These ranged from,

> *"I didn't really know much about it at all" (Student A) to "About recycling mostly. Fossil fuels and rainforest debates as well." (Student B). Most were aware of recycling but there was some confusion between terms e.g. "Before the session I just applied the word to how long things lasted – probably confusing with durability" (Student C).*

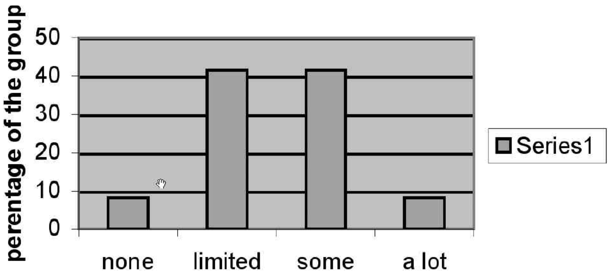

Figure 1. The level of understanding of 'sustainability' before the session

After the session 91% of the students reported a change in their understanding. One student, who had described sustainability in the first questions as "A complex area, all activities and production have an environmental impact. Sustainability is about how this is managed." didn't think that the session had made any changes (Student D). Nevertheless, when asked about which aspects of the session could be used in their classroom practice, this student identified the activity of looking "at objects and asking questions about them" which indicates that ideas were gained if not increased understanding (Student D). The most popular activity was using the handling collections of everyday objects (see Figure 2 over the page). All activities were seen to be useful for classroom practice and one student reported using product analysis on placement as well as observing it used during a food activity.

Only two students had seen 'handling collections' and or product analysis being used in school during their placements. Only two students responded positively when asked about whether they were aware of education for sustainable development taking place during their placements while seven were unaware of this going on.

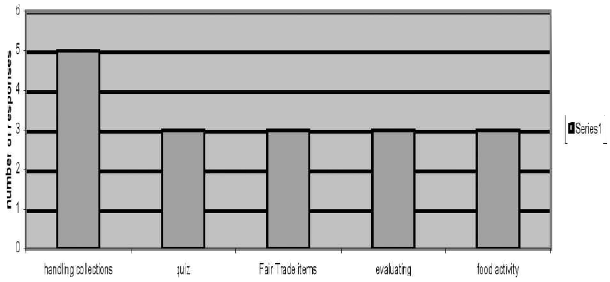

Figure 2. Aspects of the session that could be used in classroom practice.

Case Study – NQT (recent graduates) – School Based Work

As part of the WWF funded research project four newly qualified teachers (NQTs) were interviewed at the end of their first year of teaching. The focus of the interviews was how they had been able to develop their pupil's values and dispositions through design and technology activities.

The teachers were first asked to identify D&T projects carried out during the academic year 2001 – 2002

The context for these projects varied from school to school with one school organizing two and a half days blocks, week long blocks and weekly sessions. In one school there was an eco-council and the children had chosen to recycle paper as a school initiative. The opportunities also varied, for instance, some pupils being given problems to solve, e.g. pencil pots, in another school the Year 1 pupils were developing their cutting skills rather than designing and making which happened in Year 2. However, this teacher used demonstrations to develop the children's skills in designing and making, using 'choosing time' to sit with the children and 'make' pop-ups, the techniques of which the children absorbed into their own ideas.

Overall the response of the children was positive with one teacher suggesting that this was because of teacher confidence. Popular projects included QCA units on 'photo-frames' and 'money containers'. Food technology was also popular with 'healthy sandwiches', 'bread making' and 'designing and making salads' as the units described by three of the teachers. The projects also led to a focus on values and dispositions and included opportunities to taste different bread products, a focus on Indian rod and shadow puppets as part of Commonwealth week and opportunities to evaluate.

In looking at the strengths of the projects carried out in terms of sustainability the teachers reported on the way the children had been able to develop their social skills, were able to work in groups and collaborate, and the opportunity to discuss and peer conference. Self-assessment was seen in a positive way by the children in developing the skills. The projects were also seen to do a lot to promote friendships and "care for everyone else" as well as giving the teacher the opportunity to give positive feedback on the ways in which the children worked together (Teacher B). This teacher was also very positive about the development in the children's skills in listening, evaluating and helping others through the design and technology activities. The children also cherished their outcomes, having been spurred on by having the time to develop their ideas and free use of recycled materials (Teacher C). Through a food activity, the children in this class also had the opportunity to question why certain materials, types of boxes and packaging had been used. In addition to developing the children's on-going skills the way children had worked was seen as a definite strength (Teacher D).

