Developing Successful Learners in the Technologies in Primary Schools

Introduction

This report is the outcome of a task which focused on attainment in the technologies in primary schools. Inspectors visited a sample of primary schools across Scottish education authorities in 2008. The sample classes included children at the early, middle and upper stages. Schools reported that they had benefited from the constructive oral feedback and pointers for improvement during the visits. This report links with the recent publication *Technical Education: a report of current practice in Scottish schools* (HMIE 2008) http://www.hmie.gov.uk/Publications.aspx. A similar set of visits was undertaken with a focus on information and communications technologies (ICT). When the report on these ICT visits is published on the HMIE website later this year, it should be used in conjunction with the findings in this report on technologies to take forward practice and to improve children's learning experiences.

The visits took place when primary school staff were giving increased consideration to the principles of *Curriculum for Excellence*. There is a focus in this report on the extent to which children can be supported to develop the four capacities set out in *Curriculum for Excellence*, namely, to become successful learners, confident individuals, effective contributors and responsible citizens in the context of the technologies. The report also aims to stimulate debate about attainment and learning and teaching in technologies. We hope to challenge those of you involved in teaching technologies in Scotland to review the extent to which current practice is successfully promoting the four capacities in young learners.

What kind of activities are included in the technologies curriculum in primary schools?

In the primary school, the technologies span a broad area of study that covers technological developments in society, science, ICT to enhance learning, business, computing science, food and textiles, and craft, design, engineering and graphics. It links with technical education, home economics, business education, the sciences and computing subjects in secondary school. At the time of the visits, children's tasks and activities were usually planned using Environmental Studies 5 to 14 guidelines (2000).

To ensure continuity and progression for learners within technologies most schools followed a programme of study developed by their own or another education authority. These programmes of study offered a wide range of contexts for learning and usually linked to other aspects of children's learning within environmental studies. Staff made adjustments to the programmes and most delivered technologies mainly as a discrete subject. In schools which used a discrete approach, children were able to study aspects of technology in depth. In schools where teachers used an inter-disciplinary approach, children enjoyed being able to link and apply their learning across subject areas. As teachers review their

curriculum in the light of *Curriculum for Excellence*, they should be mindful of the benefits of a judicious mix of both approaches.

In the best examples, staff planned their technologies curriculum in ways that helped children to:

- develop knowledge and understanding of the important principles and ideas of the technologies;
- access and develop skills and understanding in the safe, and hygienic use of an extensive range of tools, resources and materials (e.g. saws, drills, cooking equipment and facilities, sewing machines and construction kits);
- use accurate measurements in millimetres and suitable materials to create a product of a very high standard;
- find innovative and creative solutions when designing and making products which they test and evaluate;
- develop a range of skills that enhances their capacity for critical thinking and problem solving within technological contexts;
- develop informed attitudes towards their immediate environment and help to place their learning within a Scottish and global context; and
- make links across curriculum areas and provide relevant contexts which build on prior learning.

In best practice, as children progress through the school, staff ensure that contexts extend to the wider environment and include links with industry, businesses and the community. This supports the development of children's knowledge and skills about advances in technologies. It also helps children understand how technological developments have responded to society's needs and how they might be developed further in the future. Staff plan opportunities for children to learn about *designing and making*, by selecting and using a wide range of materials including paper, card, wood, metals, plastics and textiles, and learning to use a range of tools appropriately. Children's *design and make* skills are enhanced further through open-ended tasks which develop their ability to make decisions. The resultant drawings and products are characterised as accurate and precise, with craftsmanship of the highest standard. Children also have similarly valuable experiences in food related activities which provide important contexts for learning at the pre-school and primary stages.

Technologies and *Curriculum for Excellence*

How can the technologies help to develop successful learners, confident individuals, responsible citizens and effective contributors?

In April 2009, the *experiences and outcomes* were launched for all eight curriculum areas within *Curriculum for Excellence*, including technologies 3-15. This was an important milestone in taking forward *Curriculum for Excellence* which 'aims to achieve transformation in education in Scotland by providing a coherent enriched and more flexible curriculum from three to 15, firmly focused on the needs of the child and young person.' (Learning and Teaching Scotland 2009) http://www.ltscotland.org.uk/curriculumforexcellence/technologies/index.asp.

