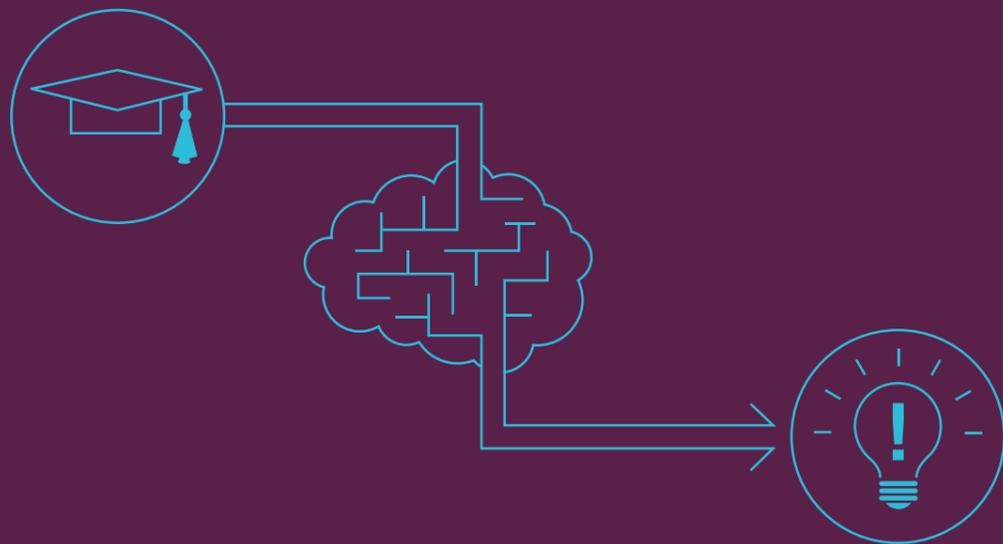


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The Aldersgate Group

The Aldersgate Group is an alliance of leaders from business, politics and society that drives action for a sustainable economy.



Lead Author
Andrew Raingold
 Executive Director, Aldersgate Group

Contributions

Ellen MacArthur Foundation team

Foreword

The Government must ensure that education and training are designed for future needs and not merely to remedy current shortages.

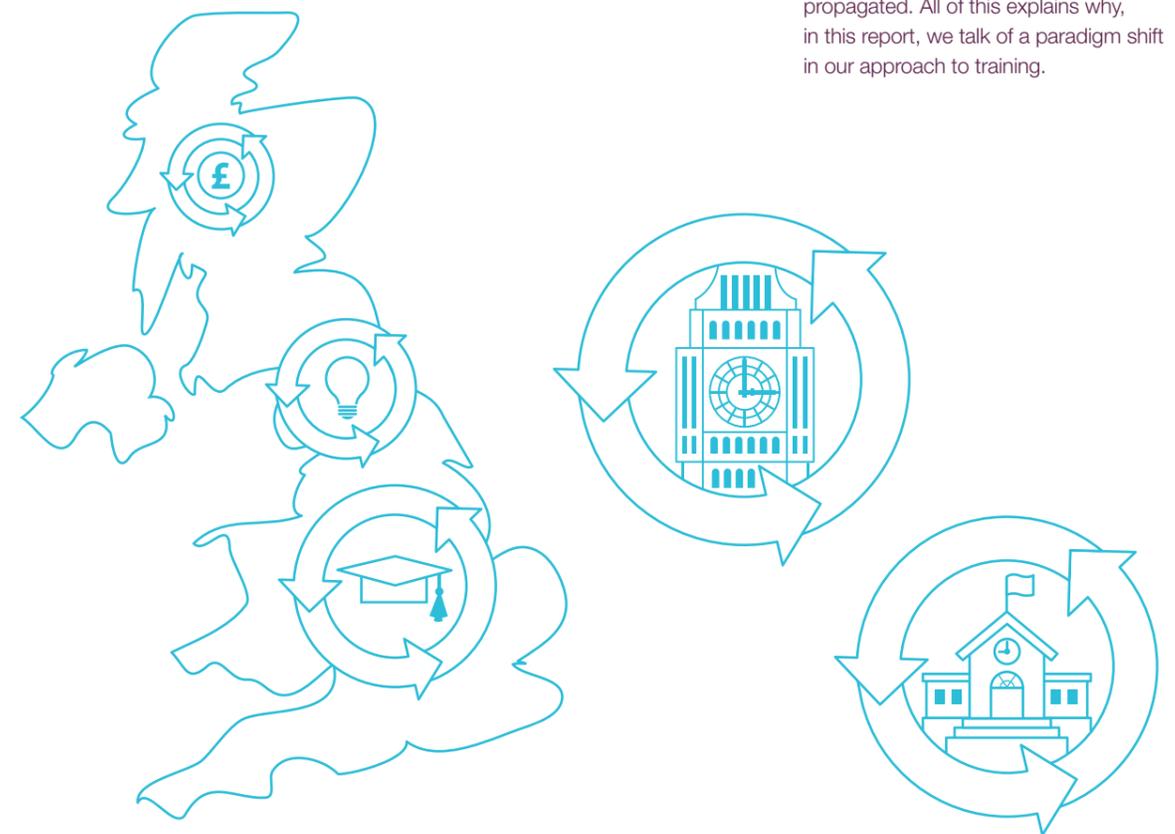
A significant consensus is developing in Britain. In politics, business and in civil society, there is a growing recognition that we need to create what the Aldersgate Group calls the “new economy”, in which top quality design, sustainable production and long term resource efficiency are more important than high levels of consumption and short term profits.

