THE ARTISAN AND THE ARTIST
Innovation Enables Transformation

Technologies Excellence Group
Curriculum for Excellence
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Innovation:

“We must build for this nation a big passion for innovation. We must make the development of the creative mind a national agenda. Unless we get really serious about cultivating creativity and promoting innovation, the transformation to an innovation economy will not really happen.”

LimKokWing University

Foreword

Our country is unsurpassed in technological achievements across history. Today "Excellence" requires that we focus on the conditions that made this possible and how we can harness that to reinvigorate learning. We now require a critical appraisal of the value of Technologies that reflects the sort of critiques we regularly see of literature and art. The recognition of the cultural values of technology, alongside an understanding of the history of our technology, also ought to inhabit a central position in building young people's learning about us as a nation. To illustrate briefly:

- In 1507 Fr John Damian was research scientist to James VI with a laboratory at Stirling Castle working on the principles of flight, as Leonardo da Vinci in Florence.
- Two hundred years later Napier was at work developing logarithms.
- Another one hundred years later, Arrol designed and built the Forth Bridge.
- In 1979 The Ninian Platform - the largest movable structure on earth.

In five hundred years a wonderful story of the small to the gigantic and, now, back to the small, with Scotland's place in soft technologies development continuing the story.

As Chair of the Technologies Excellence Group, I've been impressed by the energy the group has brought to making Technologies matter as much as possible in the school environment in general and within Curriculum for Excellence. We started with a reminder of the core principles of Curriculum for Excellence, and agreed that these should have continual restatement. Achieving a confident, successful, aspirational citizen requires a balance between academic and social skills, between scientific, mathematical and craft skills.

Understanding the value of interdisciplinary learning ought to be central to developing a holistic awareness of the inter-relationship between science, technology and mathematics; with numeracy, like, literacy as a base concept. This interdependence merely reflects realities in industry, business, and higher education. Bio-engineering or bio-mathematics are established concepts. These linkages operate not only at an academic level but also at an artisan level - craft skills, such as in home economics founded on learning in numeracy, biology and health.

As an architect the idea of focusing on Creativity and Innovation and its corollary – Design, as our goals, appeals. We can build learning outcomes and processes where the difficult and incomplete can co-exist with the structured – this is where imagination is everything. Getting creativity right into the core of learning needs a few things to come together – Ruth Wishart, who chairs the expressive arts excellence group, suggested the need for a virtuous triangle - staff/practitioners/ parents, which seemed to me to encapsulate all the main possibilities.

Our teachers have to be confident. Confident, well-trained teachers will lead to confident, well-trained students, who will in their turn, lead to a more technologically successful and responsible population, able to contribute to building their society and beyond.

Further, the aspect which links parents, teachers, pupils and curriculum is assessment and a related value system. If we are to give pupils space to fail - an essential part of creativity and innovation then some form of continuous assessment - which gives support, demands accountability but without recourse to a blame culture - requires to be implemented in schools. This in turn requires us all to invest and restore faith in our teachers as central to that assessment process. Similar forms of assessment have long been the basis of design courses at tertiary level for years.

Writing in Foreign Affairs, the Princeton economist Alan Blinder considers the question of job security and falling wages for U.S. workers in light of global competition:

"Many people blithely assume that the critical labor-market distinction is, and will remain, between highly educated (or highly skilled) people and less-educated (or less-skilled) people – doctors versus call-center operators, for example. The supposed remedy for the rich countries, accordingly, is more education and a general "upskilling" of the work force. But this view may be mistaken….The critical divide in the future may instead be between those types of work that are easily deliverable through a wire (or via wireless connections) with little or no diminution in quality and those that are not. And this unconventional divide does not correspond well to raditional distinctions between jobs that require high levels of education and jobs that do not."

In a modern democratic society citizenship confers rights but also responsibilities, particularly to fellow citizens and to the common good. Thus alongside a basic literacy and numeracy should stand the idea of citizenship, as the tools by which young adults may develop. This "high standard of ordinariness" is just as important as the idea of excellence. Itself a concept which each of us finds hard to define but equally can recognise it when confronted by it. At its extremities it is a Nobel Prize or a 'positive shift' in the material wealth of the nation. At an individual level it is being the best that one can be - achieving aspirations in life and career.