When the teachers were asked what they would like to develop further in forthcoming years each response was different. They felt they needed longer time to build skills and experiences slowly, more spontaneous design and make activities, ideas which come much more from the children and are based in the everyday experiences. More time would allow for more focused practical tasks before designing and making, a greater emphasis on where materials come from and developing the use of "scrap materials in project(s)" (Teacher A). Teacher B made a plea for children to solve "problems in everyday life in the classroom – real situations. Teacher D was already engaging the children in designing a new school, with a tabletop model, and using sketchbooks to plan. This would take the children's experiences to another level where they can use what they have done before. The children were "now better informed" (Teacher D).

Ideas for developing Education for Sustainable Development through design and technology were clearly influenced by the experience the teachers had had in their first year of teaching but also included aspects raised during the questions on skills and values during the interview. Awareness of materials used in the projects could be strengthened by more information about their origins and, using photographs to make connections (Teacher A). Evaluations and more information about different cultural contexts for projects such as 'moving toys' were highlighted by Teacher B who also talked about developing care of resources by the children planning what they need and promoting the use of recycled materials. Teacher C felt that this work would become "more productive as children get older and can articulate their ideas", and suggested that 'smaller' issues could be taught about and the consequences "to open eyes more as they get older". This teacher also suggested making greater links between D&T (food technology) and PSHE. Teacher D also suggested linking D&T with other curriculum areas such as humanities.

When asked what was preventing them from achieving their ideals the teachers were, again, concerned about time. Time to fit everything in, the need for blocked or dedicated time and the prioritizing of the core subjects were the main issues. Resources were also raised by one of the teachers. Present medium term planning was felt by another teacher to focus on developing making skills rather than designing.

Conclusions Drawn

There is still a great deal of work to be done to fully assess how effective the new, shorter sessions on education for sustainable development through design and technology education have been in the longer term. The intention is to monitor what happens when the student teachers complete their final school experience placement, and move into their first posts. While recognizing that monitoring the effectiveness through the questionnaire given to the student teachers will have an impact as will the interviews carried out with the NQTs last summer, the findings from this work indicate that, given the opportunity to explore the issues and reflect on their practice, teachers can embed education for sustainable development into their practice of teaching design and technology. Which unit of work or project they undertake with the children is immaterial. What is important is that they recognize, for example, the opportunities that children have to work collaboratively, discuss and resolve conflicting ideas, and treat each other with empathy during the activities.

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If the Cap Fits – Wear It!

Stowlawn Primary School, Green Park Avenue, Bilston, West Midlands

Sue Vaughan, Design and Technology Subject leader and Deputy Headteacher

Telephone +44 192 556463

Background

Stowlawn Primary School is situated in Bilston, a district in the north of Wolverhampton. The age range of the pupils is from 3 – 11. There are approximately 218 children on roll, with a further 25 children who attend the nursery part time. The school is set in challenging circumstances, with 42% of the children being entitled to free school meals. This is above the national average. 20% of pupils are from ethnic minority backgrounds and ten per cent have English as an additional language, both of which are above the national average. Attainment on entry to the nursery class is very low compared with that expected for children of this age.

The school was placed in Special Measures in 1998, was removed from Special Measures in 2000 and had a very successful OFSTED inspection in May 2002. The school benefits from involvement in an Excellence in Cities Mini Education Action Zone.

The subject leader was appointed in September 2001. She had previously worked on a QCA research project into Creativity in DT and also on exemplification of standards in DT in Key Stage 1 for inclusion on the NC Action Website. She was awarded a DATA award for outstanding teacher of Design and Technology in 2002.

Introduction – Why Caps?

The school scheme of work was based on the QCA scheme of work. When I looked at the long term plan for Design and Technology I felt that some changes needed to be made in light of Curriculum 2000 and to ensure that all aspects of the programmes of study were being covered. I also felt that staff should be able to make some choices over what they taught and so I introduced some alternative units of work taken from the Nuffield Scheme of Work, which also supported many of the existing QCA units.

Last year in particular I taught a very challenging year 6 class, which was underachieving because of behavioural issues. As a school, we had to look very carefully at how the curriculum was structured and how these children learned best to maximise their potential and also to make life bearable! We undertook “PEEL” (Primary Effective Early-learning) observations, which quickly identified that the children were more engaged in their learning when they took more responsibility for it and had more choices. It was amazing to see how some of our “more able” children had actually become quite adept at “looking busy” and thus avoiding the teacher’s attention in lessons. However when they were directly observed they were very much off task in some lessons. We therefore began to look for ways of giving the children more responsibility for their own learning and opportunities for developing choices and thus their own autonomy.