This interim report is the first attempt to describe the transformation that will be necessary in our education and training systems to accompany and support this transition of the British economy.

In the past the Aldersgate Group has argued that we need more creative designers, many more engineers, better skills in project management and high class communicators. More generally and every bit as importantly, we need everyone in the British workforce to have a good understanding of why our economy needs to be transformed and what changes have to be made. A widespread appreciation of how to make our economy more sustainable and restorative will be a key requirement as we move through the transition to the new economy and beyond.

The reform of our education and training systems will have to be large scale and dramatic. Every job in Britain will change to some extent and many will change substantially. So we will need training resources of a size to match our aspirations. Because we anticipate such a rapid pace of economic change, our education and training systems will need to provide the British workforce with a strong basis of theoretical knowledge so people will be able to react quickly and expertly to changes in technology.

A breadth of understanding across disciplines will be much more valuable than a narrow competence in one activity. And this broad understanding must be accompanied by high class communication skills so that knowledge can be properly explained and propagated. All of this explains why, in this report, we talk of a paradigm shift in our approach to training.



Foreword

A workforce with higher skills and a broader span of knowledge will allow a change in the notion of leadership. Better trained individuals should be encouraged and permitted to be creative. Leaders will need to be developmental in style, devolving and delegating so that the talent of the whole workforce is effectively mobilised. Organisations must take further measures to flatten hierarchies and open up decision making.

The Aldersgate Group sees a vital role for Government. At present training is demand led. To facilitate the transition to the new economy, Government will often need to intervene to ensure that education and training is designed for future needs and not merely to remedy current shortages. A rapid transition will no doubt uncover many instances of market failure and business will expect a timely and coherent response from politicians and Government Departments.

Re-equipping the British workforce for the new economy should be exciting and inspiring. Properly handled, jobs should become more satisfying and people at work should feel more valued. But the changes will be enormous and the transformation must be explained and justified. The reforms should be the subject of wide ranging consultation and discussion in the political arena, in education and in companies. The aim is to create a pathway to future prosperity and well-being, not to threaten and alienate people with massive top down changes that are frightening because they are unexplained and misunderstood.

John Edmonds
AG Lead, Skills for Success

Executive summary

The UK needs a paradigm shift in its approach to learning and training to succeed in the new economy.

The development of a successful “new economy” - resilient to inevitable and foreseeable economic, political, cultural, technological, environmental and demographic shifts and driven increasingly by high growth sectors in cutting edge technologies – will be the foundation for future jobs and prosperity. Economic competitiveness will depend ever more on all people having a broad and rounded knowledge base that will equip them for future needs.