If we are to develop further as a nation founded on the above bedrock, given increasing levels of international competitiveness, it can only be based on embedding Creativity and Innovation in our Education and thus our Commerce and Industry. The concept of intellectual property and its value and contribution to our society must be developed. If creativity and innovation are to be placed at the core of our education system; that system must be based on the holistic nature of human development, the artisan as well as the artist, the harmonious and interdependent relationship between hand, eye and brain. We can no longer relegate craftsmanship and related skills to secondary positions, particularly given the acknowledged pedagogic value of the brain learning and acquiring information through the hands – the hands essential to the training of the brain.

When we look more closely at technology from product design through woodworking to home economics – from IT through graphic communication to engineering, there are myriad opportunities to develop creative skills. Information technology itself is intrinsic and should be seamlessly part of all aspects of education from information platforms through mobile telephone technology (wi-fi) to conversational facilities – Facebook and Twitter. Capabilities in this area are often better developed in the taught, than in the teacher, and can be useful as much in English and Modern Languages as in Home Economics. This level of technology must be differentiated from the technologies that are the bedrock of creativity and innovation. However, we must also recognise the issue of rates of change not only in future proofing any strategies we may develop for embedding technology in education but also in the manner in which technology is changing. Equiping students to deal with change is essential

Whilst the group was asked to focus on these technologies as a mechanism or means to excellence, there have been areas of common purpose acknowledged by many of the groups: conversations across subjects; external relations with the commercial hinterland; devolving responsibility to school staff; changing the nature of assessment and its impact both into and from university level and industry. Diversity encourages collaboration and solutions across skill groups replicating those skills embedded in commerce and industry. This is exemplified by the number and nature of skills exhibited in any team – as it's now a team game - who win a Nobel Prize.

The concept of creativity and innovation also brings another corollary – failure or setback. This has to be acknowledged not as failure in itself but as part of life where experiment and set back is important in the development of excellence. The poet Joseph Brodsky points to the value of insecurity and uncertainty for the creative endeavour - "in the business of writing what one accumulates is not expertise but uncertainties." Comparable to Voltaire's – "doubt may be an uncomfortable condition but certainty is an absurd one." As long as uncertainty is not permitted to escalate into hopelessness it is a driving force and a source of motivation in the creative process.

The famous cabinetmaker Norman Potter in his beautiful primer, What is Design: things. places. messages; writes;

"Students who want to be useful in the world, who see chaos and want order who lack self-confidence and who are swamped by the apparently required armoury of skills and facts are sometimes rashly seduced by unitary views of disparate phenomena-it seems hopeful that way and it seems manageable…. As things are, the one thing about the future of which a student can be sure, is that the demands on him or her are strictly unpredictable: the rough shape of possibilities may be discernible, but the exact and tangible nature of a creative challenge is a happening- not a forecast."

The built environment and an ability to contribute to its improvement has significant impact and potential within our society. Developing programmes across all of those skill sets which can impact positivity on our environs -social and natural sciences, technologies and arts are intrinsic to all aspects of the built environment we encounter everyday. This is important for two reasons: it allows us as citizens to be more critical of those who influence the built environment we inherent and it reinforces those areas of citizenship which are central to our development as a responsible society in a sustainable economy.

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1.0 Introduction

1.1. The Cabinet Secretary for Education and Lifelong Learning announced in March last year a ten point plan designed to drive forward the delivery of Curriculum for Excellence (CfE). The announcement included a proposal to set up 'Excellence Groups' bringing together subject teachers and leading experts in individual fields to support excellence in education in their subject areas and across the curriculum.

1.2. The Technologies Excellence Group (TEG) has been established to offer a view to the Cabinet Secretary on the skills, attributes and features of excellence in education across the range of school curriculum subjects that form the combined technologies.