My designated unit of work for Year 6 was “Slippers”. However, I had had a running battle with my year 6 class over the wearing of caps in school. I therefore decided to capitalise on their obvious interest in caps to make these instead, whilst still teaching the objectives identified in the “Slippers“unit of work. This also meant that instead of having to take extra time to make 2 slippers, only one garment had to be made and thus would save time at the making stage.

Investigate and Evaluative Activities (IDEAs)

The children were asked to bring into school any caps that they had at home. They looked at a variety of caps and chose which ones they were going to draw. While they were drawing they had to ask themselves the following questions:

- Who would wear this cap – how do you know? (needed to challenge some stereotyping here!)
- What materials is it made of and why?
- How are the materials joined? Why?
- How is the peak stiffened?
- Can it be washed? How do you know?
- How is it decorated?

Their drawings showed they had thought carefully about how the caps were made.

Focused Practical Tasks (FPTs): Developing Skills

We then progressed onto teaching the children how to make and cover a card peak, developing the idea into a model of a cap made from card and paper.

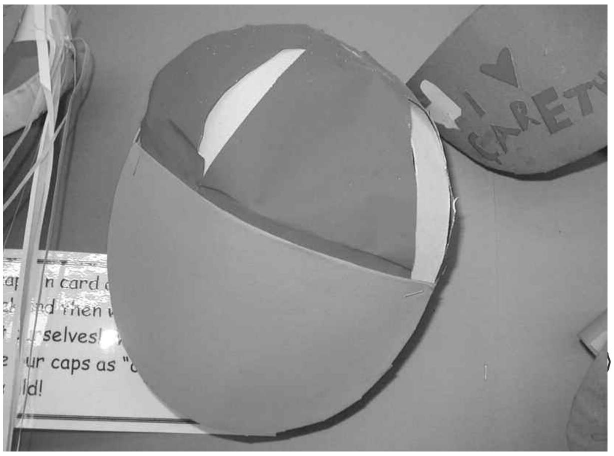
The starting point was to cover a peak made from grey card, covering it with brightly coloured paper to make it more attractive. When doing this the children learned how to make a seam allowance, snip around a curved edge and create a quality finish. Many soon found that they hadn’t allowed enough seam allowance and therefore found it very difficult to glue the paper down effectively. They then had to cover the back of it to create a quality finish. Adaptations had to be made to the peak, as some did not like the shape or it didn't fit.

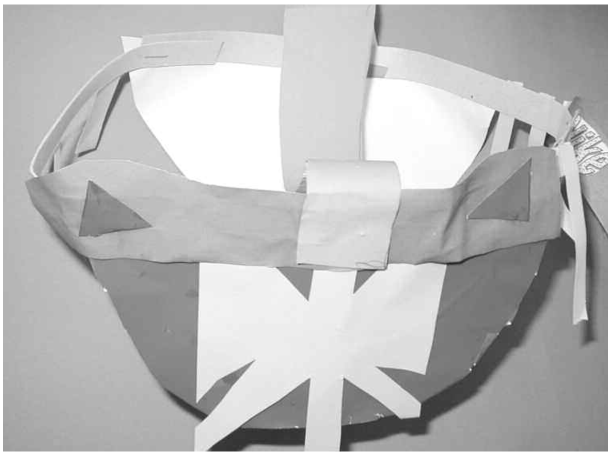
When the peak was covered, the children then had to develop their own ideas for how it could be attached onto the head. Their brief was to make it as different as possible, thus encouraging creativity. Some children opted for a simple strap to attach it, but many went for more elaborate designs, which fitted the whole head. Although the children did not record their ideas in drawing form, they were directly using materials to design their caps, learning from their own mistakes as they went.