Scotland's economic future depends on a technologically skilled society. The range of experiences offered within a high quality technologies programme offers a strong platform to build children's skills and interests and enable them to thrive in 21st century Scotland. Progressive, challenging learning experiences in technologies which meet individuals' needs can prepare children and young people to be:

- creative, productive and informed citizens, able to cope with uncertainty and with confidence to identify problems and take subsequent appropriate actions'.[1]

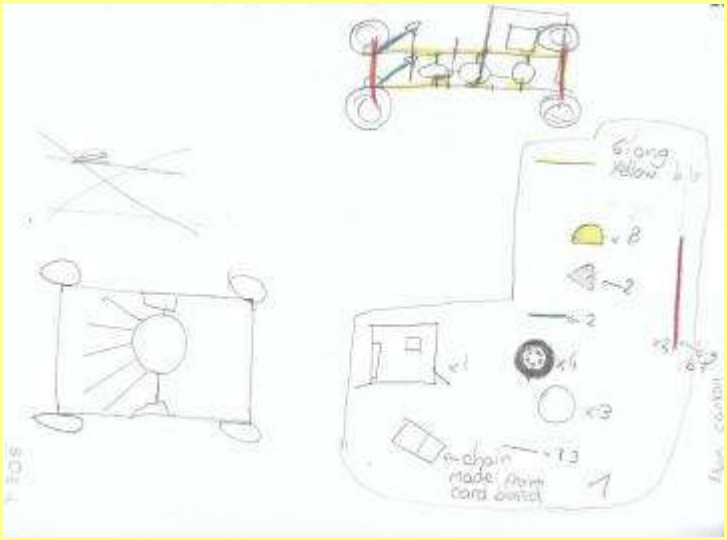
The technologies framework within *Curriculum for Excellence* provides a range of contexts for learning. Teachers plan to develop effective learning experiences for children and young people which are flexible, promote creativity and innovation and keep pace with advances in technologies. They help children to develop essential skills to work independently and collaboratively in small groups. Teachers need to support individuals and extend their learning through observations, open questioning and appropriate intervention. In the best examples, children's experiences are linked to real life contexts. Strong links are made to individuals and organisations with specific expertise to offer, such as local businesses and agencies in the community. Children benefit from regular opportunities to be involved in technologies challenges which provide relevance and create links in learning across the curriculum. They understand technologies linked within the wider context of science and understand the ways the world is affected through this connection.

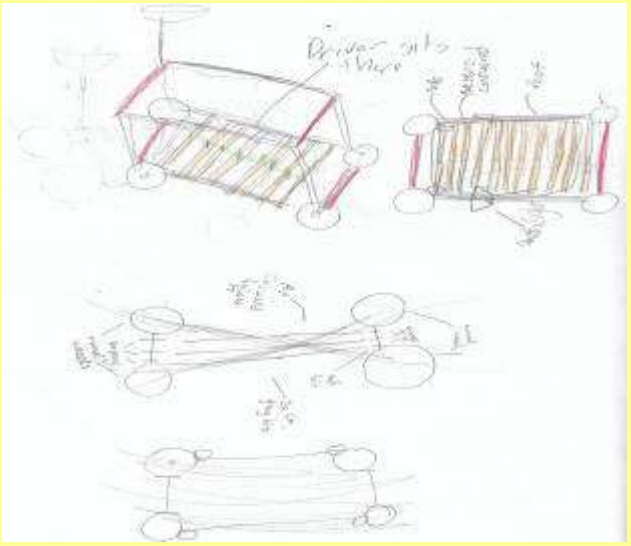
The illustrations in this report provide examples of good practice from the schools visited. The Learning and Teaching Scotland (LTS) online resource provides a short reflection guide with examples to help practitioners think about adapting classroom practice in accordance with the principles and purposes of *Curriculum for Excellence*.
http://www.ltscotland.org.uk/5to14/sharingpractice/environmentalstudies/technology/index.asp

[1] Curriculum for Excellence technologies outcomes.

How well are we developing successful learners in technologies?