1.3. Within CfE, the technologies offer young people many rich contexts for the development of technological skills, knowledge and understanding through creative, practical and work-related activities. The outcomes of learning in the technologies relate directly to real-world contexts including those in computing science, food, textiles, craft, design, engineering, graphics and other developing technology. This connectivity never has been more important than in times of global economic down-turn and widespread concerns over environmental issues. In the limited time available to it, the group held to a strategic view across the technologies, whilst recognising and celebrating the unique identity and contribution of each. That approach also had the benefit of underlining how closely the technologies coexist with other important areas of the curriculum, including in particular the STEM subjects, and the powerful links with literacy and numeracy."

2.0 Scotland's Economy

2.1. Technology - defined as the application of knowledge and skills to extend human capabilities and to help satisfy human needs and wants - has had profound historic effects on Scottish society and culture and continues to do so in the twenty-first century. Scotland has a strong and proud tradition of excellence and innovation in technological research - a truly world class reputation going back many decades, but which has also recognised vision for the future. This is especially true in areas such as engineering, electronics, optoelectronics, biomedical research, genomics and cell engineering. If Scotland is to continue to sustain an ambition of achieving long-term economic growth and prosperity, our people need to be skilled in the application of technologies and be aware of the impact of technological change and innovation on society, the labour market and the environment. Investing in education in the technologies becomes not an option, but a social and economic imperative across the short and medium terms.

2.2. The technologies make up a significant, but too often undervalued contribution to Scottish culture. As such, it would make sense now to prompt a process of continuing appraisal of the value of the technologies, similar to critiques regularly within literature and the arts.

The recognition of the cultural values of technologies, alongside an understanding of the history of our technology, ought to take a central position in building young people's learning about us as a nation. Scotland's economy too demands that there should be no differentiation between the relative value of "hand" and "mind" work, which are of equal importance in terms of future economic well-being.

3.0 Group Remit

3.1. The Group were asked to consider 4 key questions:

Skills

What skills, attributes and features of excellence in education promote deeper learning, better teaching and enhanced achievement in the technologies?

Innovation

Within the context of Curriculum for Excellence, what constitutes innovative practice in the technologies and how might this best be described and disseminated?

Barriers

What specific challenges exist that might present barriers to achieve excellence in the technologies and how might these be overcome?

Partnerships

What mechanisms need to be in place to improve the quality, sustainability and relevance of partnerships working between schools and the wider community?

4.0 Defining "Excellence"

4.1. While there is no single definitive response to what constitutes "Excellence" in the technologies, a good starting point is likely to refer to the expected outputs – i.e. young people who are ambitious and confident in the use of technologies, who can describe key technological principles, can demonstrate excellent craftsmanship as a concept fit for the twenty first century. The Group noted that excellence within education can often be associated with those individuals who work against the "system", who take risks, promote new ideas and are enterprising in their approach to learning and teaching. In addition, the traditional classroom setting can often stifle creativity; particularly where large class sizes exist.

4.2. While creativity can be evident in the delivery of the maths and languages curriculum in primary schools, there was concern that this is often lost in the transition from primary to secondary education.

5.0 Curriculum for Excellence

5.1. Curriculum for Excellence (CfE) provides a vital and timely opportunity to enrich young people's experience of learning in the technologies. In addition, CfE offers a flexible, dynamic framework for partnership working between (and within) schools, businesses, colleges and universities. CfE encourages greater opportunities for an increased understanding of skills and the application of learning across young people's experience - aiming to make the impact of the whole experience greater than the sum of the curriculum parts. The CfE "experiences and outcomes" are specifically designed to be accessible through a range of approaches. Technologies have huge potential to motivate and support learning across the totality of the curriculum. They can be creative vehicles for inter-disciplinary learning. Achieving a confident, successful, aspirational citizen requires a balance between academic and social skills, and between scientific, mathematical and practical skills. The curriculum therefore needs to be planned to allow time for teachers to promote and develop their creativity and to help young people make connections across their learning. The concept of Life Long learning must be at its heart.