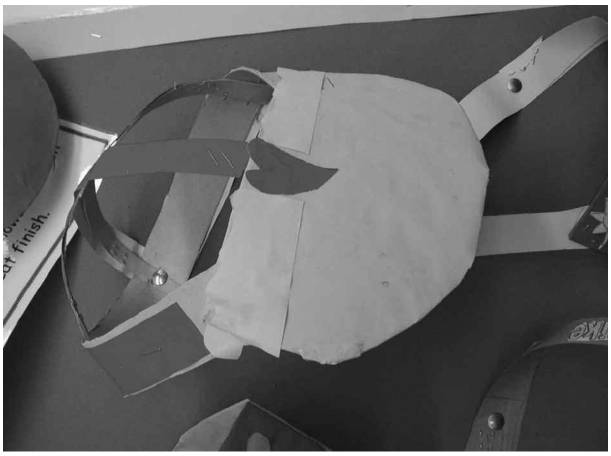
In another lesson, we investigated the best ways of joining fabrics together and used a variety of stitches to see which ones were the strongest. The children also learned how to sew buttons onto fabric – not all used these to decorate their work, but I felt it was an important life skill. In fact I recently had one boy, whose trouser button came off in the morning. He asked if he could stay in at lunchtime to sew it back on!

Designing

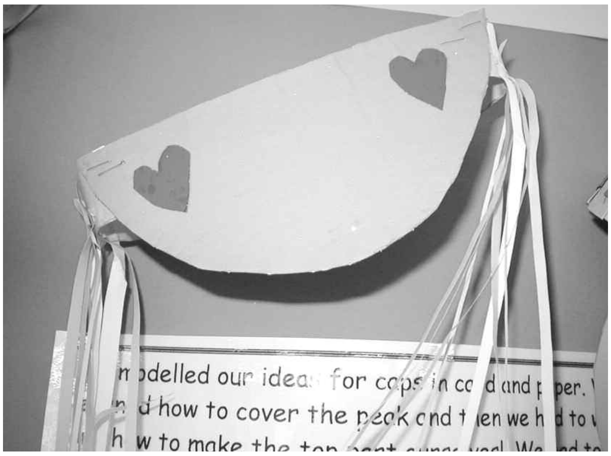
Because the children had had the experience of designing their models of caps in card and paper, they were then able to consider how they would make their own caps from fabric. They were asked to look at home for materials to bring in and it was very encouraging to see that many children did this – showing they were really involved in the project and wanted to continue with this learning at home. They brought in fabrics, old clothes for cutting up, threads, buttons etc and even the school cooks got involved. Some children even cut up old caps at home, so they could bring the peak in from these and cover it themselves.







The children made design sheets showing how they wanted their caps to look and giving instructions for how to make it. This was also a way of encouraging children to use their literacy skills across the curriculum. There was a real reason for writing the instructions and also a need to amend and redraft these as the children worked.



These models of caps produced in card and paper were all introduced from the same starting point: covering the peak. The children then developed their own ideas focusing on making their cap "different"

Making

Organisation: We rearranged the timetable for a week and "blocked" four afternoons for the making of the caps. This was to enable the children to complete their work within a short time frame – they were very motivated to do so, and to minimise the "mess" of having half finished pieces of work around for weeks. Both Y 6 classes worked together giving flexibility in groupings and enabling children to work in social groups. This also meant that staff could be used more flexibly: one supervised use of the sewing machine; one supervised using the iron for pressing etc. The children were encouraged to use their design sheets but to make changes as they went along – learning from their own mistakes.

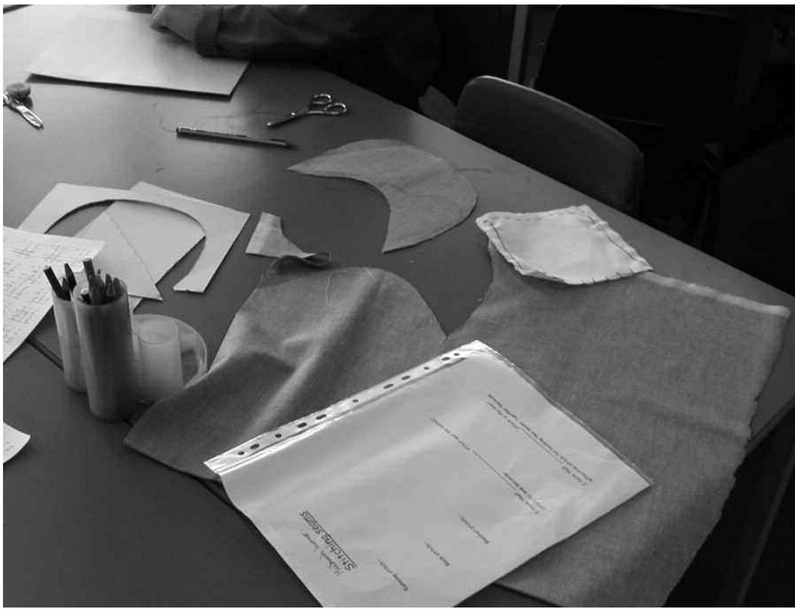
An aspect we were particularly pleased with was the peer support that the children gave each other. We saw lots of examples of peer support and children using each others' strengths. This was an aspect we actively encouraged as it meant the adults were not constantly being expected to 'help'. We also believe it is important in raising children's self esteem. Whilst some children may not excel in academic subjects such as literacy and numeracy, they sometimes do excel in more hands-on skills and are keen to share this expertise with others.

