Push and Pull – A Case Study

Abstract

Primary teachers have always recognised the value and importance of involving children in relevant practical experiences. "Design and technology offers children the opportunity to learn about the made world and to apply knowledge and skills in an exciting and creative way in their designing and making." (DATA 1997)

The practical experiences that design and technology provides for children also develops basic skills such as numeracy, literacy and information technology. (DATA 1997)

The following case study has been carried out with a year one class (five and six year olds) in a small village infant school. There are 31 pupils in the class and the project was carried out on a Thursday afternoon throughout the term. The teacher was supported with two parent helpers.

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CURRICULUM

The design and make activity carried out in the spring term was to make a model which could be pushed or pulled. This was directly linked to other areas of the curriculum.

> "Almost any area of the curriculum, or of a child's life, can provide situations and contexts for technological activity." (Newton 1992, p. 69)

Therefore, it is believed that design and technology enhances integration of the curriculum, and the knowledge and understanding gained can be used and drawn from a wide range of experiences.

The aim of the project was to develop children's design and technology capability so that they were able to respond to their own ideas and select and use a range of equipment confidently. The project had been planned for Key Stage 1 with cross-curricular links. The teacher's intentions were:

(a) to develop the children's understanding about simple mechanisms

(b) to allow the children to investigate and disassemble simple products in order to learn how they function

(c) for the children to make a simple model with at least one moving part.

The teaching of design and technology is a very distinctive and creative process which combines intellectual and physical skills through purposeful practical activities. Children will use a range of communication skills to aid their thinking in the process of designing and making. The knowledge and understanding used in design and technology is critical to the development of useful products. It will be taught specifically but will also be drawn from other areas of the curriculum. (DATA 1996)

Pupils should be taught to develop their designing and making skills with knowledge and understanding in order to design and make products. The children were taught how to use simple mechanisms, including wheels and axles, and joints that allow movement. They investigated and disassembled a simple car in order to learn how it functions. The pupils followed simple instructions to control risk to themselves and were taught to use the

appropriate vocabulary for naming and describing the equipment and materials used. The unit of work for this case study can be found in Appendix A. It provides the teacher with learning objectives, possible teaching activities, learning outcomes, resources and cross-curricular links.

Effective planning is essential in all schools. Design and technology is a developing area in many primary schools and a well constructed curriculum plan helps teachers to become more confident in their teaching. It also helps to develop specific training needs for the co-ordinators to include within the development plan. (DATA 1996)

This case study was carried out in a large classroom with good access to a wide range of design and technology resources. It provided opportunities for class and group teaching. In the early stages of the project pupils had to investigate, disassemble and evaluate activities, consequently whole class teaching was manageable and effective. The teacher made clear teaching points to all the pupils at once and was not diverted by trying to teach a range of subjects simultaneously. However, during the focused practical tasks, due to the availability of equipment it was necessary to have two activities on-going across two weeks. Additional adult help in the classroom was a clear advantage. The parent helpers were confident at using the available tools and materials, and they provided the necessary support or advice that the pupils required. To complete the design and make activity the afternoon was blocked off to provide the pupils with additional time to complete their model. A second 'techtruck' was borrowed from another class and two parent helpers provided the additional support required with a whole class activity. The final stages of the project were carried across two weeks to provide the pupils with a wide range of resources.

Clear objectives and a selection of possible activities are vital in a progressive unit of work. However, it is the co-ordinator's responsibility to note that full progression in pupils' achievement will only be realised over a period of time. Planning which is carried out now, should take account of pupils' previous experience and be set at an appropriate level for their current needs. Therefore planning documents must be regularly updated. (DATA 1996)

Differentiation and links with other subjects

> "Children of all abilities should have access to work in design and technology. The aim should be for all pupils to develop a sense of achievement." (Hughes and Hamson 1996, p.32)