One of the most critical challenges of the 21st century is the absolute decoupling of economic progress from resource constraints, insulating the economy from commodity price shocks and security of supply. There is an essential need to explore new economic models that move away from a linear system of “take, make, dispose” and adopt circular approaches that are restorative and seek to eliminate waste by design.

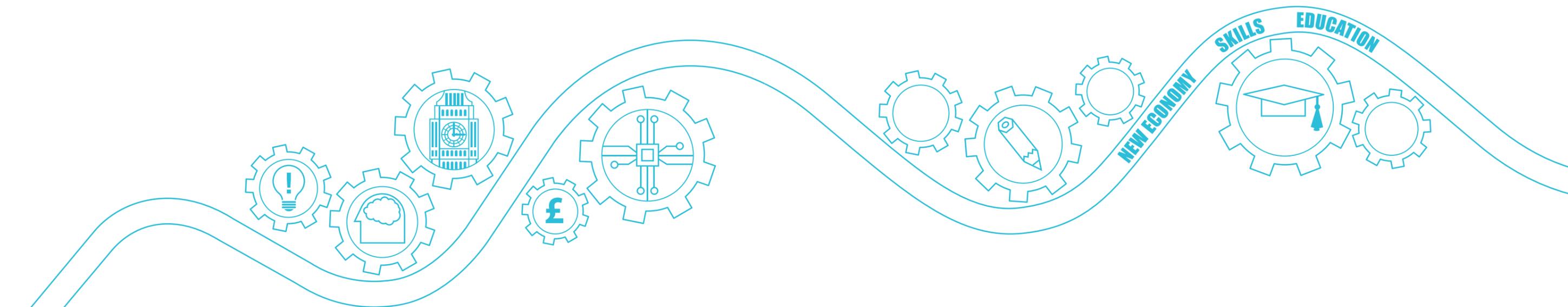
Such a transformation of the economy requires a fundamental shift in how we educate young people and develop the skills of the workforce – moving away from incremental refinements or switching emphasis within a skills hot list.

This interim report of the Skills for a New Economy initiative sets out the types of education and training requirements that are needed to build a successful new economy and barriers that must be overcome. It does not examine the skills gap in emerging new sectors but predominantly focuses on the skill and learning requirements that will be required for all jobs and professions. This is a challenge for the whole economy.

A paradigm shift

The education system must evolve to enable learners to grasp ‘whole systems’ design. This spans products, technologies, materials, and energy flows, and makes explicit those links between the subject specialties which are chronically underplayed at the present time.

This is not additive but transformative. The ability to think in a more connective and integrated way is vital to live in a highly interdependent world. So, for example, skills should not be addressed separately in different subjects but should seek to link disciplines together in order to re-design the whole system.



Executive summary

The main challenges associated with this paradigm shift can be categorised as:

1 Scale

There needs to be a transformation of the whole economy to address emerging challenges and lay the foundations for long-term success. Every company will need to adopt new business models and every job will need to change to some extent.

2 Coherence

While skills provision must target all pupils and professions, public and private sector interventions tend to be disjointed and businesses struggle to articulate future needs clearly due to a lack of certainty. In education, the circular economy, as an expression of a new organising framework, must extend across all disciplines and successfully map to the curriculum. For business, the sector approach to skills provision must be complimented with broader cross-sector actions and initiatives.

3 Proficiency

Encouraging more pupils to study STEM (Science, Technology, Engineering and Maths) subjects by bringing to life the future needs and opportunities, emphasising trans-disciplinary working across the curriculum and enthusing a new generation of engineers, designers and business leaders will be vital to succeed in a new economy.