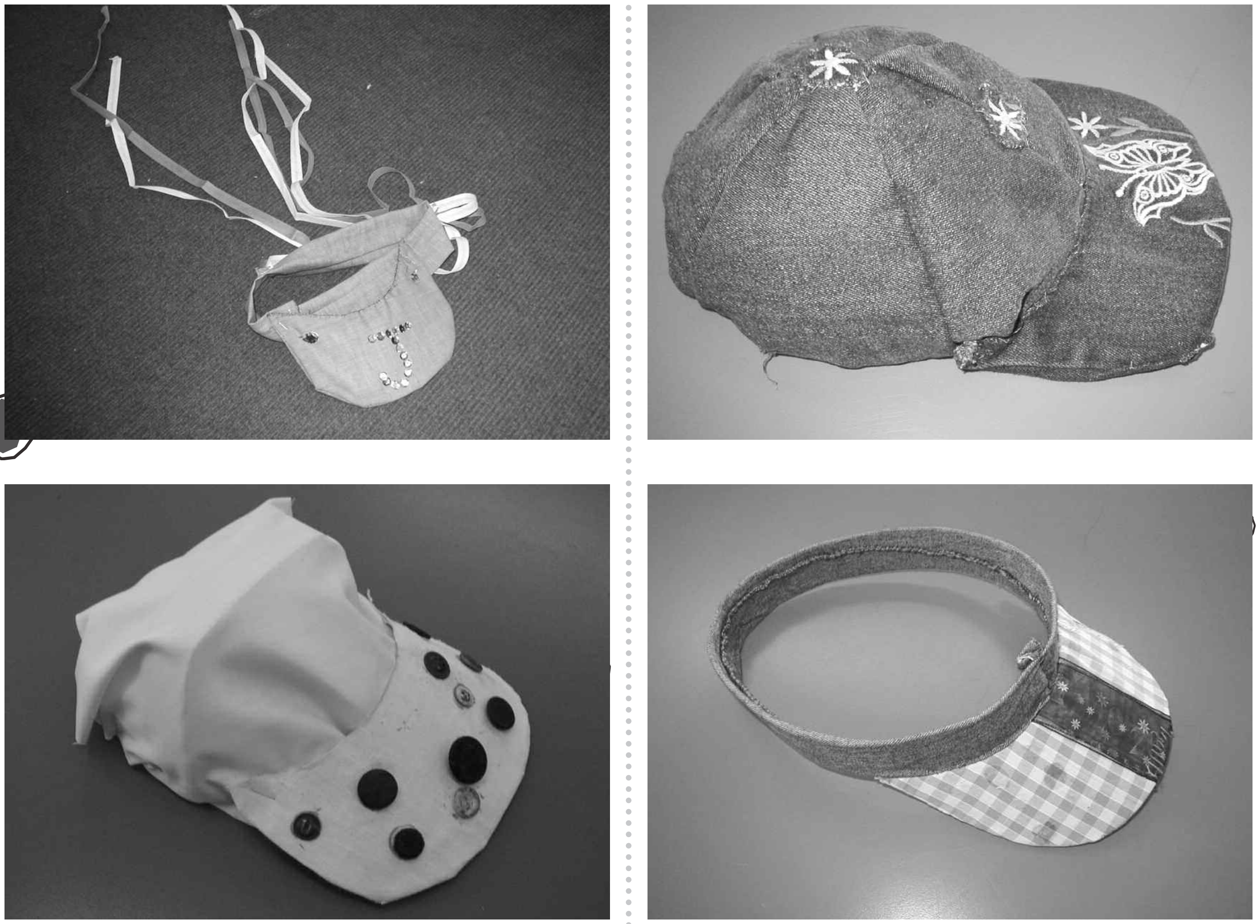
Again, many of the children showed their involvement and motivation by bringing materials from home, such as old jeans for cutting up, old caps so they could use the peak, etc. One girl brought in an embroidered pair of jeans, then used the embroidery to decorate the peak of her cap, using the denim for the rest of it.