Children who are successful learners in technologies are skilled users of a wide range of materials and can solve problems and demonstrate creative thinking. They enjoy, and are motivated by, practical tasks. They become increasingly innovative, critical designers who make connections across different areas of learning. They can discuss and evaluate a growing set of topics as they progress from the early years to the upper stages. At the early stages, children can discuss and evaluate topics such as housing and think about, for example, why we need houses, what we need to make a house, what makes a house strong and how we make it warm and dry. The most effective approaches meet the learning needs of all. A few children show increased levels of attainment and achievement in comparison with other subject areas, which in turn increases their success as learners. Within *design and make* processes, children at the early stages can draw, model and construct to communicate their ideas and find solutions to problems. Older children are less involved in open ended tasks.





They do not get sufficient opportunities to demonstrate progression, for example using more refined practical skills within their design solutions. The majority are able to clearly annotate and follow plans but drawings do not show accuracy, scale or proportion. Children are often not involved in costing their designs or aware of a wide range of considerations which may impact on their designs. For example, quality control, environmental impact or properties of materials are not taken appropriately into account. Transitions from pre-school to primary and primary to secondary are often not well planned to ensure the experiences effectively build on prior learning.

Signposts of successful learners
Children who are successful learners in the technologies:

- show enthusiasm and enjoyment in a range of practical, task-based activities;
- learn independently and think creatively;
- apply critical thinking through research, exploration and discovery;
- learn to make learning links across different curriculum areas through inter-disciplinary learning;
- are inquisitive and have the capacity to evaluate everyday items which may include assembling and disassembling;
- use a wide range of technologies well, showing a growing awareness of technologies in common use; and
- evaluate those technologies which form part of their daily lives.

Good Practice

In the most effective lessons, children are motivated and enthusiastic. They respond positively to their technologies tasks. These might include, for example, challenges related to designing and making a suitable hat to protect a 'favourite soft toy'. At the early stages in particular, children understand in a simple context how technologies contribute to the way we live. Children can talk about what forms of technologies are used to help them at home and in school. They speak well about toys and games they are familiar with, and which are interesting and entertaining. Older children understand how technologies affect the quality of their own life. They can apply these analytical skills to technological developments in the past or to different cultures in a global context.

Good Practice

In one school, children at P6 use technologies to develop their skills across a broad range of contexts. This includes citizenship, sustainable development, enterprise, creativity and culture. Teachers plan tasks and activities to tie in with the 100th anniversary of a local landmark, the Titan, the world's first cantilever crane. Children's work forms part of the local celebrations and culminates in a short animated film depicting the history of Clydebank and the crane. The film-making work links learning in literacy and social subjects through script writing, editing and researching historical background. Children are given the opportunity to work with an animator and structural engineer. In groups with clearly identified roles they are asked to focus on the technologies and materials required to build a replica structure of the cantilever crane. Children design and trial materials for their structure, including a range of commercial kit-type resources, art straws as well as junk from home. They explore the strength in materials, for example by folding or rolling paper to give greater strength for providing support. The structural engineer, working alongside teachers, has very high expectations of the quality of the designs and models constructed. All children fully understand why particular materials are used with the crane in reality. They replicate the visual appearance and incorporate the design features which give the crane its strength. The process is retested until the design is robust. Adults facilitate and undertake consultancy roles. Children lead the learning and feature their work on the local radio station and local newspapers.

How are we developing confident individuals through technologies?

Children's confidence in the technologies is enhanced through experiencing a range of 'design challenges'. This approach encourages children to plan and research factors that are influencing the processes of design and manufacture. In this way, they learn to apply their skills as well as to present, analyse and modify solutions. They become confident in their understanding that everything that is made is made from something else. They begin to see links with, for example, eco-schools work and become aware of the value of using approaches which are sustainable and not harmful to the environment.

Children tend to be confident when their skills are systematically developed so that they can apply their skills to 'make things work'. They are practised and confident in joining simple materials such as paper using glue. However, they often lack sufficient experience and skills of joining more complex resources such as wood, plastics or metals. Too often, finished products are sub-standard and do not sufficiently represent a real life solution to a problem. At times, there is an inappropriate and over-use of clear adhesive tape and construction kits are either not available to children or accessed as a reward. Children need to develop their confidence in recognising and using a wide range of methods to join materials,

finishes and develop a knowledge of moving parts that extends beyond basic combinations. They need more experience and knowledge of important mechanical devices, for example, axles, hinges, cogs, pulleys, cams, levers and motors.