4 Leadership

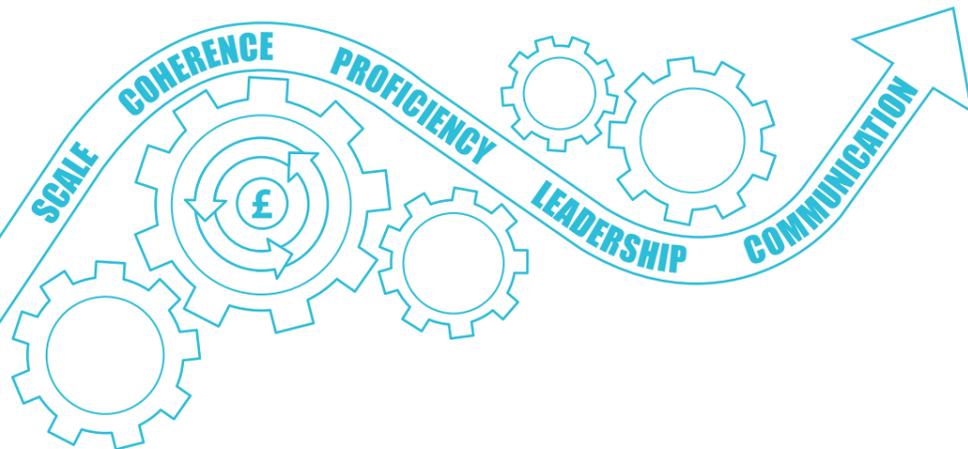
Enhancing management and leadership skills at all levels will be essential for businesses to respond to emerging challenges and drive change. We need to support the learners of today to become system thinkers; pro-active, independent enquirers; self-managers; creative innovators; team workers; reflective practitioners committed to lifelong learning; and highly adaptive.

5 Communication

A new economy is emerging based on design and innovation with significant opportunities for those with the right skill sets. *How* children learn is as important as *what* they learn. As such, there must be a particular focus on learning in real contexts that is problem-based, project-centred, peer-to-peer and trans-disciplinary.

These emerging findings seek to inform, inspire and generate further debate with leading practitioners from the fields of business, education, politics and civil society.

One of the greatest difficulties to overcome is seeking to transform the economy so that it is fit for the future, with education and training not just modelled on the frameworks inherited from the past.



Introduction

It is vital that the current and future workforce has the learning and skills to thrive in a new economy.



*Children of five who started school this year will be retiring round about 2070. Now think about that. Nobody has the faintest conception what the world will look like then, do they?*¹

Sir Ken Robinson
Author and International
Advisor on Education

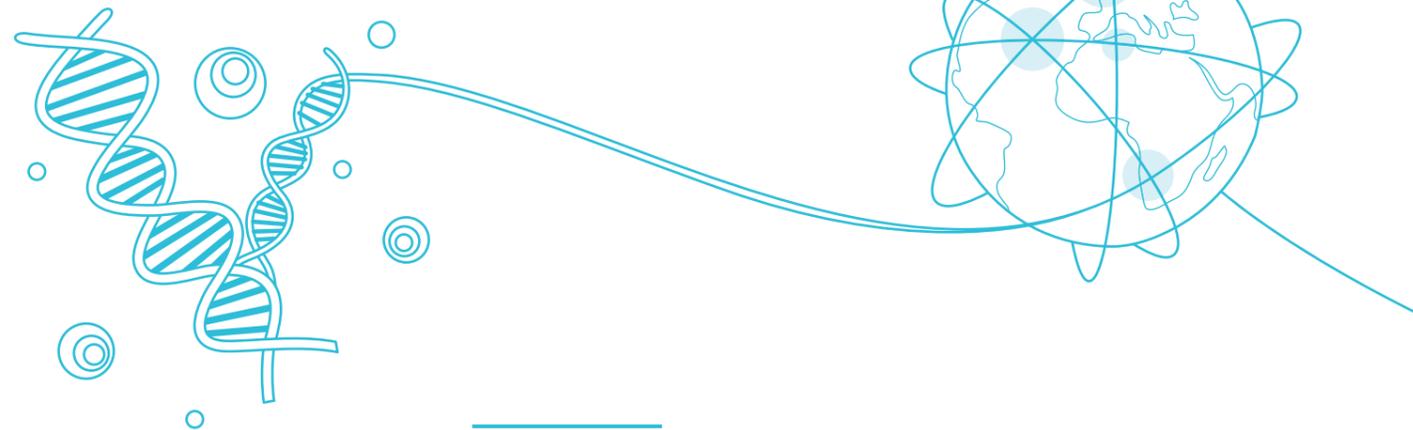
The development of a successful “new economy” will be the foundation for future jobs and prosperity. This is conventionally viewed as new industries, such as biotechnology or the internet, that are characterised by cutting-edge technology and high growth².