The children really enjoyed making their caps – this came across in the evaluation sheets.

Evaluation

The project concluded with the completion of an evaluation sheet. Digital photos were taken of the caps and the children used self-assessment and peer-assessment to evaluate them. Self assessment included looking at new words and skills that they had learned, saying what had gone well, not so well and what advice they would give to another group undertaking the project. Peer assessment included asking a friend what they thought of the cap and why. Here it was very important to create a climate of trust and constructive criticism. One of the most common areas of difficulty expressed by the children was that of joining the peak onto the band or head piece of the cap. One of the most common comments when asked whether they had enjoyed the project and why or why not was that they enjoyed making their own choices.





Examples of completed caps

Design in the South African Technology Education Curriculum

St. Stithians College, Private Bag X2, Randburg, 2125, South Africa

Karen Ann Walstra, Teacher – E-mail kwalstra@stithian.com or walstra@absamail.co.za

Introduction

Technology Education in South Africa is taught using the technological process of investigate, design, make and evaluate. Teaching children to design is a very important aspect of the technological process, as it allows the children to generate their own ideas and plan how the product will be assembled. Various methods are used to encourage the children to become creative designers; quick thinking and drawing games are played; creative products are designed which will not be built, such as a "cat-caring" machine.

Design skills are developed in the various school phases- Foundation, Intermediate and Senior Phases. The skills include sketches, talking-drawings, two and three-dimensional drawing. We need to encourage the children to design confidently and creatively, as these skills will benefit them in the long term with regards to planning and preparation for all aspects of life.

Introduction of Technology Education

South Africa consists of nine provinces. The National Education system advises the provinces as to what should be covered during the school year and each province may make regional curriculum changes that are appropriate to the province. Technology education was officially introduced into the South African education curriculum with the introduction of Curriculum 2005, in 1998. This brought many changes. The main change was the introduction of Outcomes-Based Education (OBE). Each learning area was given a set of Learning Outcomes and Assessment Standards that had to be achieved in each Phase.

The school structure was also changed. Originally the Primary Schools were divided into Junior Primary – Grade 1 and 2 and Standard 1. The remainder of the Primary School was the Senior Phase – Std. 2 to Std. 5. The balance of school education was called High School and was from Std. 6 to Std.10. Curriculum 2005 divided schools into four phases. (All years are now called grades and the standards are no longer used.) The first phase is called the Foundation Phase and is from Grade 1 to Grade 3. (Learners begin Grade 1 between the age of six and seven years.) The second phase is the Intermediate Phase from Grade 4 to Grade 7, and the third phase (the end of compulsory education) is the Senior Phase from Grades 7 to 9. The last phase related to schools is called the Further Education and Training (FET) Phase, which is Grade 10 to 12. After that learners may attend Tertiary Education.

New Learning Areas or Subjects were also introduced. Some of the names of the traditional subjects were changed, for example mathematics became Numeracy, and some of the subjects, such as history and geography, were grouped together, which became natural and social studies. The Learning Areas became:

- Literacy, (the same Learning Outcomes were set out for all languages to be taught including English, Afrikaans, Zulu)
- Numeracy instead of mathematics
- Lifeskills, which covered health education, physical education and social issues such as sex education and AIDS awareness and education
- Natural science, instead of science and biology
- Human and social sciences, which combined history and geography
- Arts and Culture which is a combination of music, drama and art education

There were two completely new subjects:
- Technology Education, which replaced woodwork, metal work, sewing and hand work
- Economic Management Sciences

The curriculum for these Learning Areas was very general, stating the Outcomes to be achieved in each phase and not in each grade. This created confusion and disagreement about what was to be taught each year in each grade. Much new terminology was also introduced.

Changes to 2005 Curriculum

With all these changes, the Education Department and Education Institutions were criticised greatly. Teachers had difficulty coping with the new Learning Areas and the new method of teaching and assessing by means of Learning Outcomes.