Signposts of confident individuals
Children who are confident in technologies:

- respond well to new challenges, needs or opportunities and make informed decisions;
- evaluate and make reasoned choices relating to the environment and to sustainable development;
- use design processes to go beyond their first idea and seek alternatives; and
- produce solutions from an initial idea, seeking alternatives where necessary and going outwith their existing skills and knowledge.

Good practice in developing confident individuals

A group of primary schools identify a range of factors which are narrowing children's experiences of technologies. These include limited access to a wide range of materials, and the health and safety risks of children using tools such as saws and drills. As part of the transition programme, teachers of technical education from the secondary school work alongside primary school staff. This approach develops the skills and confidence of the primary school staff. For secondary school staff it raises expectations and understanding of the children's prior learning. Together teachers set the children open-ended design challenges which relate directly to their space topic. For example, children are asked to design and make a model moon buggy that can travel over a range of terrains. The design solution of another task requires creation of a mechanism capable of lifting space equipment onto the space shuttle either on earth or the moon. Children have access to paper, card, wood, plastic, textiles and metal. They use construction kits with pneumatics, motors and transmitters. They safely use a range of tools including saws, drills and a vice. Through the support provided, the children create products of a very high standard. There is also a focus on numeracy, particularly in measurement tasks using millimetres and angles. High quality interactive displays are created that encourage children to lift, touch and explore products. Digital photographs are used to record ideas and stages of construction, and are clearly annotated to reflect materials which are used in a real life context.

How well are we developing individuals as effective contributors in the technologies?

Children who are effective contributors have useful skills for learning, for life and for work. They work effectively individually and in teams and develop a capacity to identify and solve problems. They are keen to offer ideas and innovative solutions.

In primary schools, children have an increased range of opportunities to work with, and evaluate, each other's work. This is particularly relevant when *designing and making*. Children can be supported to make confident judgements in relation to design specifications and suggest improvements to enhance a design. There tends to be fewer opportunities for children to carry out and modify designs. As a result, these skills are less well developed. The focus is too often on art and design activities which, whilst valuable where that is the intention, do not give enough opportunity for appropriate technologies skills development. There needs to be a shift of emphasis from the all too common low-skill, low-challenge junk modelling activities towards designing and making products that are well thought through by children, include different moving parts and fulfil a realistic purpose.

Signposts of effective contributors
Children who are confident contributors in technologies:

- work well as individuals and collectively within teams;
- use trial and error to change approaches, reach solutions and solve problems;
- develop their entrepreneurial and presentation skills;
- confidently evaluate commercially-produced products for their purpose, reliability, durability and appearance; and
- evaluate their own work and that of others.

Good practice in developing effective contributors

A group of P3 children undertake an inter-disciplinary study on Malawi. They use the internet and digital images to research modes of transport and toys used in Malawi. Children design and build working model cars using recycled materials from home. As a class, they agree the criteria to evaluate their models. Each model created is unique and features of the designs are clearly annotated. Children test, then revise their plans and models until satisfied with their product. They compare the range of resources available within their homes to the more limited range available in homes in Malawi. They explore how needs can be met when resources are limited. They discuss and understand why some of their toys might be of little use to a child in Malawi. They imagine trying to live without some of the technological advances they now take for granted. This provokes stimulating discussion. They make and compare bread and cakes from African recipes using the technologies available to them in Scotland and those available in Malawi.

How well are we developing responsible citizens?

Most primary children are able to select suitable resources from a range of materials to complete a task. They know, for example, that paper originates from trees. They are less confident in discussing the origins of a range of materials used or the processes involved. For example, few know that plastics originate from oil, which in turn originates from plants and animals which roamed the earth millions of years ago. Most children have a well-developed knowledge and understanding of the impact of technologies and their effects on society. They are less confident at

discussing the balance between the benefits and drawbacks. For example, the advantages of mechanised transport set against the impact on health and valuable natural resources. The Eco-Schools Scotland initiative has had a significant impact on children's understanding of their environment. Children often demonstrate very informed attitudes to the environment especially in their knowledge and understanding of recycling. Most children, within the context of technologies activities, are able to appreciate the interrelationships between people and the immediate environment. They are less able to transfer this understanding into the wider community or global context.