This can be achieved by building on pupils' previous experiences and presenting work which is both, interesting and challenging. Children are more likely to persist with a difficult task if they are interested in it. Making the task challenging will give pupils opportunities to develop their potential. The design and make activity should be suitable for all abilities, allowing the highest possible standards to be maintained for the most able pupils while carefully catering for pupils unable to reach those standards. Consequently, the task should be a broad and balanced

programme for all pupils. (Newton and Newton 1992)

Differentiation in design and technology is usually by outcome but other aspects were considered in this case study:

- Teaching strategies, methods, pace and language must be suitable for all pupils in whole class teaching. However, in group sessions the strategies can be geared to the ability level of the group.
- The materials and resources provided must be suitable to the group using them (e.g. left handed scissors).
- The level of teacher intervention. The teacher must be able to judge when and how to intervene in the work, both to teach new skills and to extend the pupils' thinking processes. Some groups may need more intervention than others.
- The level of choice offered to pupils.
- The content must be challenging yet achievable.

The pupils worked extremely well in mixed ability groups and were observed helping and guiding each other. More able pupils helped with reading and used the appropriate vocabulary. This ensured that all pupils were familiar with the vocabulary by the end of the project.

One of the strengths of design and technology is that it offers many practical opportunities to develop skills and knowledge from a variety of subject areas. The programme of study specifically identifies the need to teach pupils to apply skills, knowledge and understanding and makes particular reference to art, mathematics and science.

The pupils in this case study applied skills, knowledge and understanding from the following subject areas:

- mathematics – measuring skills were used to find out the length and weight of their model as well as measuring the distance it travelled. They interpreted data in a traffic survey
- art – the pupils painted a plan of their design showing an understanding of pattern and colour
- English – the pupils used speaking and listening skills particularly in the planning and evaluative stages of the project
- science – the pupils looked at the force, of push and pull
- I.T. – the pupils entered and analysed data for a traffic survey. They used a programme called Science Fair – Push and pull
- P.E. – the pupils explored push and pull movements when travelling and balancing.

It is easy to see the links between design and technology and other subject areas. An outline plan (see appendix B) provides an overview of the terms works and clearly shows the cross-curricular links.

However, when planning it is very important to be able to distinguish between design and technology activities and other such comparable activities that involve pupils in constructing. Children should be taught to

combine their designing and making skills with knowledge and understanding to design and make products. Products should have a purpose and as such are designed to be used. (DATA 1996)

Delivery of teaching and learning, assessment and recording

Pupils are involved in clarifying the task through listening to the teacher and then undertaking initial enquiries to ensure they understand exactly what is required of them. The clarification will continue through interpreting a range of requirements which will vary in complexity depending on the age and experience of the pupils. Pupils may need to talk to their teacher, research in books, talk to other adults, or look at existing products. As more information is gained and the definition of what is required becomes clearer, pupils may begin to generate ideas. (NAAIDT 1998)

After listening to the teacher describe the task, the pupils investigated a collection of toys which could be pushed or pulled. Key questions were asked to help the pupils find out how the mechanisms worked e.g. Can you make it move? Which parts move? What is it made out of? Does it work well? The pupils used this knowledge to disassemble a toy car. They then had to think about the materials used and how the parts had been joined together.

Once the pupils had looked carefully at the toy models they were ready to consider ways in which new designs could be generated. Possible ways for the toys to move were discussed. The pupils explored their ideas using construction kits.