The implementation was meant to continue in stages until 2005, but due to lack of training of teachers and the unavailability of resources, the process had difficulty continuing as originally suggested. In 2000, the discussion of revising the curriculum once again began, and in September 2002 a Revised National Curriculum Statement was published. It included the same Learning Areas, but each Learning Area now had fewer outcomes, called Learning Outcomes. A more specific breakdown of knowledge and content to be covered in each Grade was given, in the form of Assessment Standards. Now each grade has its own Assessment Standards, instead of each Phase, which should make lesson preparation and teaching easier. The Revised National Curriculum is to be implemented in the Foundation Phase during 2003, in the Intermediate Phase in 2004, and then each grade of the Senior Phase will be implemented separately. So Grade 7 will be implemented in 2005, Grade 8 in 2006 and Grade 9 in 2007. The FET Phase is still in a planning phase, and has not changed much over the last few years.

Learning Outcomes

The new Technology Education curriculum has three Learning Outcomes, instead of the original seven Specific Outcomes. They are:

- Learning Outcome 1: The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology.
- Learning Outcome 2: The learner will be able to understand and apply relevant technological knowledge ethically and responsibly.
- Learning Outcome 3: The learner will be able to demonstrate an understanding of the inter-relationships between science, technology and the environment.

Each Learning Outcome has Assessment Standards for each grade. This helps the teacher in planning lessons and teaching material, as the Assessment Standards explain what the learners need to achieve by the end of each grade.

Technological Process

In both Curriculum 2005 and in the Revised National Curriculum, the technological process is the methodology used to teach technology education. In Curriculum 2005, the technology process consisted of investigating, designing, making and evaluating. In the Revised National Curriculum (RNC) the technological process became technological processes and skills. Communication has been added as one of the stages of the technological process. So the technological processes includes investigating, designing, making, evaluating and communicating. The RNC uses the "the design process" as an example of a technological process that could be taught. Therefore teachers may now use any technological process as a methodology.

Assessment Standards are given separately in the RNC for each of the technological processes stages; namely: Investigates, Designs, Makes, Evaluates and Communicates.

Under the Assessment Standards of both Design and Communication, design skills are developed and need to be taught for the learners to achieve them. The development of a portfolio or a record of work is also included in these two stages.

Pre-schoolers

The pre-schoolers in the Reception Class (or Grade R) are introduced to Technology Education. They are only assessed on Learning Outcome 1, which focuses on the technological processes and skills. The Reception Class and Foundation Phase learners do not have any Assessment Standards for the 'communicates stage' of the technological processes. The Assessment Standards for the design stage for these learners is to make simple products from a given range of materials or substances.

For example: Choose different ingredients to make a nutritious sandwich. Make a choice from various materials to build a simple vehicle using moving axles, to hold a small plasticine man. Choose an appropriate material that could be used to join different materials together. (For example: When making a birdfeeder from a plastic bottle choose which materials would join the birdfeeder best, so that it is not damaged in the rain and other weather conditions. Possible materials: thin wire, string, cellotape or wood glue). A wide variety of simple products could be made during the year, allowing the learners to use various materials appropriately and to learn basic joining skills, while working through a technological process.

Foundation Stage

In the Foundation Phase (Grade 1 – 3) only Learning Outcome 1 is assessed. The learners in Grade One and Two need to choose appropriate materials to make simple products to solve a given need problem. For example: they could decide what materials could be used to make shoes to wear in rainy weather. The Grade 2 learners should also be able to make suggestions on how the problem, opportunity or need could be solved. In Grade 3 the learners have to suggest possible solutions, choose one and complete simple free hand sketches for that solution. Their designs would be simple freehand sketches, and they would be able to explain what materials they are going to use to build the product.

Intermediate Phase

In the Intermediate Phase (Grades 4 – 6), design skills are developed further. The learners are taught to write a simple brief (design brief). They are to draw at least two possible solutions to solve the given problem, and then choose one of the designs to build or make.

Communication is now included as part of the technological processes where the learners have to create a record of work or portfolio. This demonstrates their understanding of the Technological Processes and their ability to solve a technological problem within a given knowledge area, such as structures, systems and control or processing. In Grade 6 the learners have to evaluate their chosen solution and give reasons for their choice before doing their final design. As part of the communication stage different ways of presenting the technological process are to be used, such as posters, written portfolios, models or charts. The possible ideas and the final designs of the product should be included, using two-dimensional drawings.

Senior Phase

In the Senior Phase (Grades 7 – 9) skills in the Design and Communication Stages are more complex and detailed. Grade 7 and Grade 8 learners need to write their own brief for a given need or problem. They should list design specifications about cost, people, safety, the environment, appearance, cost and purpose for the problem and complete two annotated and different initial idea designs. Then they should evaluate their ideas, justifying their choice. After that, they should design and develop their chosen solution using appropriate graphic or modelling techniques.