5.2. Curriculum for Excellence must also to be about ambition. Raising standards for everyone means a greatly increased focus on understanding, skills and the application of learning. Knowledge is just as important as it has ever been. However, it is not enough. An ambitious curriculum needs to go further and concentrate on what it will enable young people to do. We must nurture self-confidence and recognise achievement across the curriculum. The technologies experience provides a wealth of real world contexts for the application of literacy, numeracy and health and well-being. The technologies also relate clearly to the other STEM components of science, engineering and mathematics, offering mutual re-enforcement and promoting effective inter-disciplinary approaches, in keeping with the principles of CforE.

5.3. The Group noted the recently published Donaldson Review report – Teaching Scotland's Future – and identified a clear opportunity to follow through on the report by considering its implications for the STEM subjects. This was believed to be important since there is widespread evidence that primary teachers in particular lack confidence in the delivery of technologies in the classroom. Teacher training in all its forms should build technology skills.

6.0 Classroom Practice

6.1. The central focus of the work of the Group has been on 'classroom practice' but it has also considered the key role of other partners supporting and promoting excellence in the curriculum, including colleges, universities, business and industry partners. Each partner can make an important contribution towards resolving some of the intractable issues associated with the learning in the technologies, including the need to ensure that the curriculum remains in step with leading edge developments.

Similarly, the role of new media and communications technology and digital engagement in supporting learning, teaching and the acquisition of skills, has been an important consideration in the Group's work.

6.2 We must engage positively with the inter-net to take advantage of its benefits, grapple with its contradictions, and consider the opportunities it presents to staff, students and parents. This requires management of risk rather than being risk averse.

7.0 Qualifications

7.1. Education professionals need freedom to balance individual accountability against the need to effectively measure and support individual pupils. Greater awareness is needed of the fact that not all pupils will continue their education beyond the official school leaving age and the Group are pleased to note that SQA “Skills for Work” courses will continue. For those who do continue with their studies in the technologies, there are good future labour market opportunities, in the oil and gas industries for example, where significant skills shortages are envisaged at engineering technical level. Schools should ensure that there are clear, flexible and responsive routes across the technologies and relating appropriately to other areas of experience, including entrepreneurship and creativity. The Group welcomed the recent publication by the SQA of a suite of technologies courses it wishes to develop and their proposals for rationalisation of provision. National Qualifications are valuable in that they signpost opportunities to develop skills for learning, skills for life and skills for work to support learners and teachers to ensure a breadth of skills development.

7.2. Schools should be encouraged to take greater risks within the curriculum, avoiding the need to protect departmental or subject-specific interests. Young people can effectively learn through the experience of failure and both they and their teachers should be encouraged to be less risk averse.

7.3. While many primary schools are effective in offering good quality opportunities for deep and meaningful learning, teachers need to be mindful of the challenges posed by superficial learning and the temptations of a "tick box" approach to assessment and task management. More effort is needed by local authorities and senior school managers to acknowledge the value of “qualifications” as reflecting young people's achievements, including, but also going beyond, formal certification. The Group accepts that core skills are embedded within National Qualifications and HNC’s and HND’s at present and acknowledges that LTS has published guidance on recognising achievement. Skills for Learning Life and Work will be signposted in New Courses. However, it believes that some form of "technologies skills portfolio" might be considered to identify and accredit work experience, voluntary contributions and other experiences undertaken by young people, both within and outwith school.

7.4. Perceptions persist that some young people are “too clever” to study the technologies, and there appears to be a failure to recognise that the technologies provide opportunities for both craft and intellectual skills.

7.5. The STEM-ED Scotland team (part of Glasgow University) is currently undertaking a small-scale research project designed to illustrate a journey of learning, relating to science. The research may yield important messages relevant to technologies, and might be conducted similarly for the technologies.

The current research will show how understanding of core concepts/ideas and scientific skills can build up from nursery to secondary (3-18) in two "big ideas" in science. The two pathways will take into account CfE and build connections across the curriculum. The project is collaborating with science, technology and mathematics education practitioners in schools and universities and organisations working in these areas. The two areas are Energy Transformation and DNA and Inherited Characteristics. HMIE, the Technology Teachers Association and the Association for Science Education have been involved in a similar joint project around this type of activity.