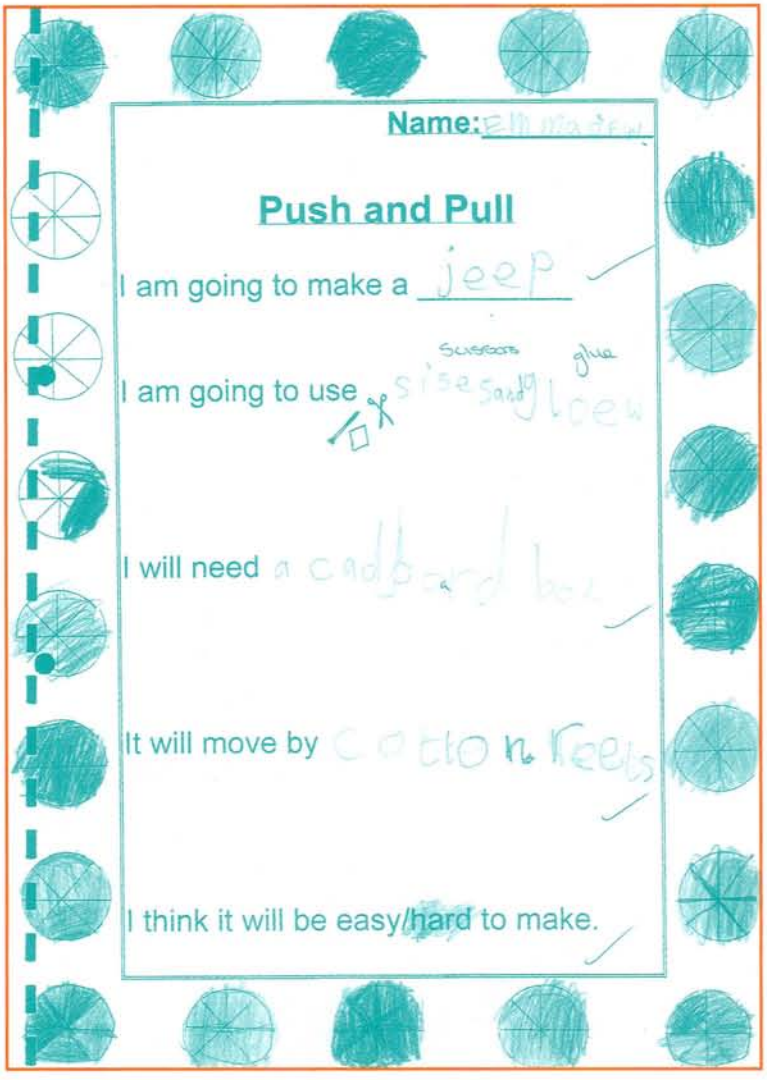
The pupils were then taught key vocabulary for making a very simple jinx frame with wheels and axles. They explored a variety of ways of fixing materials firmly together.

The next stage of the product involved the pupils planning their model. They began by painting or drawing a picture of the model they wanted to make. They then completed a planning sheet to encourage them to think about the resources they would need and how their model would move. A selection of plans have been included in the case study. They were used as part of the teacher assessment.

> "Pupils communicate ideas through discussions, written work, sketching and modelling. Ideas may be described using a formal technical vocabulary or in more subjective terms." (NAAIDT 1998)

The types of questions asked by the teacher are very important. Structured help with the skills of communication is also important and specific techniques can be taught through focused practical tasks. The main focus for development will be group discussions and one to one support as work progresses. Pupils need to be asked to explain their thoughts and teachers need to extend vocabulary and refine meanings. The pupils must be asked to "show and tell". This values their work and stimulates communication.

Handling materials and exploring their properties is very important in the early design of a product. Pupils need to develop a set of practical skills which they should perform safely and effectively. Pupils were encouraged to measure, mark out, cut, shape, combine and join two and three-dimensional



forms. They used their plans as a basis for their idea. Materials were joined using split pins, bambi stapler, masking tape, PVA glue, and elastic bands. The pupils were encouraged to select resources themselves from the appropriate place and replace the equipment carefully, being responsible for their working area.

Evaluating is an activity which allows pupils to make a judgement about aspects of a design as it develops, or to reflect on the strengths and weaknesses of the completed product. It occurs constantly throughout projects. At Key Stage 1 it is usually in the form of constant discussion and commenting on each others' work. Pupils talking about their work is an excellent way of developing an appropriate technical vocabulary. The pupils were very keen to 'show and tell' their models to the class, whom appeared interested and motivated by the questions raised. They also completed an evaluation sheet which was kept very similar to the planning sheet in order to keep it simple and attainable. The evaluation sheets have been included in the case study to show an example of pupils' work.