Signposts of responsible citizens
Children who are responsible citizens using the technologies:

- make informed choices which reflect an understanding of their responsibilities towards and ethical actions on the environment;
- have a well-developed knowledge and understanding of technologies and their effects on society;
- are well informed about local, national and international use of technologies to meet individual needs; and
- become informed consumers who are environmentally aware of sustainability.

Good practice using technologies to develop responsible citizens.

Teachers in a primary school plan a range of challenging activities which require children to research, solve problems and explore an unfamiliar context. The school has productive links with a local charity which provides residential care for young people with profound physical and learning difficulties. Recent legislation requires the care setting to upgrade its facilities. In groups, children work alongside architects, care staff, service users and individuals to design plans which can be incorporated into the work and meet all stakeholders specifications. At various stages of the process children report their progress to classmates. On completion of the task they evaluate progress through close examination and discussions with service users. They deliver a presentation to peers and parents about their involvement in the project. They talk confidently about the impact of the products used and the influence that well-targeted use of technologies has in improving the lifestyles of individuals.

What are we presently doing well in technologies in the primary school, and what do we need to improve?

In best practice, children work collaboratively and develop creative and innovative ideas. They confidently solve problems and make products designed to meet human needs. They are involved in critical thinking, planning, reviewing and evaluating. However, this level of

performance is currently to be found in only a small minority of schools. (Improving Scottish Education 2005-2008)

Key strengths in technologies

Children are provided with practical tasks which motivate them and help develop positive attitudes towards. They learn to:

- talk, write, model, sketch and draw using a range of media and tools, including ICT, to communicate graphically their achievements in technologies;
- develop their skills and understanding through work in technology and in related areas such as enterprise, citizenship and Eco-Schools Scotland tasks;
- enjoy and apply their knowledge to real contexts locally, nationally and globally;
- work collaboratively in pairs or small groups to research a given problem; and
- confidently identify their progress and strength as learners.

Aspects for improvement

The following suggestions offer an agenda for practitioners who are seeking improvements in their practice in the technologies. These include the need to:

- ensure planned progression of skills and understanding taking full account of prior learning and give children opportunities to apply their skills, knowledge and understanding to real life contexts;
- make more effective links with pre-school establishments and secondary schools to maintain continuity and progression;
- ensure that all staff have shared expectations of processes for *designing and making,* that designs are accurate and measured with precision and products are made to the highest possible standard;
- increase children's confidence and safe use of a wider range of tools, for example, hand drill, hacksaws and other work-holding and shaping tools, food related tools and equipment such as, microwaves, food processors and sewing machines, and mechanical devices such as motors and pulleys;

- improve children's skills in communicating graphically through for example, digital cameras, MP4 images and computer–generated graphic designs;

- plan experiences that develop children's analytical skills through, for example, discussions about everyday objects that challenge them to evaluate what need they fulfil, their reliability, durability, safety and appearance; and

- ensure that as children progress through the school, tasks do not become more teacher led – rather that they provide children with greater opportunities for independence, collaborative working and additional responsibility.

As *Curriculum for Excellence* moves further into the implementation phase, staff are beginning to engage with the final experiences and outcomes for technologies. This will help to transform the Scottish education system and to achieve better educational outcomes for all children and young people. HMIE has produced three important guides to support schools as they make changes. These are: *Improving our curriculum through self-evaluation*; *Improving outcomes for learners through self-evaluation* (HMIE 2008) and, *Learning Together: Opening up learning* (HMIE 2009) which can be found at http://www.hmie.gsi.gov.uk/publications/inderx/asp.

The national initiative GLOW provides education staff with a dynamic learning environment for groups and individuals to link with each other and access a wide range of expertise in technologies - http://www.ltscotland.org.uk/glowscotland. Users are encouraged to contribute and share good practice. These support mechanisms, used in conjunction with the guidance in the *Building the Curriculum* series, aim to support schools to improve their curriculum and take account of the seven design principles of *Curriculum for Excellence*.

Further examples of good practice in technologies can be found at http://www.hmie.gov.uk/SelectEstablishment.aspx?typeid=2.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