8.0 Assessment

8.1. SQA qualifications in the technologies are currently being re-designed to build on the broad general curriculum provided under Curriculum for Excellence. This offers an ideal opportunity to change the status quo. The SQA should consider in their work through the CARG and relevant development activities the need for continuous assessment of creativity through project work and how this could potentially benefit young people more than summative assessments. Space needs to be found in the curriculum to teach and support innovation, with teachers working in partnership and lessons being enhanced by external visitors. Assessment arrangements also need to be reliable, valid and proportionate.

Reliable through providing high quality evidence and information;

Valid through using a range of evidence that is fair;

Fit for purpose and based upon sound criteria; and

Proportionate by not placing excessive burdens upon learners and school staff.

8.2. Quality assurance and moderation is essential to ensure consistency of understanding and application of standards in the technologies at national and local level. Through sharing, understanding and applying standards, quality assurance and moderation enables teachers to raise standards and expectations and levels of consistency across teaching staff, schools and education authorities. Further, the aspect which links parents, teachers, pupils and the curriculum is assessment and a related value system.

8.3. The Group were strongly of the view that pupils needed to take risks in learning, and develop the resilience to handle the challenges of failure. It was felt that such an approach was an essential element for the promotion of creativity and innovation. To encourage this approach, some form of continuous assessment is necessary to provide support for teachers and ensure accountability but avoid encouraging over-cautious, risk-averse approaches in learning.

8.4. Technological advances now provide good opportunities for schools to offer young people an e-portfolio log of their learning. This approach could be used by all schools and for all subject areas, provided there were an agreed set of national standards allowing for, among other things, recognition of the "soft skills". The new National 4 qualifications will be wholly internally assessed and the new National 5 qualifications will be a combination of internal and external assessment, including examinations.

9.0 Contextual Learning

9.1. Research evidence consistently suggests that young people learn better from active, engaging approaches. Examination pressures can often lead to constraints in the time available for project work of kinds which encourage active learning. Although SQA has acknowledged progress is being made with project based assessments, more needs to be done to ensure that pupils are fully engaged in their learning. In the technologies, it is essential that teachers and other education professionals keep apace with technological developments and newly-acquired technological innovations.

9.2. Professions, such as those in medicine, architecture and the law, are required to maintain their professional or chartered status through a period of continuing professional development in ways which hold important messages for the teaching profession. Glow, the schools intranet, already provides a good opportunity for sharing good practice and should be further developed to ensure that the most up-to-date research and case study evidence is available to teachers of the technologies.

9.3. In defining good practice, the Design and Technology Association and Learning and Teaching Scotland provide good reference points along with the Technology Teachers Association, the Association for Science Education and the Scottish Schools Equipment Research Centre. As outlined by the Donaldson Review, new technologies too provide the opportunity for Continuing Professional Development across the disciplines and ready access to up-to-date research and case study material. A greater focus by schools should therefore be placed on maximising the CPD opportunities now available.

10.0 Industry Engagement

10.1. The benefits of positive engagement between schools and industry can often be overlooked or under-estimated. Determined to Succeed (DtS) has employer engagement at the heart of its policy and local authorities report that in the period 2009/10 there were 17,500 employer partnerships, formal and informal, already happening in schools. Education professionals should be made more aware of the value of such engagement and the wider socio-economic rationale for doing so. The STEM Ambassadors programme is another good example of this kind of positive engagement.

10.2. Opportunities to support CPD development should be supported, including a greater use of Excellence through Education Business Links (EEBL) placements to engage technologies teachers and their peers and learning from the valuable experience of industry partners. There are significant opportunities for a range of school partnerships, which the Group consider are not being fully exploited. Colleges and universities could make physical and human resources available to raise the bar of ambition and achievement. The Group discussed whether it was possible to formalise the engagement between schools and industry partners and the benefits and challenges of formalising such engagement. This should also include expanding vocational training within schools.

11.0 Inter-Disciplinary Learning

11.1. Curriculum for Excellence identifies interdisciplinary learning as one of the four cornerstones of the curriculum. Understanding the value of interdisciplinary learning is central to developing a holistic awareness of the inter-relationship of the technologies with, for example, science, mathematics, creativity and entrepreneurship. Further, the technologies, offer a host of opportunities for the development of high order skills in literacy and numeracy. This interdependence merely reflects realities in industry, business, and higher education for example in the context of bio-engineering or bio-mathematics.