> "Assessment is an integral part of the planning, teaching and learning process." (DATA 1996)

In the revised National Curriculum requirements for design and technology, emphasis is placed on teacher assessment. The purpose of teacher assessment is:

- to identify pupils' achievement and progress
- to identify the next stage in a child's learning
- to evaluate the effectiveness of teaching strategies
- to provide information about a child's progress that can be shared with colleagues, parents and governors.

In addition to learning how to design and make, pupils will be taught a range of knowledge, skills and techniques to support them in their designing and making capability. In their everyday work with the pupils, teachers make informal assessments. This information helps to track the progress of the pupil. In design and technology, teachers assess the following aspects:

- the pupil's capability in designing and making
- the pupil's repertoire of knowledge, skills and techniques.

The purpose of recording is to make a record of pupils' progress in design and technology and identify the next stage of learning. It is important to distinguish between making a record of the pupil's progress and the teacher's curriculum planning. Criteria for effective recording includes:

- easy to use
- manageable
- provides information to help teachers identify the next stage of learning
- provides information to be used in reporting
- provides information for the co-ordinator on the span of the ability.

It is necessary to outline the arrangements for assessing, recording and reporting design and technology, in the school policy. Devising recording systems for individual pupils or record sheets for the whole class are very valuable.

An example of recorded assessment can be found in appendix C.

Evaluation

The aims of this project were:

(a) to develop the pupils' understanding about simple mechanisms

(b) to allow the pupils to investigate and disassemble simple products in order to learn how they function

(c) for the pupils to make a simple model with at least one moving part.

The pupils enjoyed the challenge and were eager to explain how they made their model and what made it move! Some of the pupils measured accurately and used vocabulary such as axle, movement, rotation. They worked particularly well in mixed ability groups and supported one another to fulfil the task. Some pupils experienced difficulties when attaching the axle to the body part but often overcame the problem by talking it through with an adult or friend. They were very interested and motivated in the investigative and disassembly task. Several questions were raised such as: How does that turn? What materials have been used? How could we make it bigger?

The pupils were very careful when decorating their models which were all very colourful and visually appealing. The unit of work was also very useful and successful. It provided a number of progressive activities. The focused practical tasks enabled the pupils to use the skills learnt in their design and make activity.

If the project was repeated, the amount of time spent on it could easily be extended. A lot was covered in a very short period of time. More use of construction kits could be used to support pupils' learning. Follow-up work which may be considered could include extending pupils' understanding and techniques of working with mechanisms. Increasing the range of materials made available to the pupils, and for some pupils perhaps to include two mechanisms in their model.

The visual aids used in this project were a valuable resource and definitely recommended for future work. The parent helpers were invaluable but with more initial discussion and preparation time the learning objectives could be shared. Therefore their role would be of even more importance. Finally, clearly labelled and organised resources enable pupils to make the correct choices.

This case study provided opportunities for pupils to develop their knowledge, skills and understanding in activities which were challenging, relevant and motivating. It furthermore enabled my own personal development through reflection and consideration of both the pupils' and the projects' needs and aims.

Bibliography

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A Push and pull model Focus - Mechanisms

Learning Objectives	Teaching activities	Learning outcomes
IDEAS		
That simple mechanisms can be used to create movement. That mechanisms and components are in products.	Discuss with the children a collection of cars. Look at cars in the car park or school road. How does it work? What does the moving part do? Does it work well? Disassemble a toy car. What materials have been used? How have the parts been joined?	Identify simple mechanisms and explain how they work. Use appropriate vocabulary to describe mechanisms.
FPT		
That construction kits can be used to try out ideas. To make a simple wheel mechanism. To use tools e.g. scissors, hole punch safely.	Explore simple wheel mechanisms using construction kits. Make a simple jinx/box frame using wheels and axles.	Toy out ideas using construction kits. With some adult support assemble wheels and axles on to basic frame. Use tools safely.
DMA		
To suggest ideas and explain what they are going to do. To make their design using appropriate techniques. To evaluate their product by discussing how well it works in relation to the purpose.	Design and make a model which can be pushed or pulled. Discuss the requirements for their model. What might it be like? How could you do this? Discuss finishing techniques e.g. pens, paint, collage. Ask the children to plan their ideas first on paper. Evaluate the final model. How could it be made better/ stronger?	Apply what they have learnt in their DMA. Develop ideas through talking and modelling. Evaluate strengths and weaknesses.