Communication Stage

The Communication Stage covers two aspects. Firstly, the use of different types of technologies to record the technological process. Secondly, various graphic or design skills. In Grade 7 the technologies to be used are computers and audio-visual recordings. The learners' designs should use a variety of graphic skills, detailed notes and labels to communicate their ideas. In Grade 8 the learners should be able to produce a report, poster presentation or a project portfolio to show how a problem was solved. The contents should include detailed graphics and written information, which is suitable for a target audience. The graphic skills to be developed are two and three-dimensional drawings, system and circuit diagrams. Grade 9 is the final year of compulsory education, and is the culmination of all the learners have learnt from Grade 1. Therefore the Design and Communication Stages are detailed. The design skills to be assessed are identifying a problem, writing the brief and the appropriate and thorough constraints and specifications for the problem, generating a range of initial ideas and possible solutions, and stating how the designs solve the problem. The final design and chosen solution should be drawn neatly and in detail. The Communication Stage states that various technologies should be combined to create a well-organised and detailed record of work. This should be a detailed portfolio that contains the various types of graphics as in Grade 8, but also includes rendered designs, showing colour, texture, shadow and line.

The Assessment Standards that are assessed in Learning Outcome One, in the Design and Communication Stages develop the learner's confidence and abilities to record information and ideas. The skill of being able to record a technological process is a skill that will benefit the learner right through their lives, as they have to plan and organise themselves before they are able to build and create a product. Once the product is developed it is evaluated and reflected upon and constructive criticism is learnt. So the Design and Communication Stages should not be seen in isolation but rather as a part of the technological processes. Each stage is every important and one relies on the other.

A Range of Cultures

In the Revised National Curriculum, Learning Outcome Three exposes the learners to the designs of products from different cultures, as well as the designs on products such as beadwork, pottery or textiles. The following are a few examples of how designs are used in different African cultures, showing how creativity and originality are recognised. For centuries people have used available materials to create interesting designs on household implements such as bowls and serving dishes, and decorative weaving when making the grass mats for sleeping on or for the floor. Fabric was coloured and dyed; detailed beadwork patterns were designed and used on clothing and to create pieces of jewellery. The various groups of peoples used different types of materials and specialised in different designs.

Jewellery

In West and Central Africa brass was used to create necklaces, bracelets and other metal objects, using the technique known as lost-wax-casting where a clay core has a layer of bees' wax placed onto it which is carefully sculptured and then more wax is placed over the clay. This is fired, the wax melts, and where the wax was, a vacuum forms as it runs out. The heated metal runs freely into the gap. Once cooled, the clay mould is removed and the newly formed object is revealed. The intricate and symmetrical designs on these objects show much creativity and originality. The metal objects were often decorated using pictures of plants, animals and other creatures. Other metals such as gold and copper were also used.

Masks

Metal masks made by a group of people from Nigeria for their king were in the shape of animals' heads. These masks were often worn on the hip as part of a ceremonial outfit for special occasions. The designs on the masks were stylised and detailed, using straight and curved lines.

Beadwork

Another material or product used to create products was a bead. In Africa, the first evidence of beadwork made from ostrich shell ground discs, is from about 10 000 BC. The Masai women in Kenya design and make different beadwork garments and jewellery to depict different stages of life or for a particular ceremony. For example, they make long-beaded earrings; which women who have sons that have become warriors may only wear. In South Africa, the Xhosa and Zulu people also make beaded garments, where the colours and patterns in the designs tell a story or have a particular meaning. Beaded garments such as neckbands, skirt fronts worn over leather skirts, bags and necklaces were traditionally made.

Patterns

The Ndebele women, also in South Africa, decorated their homes with geometric patterns, using bright and bold colours. Traditionally these colours were produced using plant and animal matter. Today commercial paints are used.

Importance of Design

Design has always been important in African cultures past and present. We need to teach our African learners today about the use of design and how it relates to beliefs and ceremonies, so that this knowledge and significance is not lost but built upon and recognised for its importance. By teaching this information, knowledge may not be lost and an appreciation for traditional knowledge, skills and products will be developed and upheld. Design is very important in many aspects of our lives and we should create awareness in various ways among our learners, thereby developing their own design skills and also the admiration of design by others around them.

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NOTES

CONTACTS

CONTACTS

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

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