A thriving “new economy” must also prepare and respond to global megatrends; inevitable economic, political, cultural, technological, environmental and demographic shifts, such as increased globalisation and interconnectedness. While it is complex to predict the micro-economic detail of such global developments (such as the company or technology that will add the greatest economic value), the most prudent actors are already seizing new opportunities³ and implementing strategies to be at the forefront of new markets.

In terms of learning and skills, is the UK well equipped to respond to these challenges? The Government’s overall skills strategy⁴ is based on a demand-led model in which businesses, through Sector Skill Councils, National Skills Academies and others, identify and articulate the skills they need and the educational system responds accordingly.

The Government recognises that in many of the areas relating to a new economy, businesses generally are not articulating their future needs clearly due to a range of systematic barriers⁵. Fundamentally, the current skills model must be strengthened so that it can respond more effectively to (inevitable) future demand.

Economic competitiveness will increasingly depend on all people having a broad and rounded knowledge base that will equip them for future needs.



¹ » Sir Ken Robinson (January 2007) Keynote Speech to the Music Manifesto State of Play Conference.

² » See Oxford Dictionary Online (www.oxforddictionaries.com).

³ » For example, total global sales for low carbon environmental goods and services sector in 2010/ 11 was £3.3 trillion, an annual increase from 2009/ 10 of 3.7%. See BIS (May 2012) *Low Carbon Environmental Goods and Services: Report for 2011/12*.

⁴ » Department for Business Innovation & Skills (BIS) (November 2010) *Skills for Sustainable Growth*.

⁵ » HM Government (October 2011) *Skills for a Green Economy*.

Introduction

Transformation of the economy

One of the most critical challenges of the 21st century is the absolute decoupling of economic progress from resource constraints, insulating the economy from commodity price shocks and security of supply. There is an essential need to explore new economic models that move away from a linear system of “take, make, dispose” and adopt circular approaches that are restorative and seek to eliminate waste by design (see next section on the circular economy).

Such a transformation of the economy requires a fundamental shift in how we educate young people and develop the skills of the workforce. It is not a question of refinement, overcoming bumps in the road or switching emphasis within a skills

hot list. A new economy is emerging based on design and innovation and developing the relevant competencies will be essential for economic success.

It is essential that we respond to this immense challenge by developing skills for relational or systems thinking. The ability to think in a more connective and integrated way is vital to live in a highly interdependent world⁶. So, for example, skills should not be addressed separately in different subjects but should seek to link disciplines together in order to re-design the whole system.

Aldersgate Group

The Aldersgate Group is an alliance of leaders from business, politics and society that drives action for a sustainable economy. Its previous report on skills, *Mind the Gap*⁷, sets out how an effective policy for skills and employment requires a much deeper understanding of the nature of the transition to a resource efficient economy and the barriers which must be overcome. It puts particular emphasis on building on existing skill sets, developing science, technology, engineering and maths, or “STEM” skills, reforming institutions to deliver more effectively and the role of companies to engage their staff at all levels.



Introduction

Skills for a new economy collaboration

The Aldersgate Group established the Skills for a New Economy initiative to identify the key challenges to accelerating the knowledge and practical skills required in today’s workforce for all professions in the transition to a new economy. The objectives of the project are to:

- » identify the main barriers in developing knowledge and practical skills;
- » engage with industry and showcase examples of best practice;
- » raise awareness across different actors; and
- » establish programmes and initiatives to drive change.