Appendix B – Outline plan showing cross-curricular links.

Blackbird Class →
Spring Term

OUTLINE PLANNING.

SUBJECT	WEEK BEGINNING: 6.1.99	WEEK BEGINNING: 11.1.99	WEEK BEGINNING: 18.1.99	WEEK BEGINNING: 25.1.99
ENGLISH	Factual writing creative writing caps & full stops ff	The 3 Little pigs Instructions & capital letters Playscript -ll Character profiles	Push and pull Factual book. Instructions & labels -ss Full stop/sentence	The four seasons contents & index internet link Read for info. & understanding ck capital letters
MATHEMATICS	Linear measurement → Step 1(17) ← On-going	2(10) addition and	ordinal Numbers. subtraction	Mass/weight Step 1(32) →
SCIENCE	Moving in diff. ways - which body parts? describe	Watch traffic from school - Describe movement	Recognise moving hazards Safety videos Road safety	I.T → Link Dacta - Push & pull machines
HISTORY	Compare & contrast activities that are carried out in school now, & in the past.		Compare equipment used in schools now with the past. Local visitor to communicate	
GEOGRAPHY	Collect simple information about Hextable → State own address → Describe Hextable using Geog terms - Road, hill,	field, park, shop, house, church		Link to literacy labels Simple map/plan of Hextable to include main features
DESIGN TECHNOLOGY	Push & pull models IDEAS - disassemble toy car Look at [illegible]	Wheel mechanisms using construction kits. Make a frame with wheels & axles	Wheeled mech. using construction kits	Make a model which can be pushed/pulled
INFORMATION TECHNOLOGY	Pictogram of favourite colours. Enter data & print & analyse ← colour word bank to label objects in the classroom →		Enter & analyse data re. traffic survey	Push & pull I.T.
ART	Colour mixing → Red/yellow	Blue/yellow Colour wheel Paint	D.T. design Blue/Red -	Adding white to one colour to change shade
MUSIC			Listen and appraise African music. Timbre	
P.E. Gym Dance		Touching floor with hands & feet Push/pull Response to Push & pull	Touching floor with diff. parts	Travelling on hands & feet Push & pull movements
R.E.		New Years Resolutions	Introduction to Judaism	Jewish Symbols in the home
OTHER P S H E	Why do we wash? clean teeth?	Rules - Revise & add [illegible]	Injections - Why? Read relevant story Discuss	"I'm not well" Brainstorm on board

NO MON/TUES

Appendix C – An example of recorded assessment.

Hextable Infant School

Design and Technology formative record sheet

Class: Blackbird Year group: One Date: 18.1.99 Whole Spring Term

Context:

To plan and design a model which could be pushed or pulled

NAMES.	OBJECTIVE 1. Planning		OBJECTIVE 2. Working with materials		OBJECTIVE 3. Health and safety		OBJECTIVE 4. Evaluating	
Rachel	Clear design but could not describe what it would do	W	Selected from a range of materials	1	Followed instructions + worked safely		Did not explain movement in detail	
Niall	Generated initial ideas	1	— " —	1	— " —		Found it difficult to suggest improvements	
Danielle	Able to think and communicate	W	— " —	1	— " —		Explained movement & suggested improvements	
Lauren	Used pictures + plans to clarify ideas	1	— " —	1	— " —		— " —	
Connie	Generated initial ideas	1	— " —	1	— " —		Recorded a no. of improvements + discussed evidence	
Sean	Recorded well + communicated verbally	1	— " —	1	— " —		Excellent recording	

W - working towards
1/2 - N C levels