11.2. These linkages operate not only at an academic level but also at an artisan level - craft skills, such as in home economics founded on learning in numeracy, biology and health. There is a need for greater exemplification of the connections between the Science, Technologies, Engineering and Mathematics (STEM) disciplines as these are currently reflected in the school curriculum. Greater connectivity between the school and business/research communities will help breakdown barriers that exist across the range of STEM school subjects. This connectivity can be brought to life through the greater focus on the “big ideas” to which each discipline can contribute – such as in climate change or carbon capture.

11.3. The physical constraints of school buildings along with time-tabling considerations can often present unnecessary barriers to inter-disciplinary learning. School managers and local authorities should be aware of the potential benefits of suspended time-tabling which can often allow for greater creativity by both pupils and teachers. Schools should be actively encouraged to experiment with a variety of organisation models, including mixed-age and mixed ability arrangements and interdisciplinary learning within and between the technologies and other school subjects. Care should be taken when planning both in resource allocation and in ensuring that meaningful and relevant cross-curricular connections are made, moving beyond superficiality.

12.0 Skills

12.1. Communications skills should be more embedded in learning around the technologies. High order skills such as analysis, synthesis, practical thinking and entrepreneurship are vital. Independent learning should also be encouraged. Craft skills of many young teachers tend to be poor and there is some evidence of a hierarchy of status surrounding the technologies. For the sakes of the economy and the current and future jobs market, these cultural and outdated perceptions need to be challenged head-on, both within the teaching profession and in wider society.

12.2. Effort is needed to ensure that the essential skills of the artisan are strengthened and maintained. Bright young people need to be encouraged into the technologies and challenged by them as exciting, stimulating and aspirational experiences on a par with career routes in areas such as medicine and the law. The technologies have the capacity to deliver an understanding of both the craft skills essential to understanding good design, through improving hand/eye/brain interactions and the technological tools, including ICT, that enable learners to manipulate, plan and execute design outcomes in the modern world. A feature of technologies is the need for pupils to be able to learn independently and to enjoy the freedom to take control of their learning.

13.0 Teacher Confidence

13.1. All teachers need to have the necessary confidence and skills to deliver the wide range of outcomes and experiences in technologies and adequately prepare pupils from the transitions from primary to secondary school and for post school transitions. Many teachers, particularly those in the primary sector, would benefit from more focused training to develop their confidence in the delivery of the technologies curriculum. While young people often work well together and show excitement and enthusiasm for the technologies in primary school, this can be difficult to sustain as they enter secondary education. Teachers should be encouraged to develop their own technological capabilities and should have more and easier access to contemporary technologies as a vehicle to underpin their own and their pupils' creativity, challenge and enjoyment.

14.0 Practical Technologies

14.1 For most young people, practical technologies – those associated with, for example engineering and vocational crafts – can be particularly relevant and stimulating. Young people enjoy the practical nature of the activities, not only for the immediate pleasure of creating but also recognising their relevance to a spectrum of employment opportunities. It is important that all such activities are challenging, and relate as closely as possible to current practices and interests, for example in contexts in the information sciences. One way of maintaining the currency of practical technologies is through access to leading edge practice in industry and higher education, partnerships which schools are encouraged to develop.

14.2 Practical activities should always promote excellence, - “craftsmanship” - in the contexts of information sciences, business practices, food and textile applications, or craft, design engineering and graphics. A focus on current demands on technologies, such as media coverage of an innovative piece of architecture, a major natural disaster or the debate on climate change, can provide the vehicle for excellence in thinking and skills development. It is important that teachers use these opportunities to the full. The power of the relationship between, say craft skills and quality of life, or the role of medical technologies, should not be underestimated and the skilful teacher will help the student make the connection between their task and real-world applications.