The initiative has included a number of high profile events, roundtables and workshops with leading representatives across the fields of education and business (such as leading

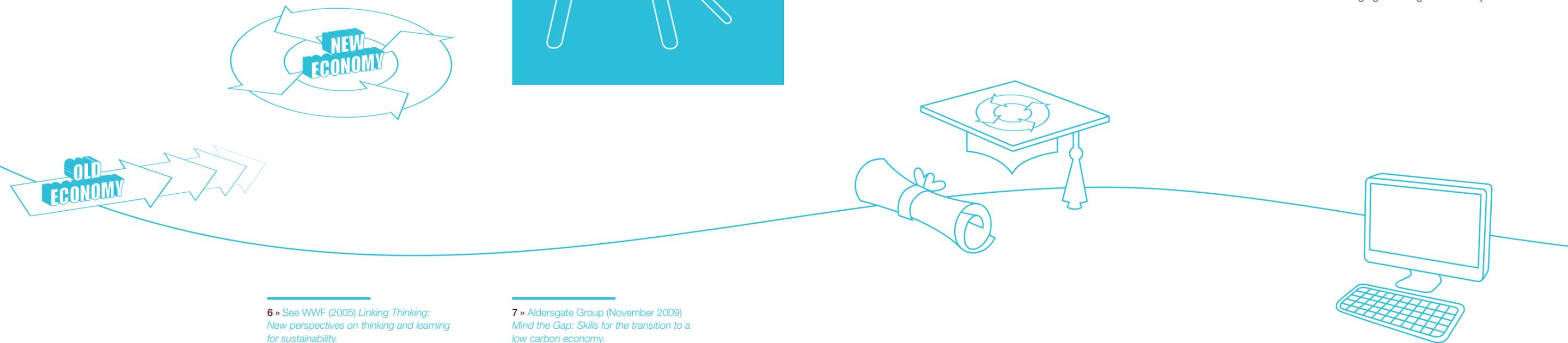
corporations, schools, training providers, trade unions, recruitment consultants, trade associations, public sector bodies, academics and NGOs).

This interim report outlines emerging findings that seek to inform, inspire and generate further debate with leading practitioners. It sets out the types of education and training requirements that are needed to build a successful new economy and barriers that must be overcome.

The main challenges are set out in five key areas:

- 1 Scale**
- 2 Coherence**
- 3 Proficiency**
- 4 Leadership**
- 5 Communication**

This report does not examine the skill gaps in emerging new sectors but predominantly focuses on the skill and learning requirements that will be needed for all jobs and professions. Above all, it emphasises the need for “systems thinking” and for cross-disciplinary learning in order to address the interrelated nature of emerging challenges effectively.



6 » See WWF (2005) *Linking Thinking: New perspectives on thinking and learning for sustainability*.

7 » Aldersgate Group (November 2009) *Mind the Gap: Skills for the transition to a low carbon economy*.

The circular economy

Presenting opportunities for growth and competitive advantage in a resource constrained world.

