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Linking science and technology in the primary school

Eileen Chadwick
Teacher Adviser Technology, Education and Business Partnership, Winchester

Abstract
All children are naturally inquisitive and inventive and enjoy learning science and technology. The two subjects are often intertwined in the primary school so that one feeds from the other. Scientific principles may be seen in inventions we all use everyday and may be introduced with ease to children of all abilities through a technological approach to learning which involves designing and making. Such science principles contribute to the physical sciences, an area in which primary teachers often have little experience and even find frightening.

The debate over differences and similarities between science and technology as school subjects is well known but it is a debate which often confuses the non-specialist primary teacher. The outcome is that teachers often fail to recognise and understand that the principles are the same and can be traced almost identically to both National Curriculum documents. A teaching strategy is outlined.

The purpose of this paper is to explore how some programmes of study for National Curriculum Science and Technology overlap and how these might be taught together in primary classrooms. Children understand science more easily through seeing real life applications of technology all around them. But it is the learning by doing approach of designing and making which often enables children to understand science concepts at a surprisingly high level.

Children cannot develop technological capability without understanding scientific principles. Structures and forces, machines and energy as well as materials and their properties are areas which cross both science and technology.

The problem is that primary teachers who, often, have had little training in science and technology may be quite unaware of how to make the most of learning opportunities for linking the two subjects together. The overlaps in the two National Curriculum Orders are often:

- not perceived by the primary teacher
- not made because teachers do not feel confident they can cover both orders together
- not made because teachers are confused by the relationship between the two subjects.

Before considering how technology and science interact in children's learning and the real world, it is important to look briefly at how schools are coping with putting the two subjects in place.

Background - The Primary School and Technology
Technology is still in its infancy yet once again its nature is being debated! The current confusion has not helped primary teachers to implement this completely new subject. Head teachers are reluctant to spend inservice budgets on Technology until the confusion is sorted.

On the whole most schools have received little training in Design and Technology. Although teachers have worked hard to try to implement it, it often lacks quality in process and product. This is hardly surprising as primary teachers may have little understanding of its nature, or how to unwrap the National Curriculum Order. They have difficulty translating the programmes of study into classroom projects in the depth or breadth intended in the Order. Systematic training in the concepts and skills for technology needs to be addressed. Many of the unfamiliar concepts are from physical science.

Although much good work happened in the 1980s through E.S.G. schemes and other initiatives, technology had only just begun to be established when the core subjects took their demands on inservice time. These were still being established when the order for technology was published. The almost immediate introduction of history and geography often meant that schools gave priority to these. These subjects were reassuringly familiar to the primary teacher and there was much new content to learn. The rumours of a revision in the Order
further prevented technology being given priority for inservice training.

A major problem now is that primary schools are addressing the core subjects again. The problem is will technology ever be given any priority?

The Primary School and Science
Primary Science is more established than Primary Technology. The reasons are:

• It has been on the primary curriculum for longer
• It is a core subject
• There is more agreement on what science is than what technology is
• It has more status and more time and energy are devoted to putting it in place.

The E.S.G. schemes for supporting primary science by a dramatic increase in advisory teachers had a great effect in making science a popular activity in primary schools. Much emphasis was placed upon process and science from everyday things. Unfortunately, funding stopped at the time when concepts needed to be more systematically taught to teachers so they could teach them competently to their pupils.

Teachers need much more training especially in concepts related to physical science particularly Forces and Energy found in AT4 Physical Processes. Primary teachers may have had successful no science experiences themselves especially in physical science.

Science and Technology
Children's natural inquisitiveness and inventiveness makes them want to discover and invent. The motivation to learn is intrinsic and builds upon the human need to find out and create. We can recognise the scientist in the child as she constantly checks her world view as she plays. Her hypothesising is similar to that of a scientist. She tries to make sense of her world through searching for patterns. Patterns enable the child to form concepts, her own world view.

The concepts are used as she invents artefacts, systems, environments. More patterns are perceived through the need to know. Is this National Curriculum science and Technology? No just learning through play!

The need to create is as strong as the need to discover. These processes are early science and technology which need to be nurtured and developed through the process of education for the benefit of our nation.

In the real world science is intimately linked with technology, as intimately as the processes by which the young child learns. The activities of scientists are an attempt to explain the natural and human world, whilst those of technologists to use scientific explanations to manipulate the world, to use its properties to build new objects and systems to fulfil the needs of society.

Much of our daily lives is passed in a man made environment. The world produced by technology is still continuously changing and affects the whole fabric of society. The economy of our country depends on its ability to create wealth by designing and making products to sell.

For example the invention of the telescope, or of techniques for the cooking, canning or bottling of apples are technologies, they add to our control over the world around us. The discovery of the laws of optics or chemical analysis of the constituents of apples provides a scientific knowledge base which is of use to technology.

Alan Smithers in Getting It Right defines technology as the practical organisation of knowledge and points out its difference to other forms of knowledge described by Hirst.

In the real world technology, in addition to science, uses knowledge and skills from different crafts, art, business and economics, the social sciences, English, maths. Subjects contribute in different amounts to the designing, manufacturing and retailing of different products.

The problem of putting technology in place as a crosscurricular subject is not the same for primary schools as for secondary schools. A problem for primary schools is to train teachers in areas of which they have little experience, or are even fearful, so they can teach the subject to the level the children's are natural capability.

Science and Technology From Everyday Inventions
The classical five machines are areas common to both technology and science. They can be seen in everyday inventions such as in taps, tin openers, salad servers, garlic crushers, washing lines. They are an excellent starting point for designing and making as they begin with the children's immediate environment.

The principles of the five machines have been used
in technology for thousands of years. For example the inclined plane, or screw, was used by Archimedes in his famous water lifting device, the lever was used by the Ancient Egyptians in the shaduf, the pulley in more recent times in the well. We still use the inclined plane or screw in taps today! A study of fitness for purpose of taps is an excellent place to begin a water project for history and geography. Designing and making a machine to lift water can make the other subjects more relevant due to the learning through experience approach. However, the principles of machines and important craft skills need to be taught if the children are to be competent little technologists.

The youngest child’s intuitive grasp of science and technology needs to be nurtured by systematic teaching. The teaching of concepts and skills does not prevent the child from being creative. The process of technology ensures that children have the opportunity to develop their creativity alongside other abilities such as practical skills and analytical thinking.

The teaching of physical science from technology in everyday life demystifies a frightening area for many primary teachers. But it is the use of principles through designing and making which leads to scientific understanding and technological capability.

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