15.0 Executive Summary

In considering the evidence it has received, the Technologies Excellence Group wishes to make the following recommendations:-

15.1. **Economic Development.**
To continue to sustain an ambition of achieving long-term economic growth and prosperity, Scotlands people need to be skilled in the application of technologies and be aware of the impact of technological change and innovation on society, the labour market and the environment. Investing in education in the technologies becomes not an option, but a social and economic imperative across the short and medium terms.

15.2. **The Culture of Technologies.**
The recognition of the cultural values of technologies, alongside an understanding of the history of people's learning about us as a nation our technology, ought to take a central position in building young people's learning about us as a nation.

15.3. **Excellent Skills.**
Scotland's economy demands that there should be no differentiation between the relative value of "hand" and "mind" work, which are of equal importance in terms of future economic well-being. Achieving a confident, successful, aspirational citizen requires a balance between academic and social skills, and between scientific, mathematical and practical skills. There are no "soft" skills in the real world that we encounter. For innovation to flourish it is now more important than ever that we ensure that the essential skills of the artisan are strengthened and maintained.

15.4. **Information Technologies.**
The role of new media and communications technology and digital engagement in supporting learning, teaching and the acquisition of skills, is an important consideration. Communications skills should be more embedded in learning around the technologies. High order skills such as analysis, synthesis, practical thinking and entrepreneurship are vital-their application greatly enhanced through an excellence in skills in ICT.

15.5. **Excellent Technologies.**

Curriculum for Excellence (CforE) provides a vital and timely opportunity to enrich young people's experience of learning in the technologies. Research evidence consistently suggests that young people learn better from active, engaging approaches. Understanding the value of interdisciplinary learning is central to developing a holistic awareness of the inter-relationship of the technologies with, for example, science, mathematics, creativity and entrepreneurship.

15.6. **Ambition.**

Curriculum for Excellence must also to be about ambition. Raising standards for everyone means a greatly increased focus on understanding, skills and the application of learning.

15.7 **Accountability and Reward.**

Education professionals need freedom to balance individual accountability against the need to effectively measure and support individual pupils. This balance of efficiency and effectiveness is crucial. All teachers need to have the necessary confidence and skills, backed by appropriate support, to deliver the wide range of outcomes and experiences in technologies and adequately prepare pupils from the transitions from pre-school through primary to secondary school and for post school transitions.

15.8. **Issues of Assessment.**

Across the sectors where they can be seen as championing interests relating to their remits, HMIE can play an important role in advocacy. National quality assurance approaches should ensure an appropriate focus on the quality of educational experience which young people have across the technologies, for example through inclusion in inspection frameworks. All those involved in external evaluation should be familiar with the principles we have sought to establish throughout this report.

15.9. **Change and Innovation.**

Space needs to be found in the curriculum to teach and support innovation. We must recognise the issues of rates of change not only in future proofing any strategies we may develop for embedding technology in education but also the manner in which technology is changing. Equipping students to deal with change is essential

15.10 Alliances and Partnerships

There are particular benefits for the technologies from teachers working in partnership with commerce and industry and lessons being enhanced by external visitors. Schools should be actively encouraged to experiment with a variety of organisation models, including mixed-age and mixed ability arrangements and interdisciplinary learning within and between the technologies and other school subjects. Greater opportunities need to be available to allow young people access to facilities and experiences including those in university and industry.

16.0 Objectives

16.1. The Group felt that with the conclusion of the findings in Technologies within Curriculum of Excellence, a series of objectives should be laid out for consideration and implementation:

- Publish the report and its findings.
- Disseminate the information to all sectors of education.
- Ensure that the central role Technologies play in all our lives is recognised and reflected in any Curriculum for Excellence.
- Recognise that skills embedded in all Technologies can assist in developing higher order skills.
- A serious development of education in its widest sense to reflect the principles of creativity and innovation as central to the development of a modern Scottish economy.

"As JCB is demonstrating with its upcoming engineering academies, businesses need the best people to make discoveries. While the right environment for companies helps, developing talent is a long-term endeavour that needs to start now. High quality teachers inspire young people to become creative problem solvers, and to be excited about nurturing their innate skills - taking things apart, seeing how they work, putting them back together."
Sir James Dyson. Feb 2011.