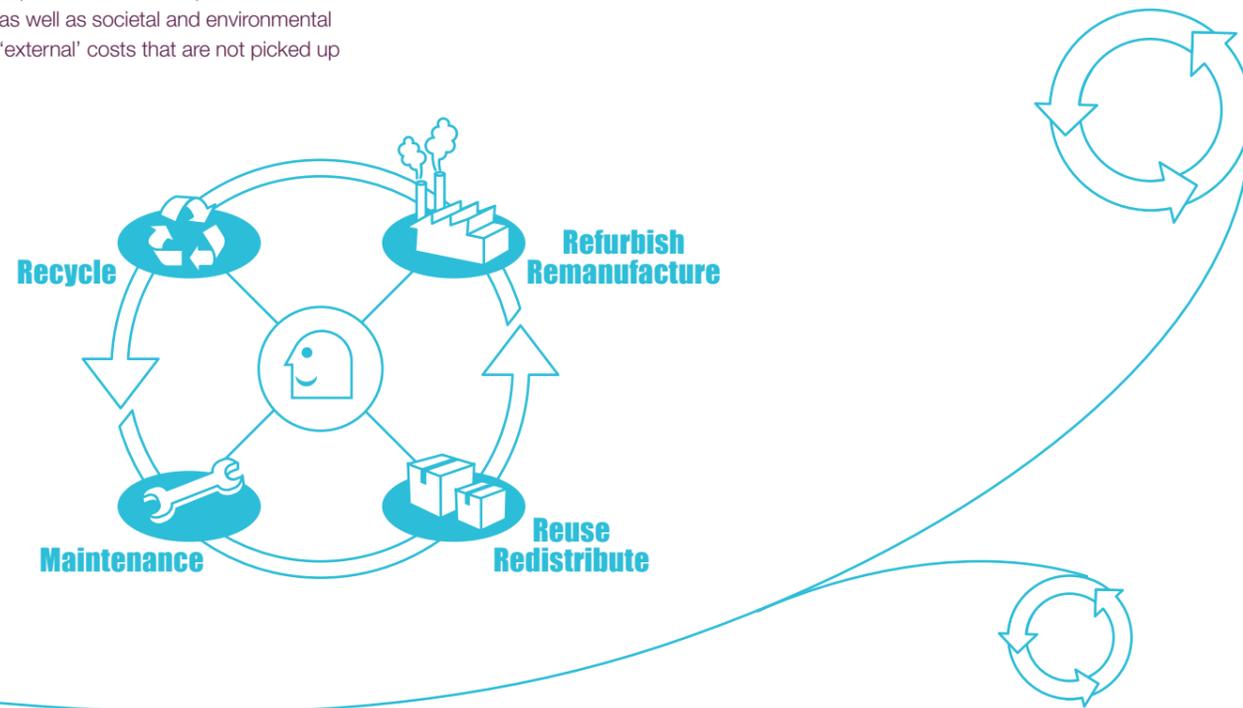
The time is coming when it will no longer make economic sense for 'business as usual' and the circular economy will thrive. Our thinking is in its infancy but we're taking steps now to see what works in practice and to understand the implications of reworking our business model⁸.

Euan Sutherland
CEO, Kingfisher UK & Ireland

by companies. Adopting a circular model would shift the economic balance away from energy-intensive materials and primary extraction, and create new sectors dedicated to materials innovation, design, reverse cycle activities for reuse, refurbishing, remanufacturing, and recycling.

Rather than focusing on mitigating the negative effects of our current "take, make and dispose" model and optimising it through a "reductionist" agenda (e.g. minimise emissions and energy consumption), the circular approach aims to be regenerative by intention. It relies on efficient material flows, radical design and adapted logistical chains to maintain resources in circulation, insisting on components recovery and re-manufacturing in the technical cycle. Bio-based materials and associated distribution/collection circuits, on the other hand, are designed to re-enter the biosphere safely (e.g. through restorative agricultural processes, like natural fertilisers) and kept contamination-free.

A circular economy approach offers economies an avenue to resilient growth, a systemic answer to reducing dependency on finite resources and a means to reduce exposure to resource price shocks as well as societal and environmental 'external' costs that are not picked up



8 » Ellen MacArthur Foundation (January 2012) *Towards the Circular Economy: Economic and business rationale for an accelerated transition.*

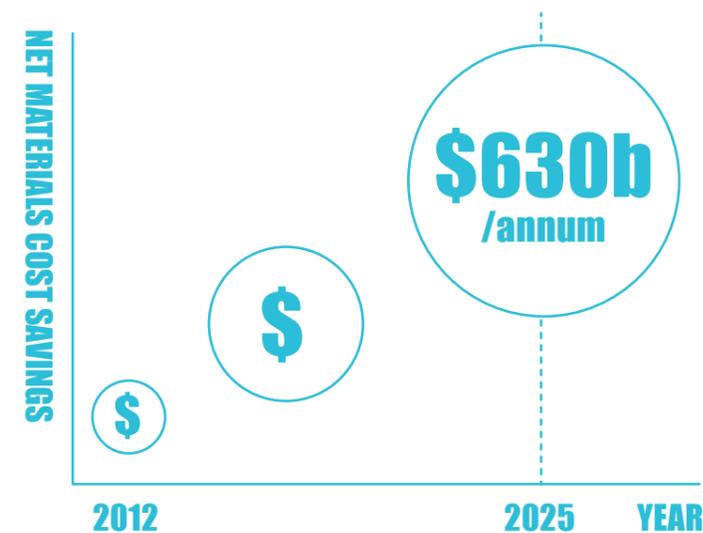
The circular economy

Using product case studies and economy-wide analysis, the *Towards the Circular Economy*⁹ report published by the Ellen MacArthur Foundation and featuring analysis by McKinsey & Company details the potential for significant benefits across the EU. It argues that a subset of the EU manufacturing sector could realise net materials cost savings worth up to \$630 billion per annum towards 2025, stimulating economic activity in the areas of product development, remanufacturing and refurbishment.

As such, radical design, innovative business models and increased capacity in reverse logistics have been identified as the main building blocks of a circular economy, which also benefits from the coming of age of high-performance communications networks (crucial when building efficient supply chains).

Such a transition offers new prospects to economies in search of a credible pathway towards long-term prosperity and employment perspectives. At the same time, it is a source of resilience and stability in a more volatile world.

The time to act is now, and an unprecedented conjunction of enabling factors opens a new window of opportunity: environmental constraints and tighter regulations are here to stay, while commodity prices (which had steadily decreased over the 20th century) are on an upwards long-term trend¹⁰. Furthermore, the necessary information technology is available and a shift in consumer behaviour towards more acceptance of access instead of ownership, is starting to be visible.



9 » Ellen MacArthur Foundation (January 2012) *Towards the Circular Economy: Economic and business rationale for an accelerated transition.*

10 » "Time to Wake Up: Days of Abundant Resources and Falling Prices Are Over Forever" Jeremy Grantham. GMO Quarterly newsletter, April 2011.

The circular economy

Business should not delay seizing this opportunity, and education naturally has a major role to play when it comes to equipping young people so they can find a place in that new economy and sustain its development, bringing it resilience.

For more information on the circular economy, see the *Towards the Circular Economy*¹¹ report commissioned by the Ellen MacArthur Foundation and the *Resilience in the Round*¹² report by the Aldersgate Group.

Circular economy: definition

The circular economy is a generic term for an industrial economy that, by design or intention, is restorative and eliminates waste. Material flows are of two types: biological materials, designed to re-enter the biosphere safely, and technical materials (non-biological), which are designed to circulate at high quality, with their economic value preserved or enhanced.



Biological Materials



Technical Materials

A paradigm shift

The skills and education requirements of the new economy must evolve to enable learners to grasp 'whole systems' design.



*Synthesizing and creating are also intellectual/cognitive capacities, and thus within the purview of school, and they are more important in the 21st century than ever before. But educators have less experience in training these 'habits of mind' and unless teachers themselves have these latter skills, they will not be able to inculcate them effectively in students.*¹³

Howard Gardner
Professor of Cognition and Education at the Harvard Graduate School of Education

This shift is consonant with reinventing progress to reflect new insights into living systems. This scientific world view recognises the importance of connection and flow, where feedback drives change and where the old one-way idea of a 'cradle to grave' production system is replaced by 'cradle to cradle', just as the relationship of the part to the whole has reversed in emphasis. Our new concern with the state of the whole in relation to the part replaces exclusive focus on the part.

Education, at least in the formal sector and before the age of 19 is often seen as delivering specified content (knowledge). Learning is usually understood to result from teaching and that certification guarantees at least a portion of that knowledge. It tells us little about what has been learnt, how learning has been facilitated, what skills have been developed and what perspectives have been explored. It is a great distance from an ambition to "rethink and redesign".

The education system must evolve to enable learners to grasp 'whole systems' design. This spans products, technologies, materials, and energy flows, and makes explicit those links between the subject specialties which are chronically underplayed at the present time. This is not additive but transformative. The ability to think in a more connective and integrated way is vital to live in a highly interdependent world. So, for example, skills should not be addressed separately in different subjects but should seek to link disciplines together in order to re-design the whole system.

The root of our existing educational system mirrors that of our economic system. Both emerged from the traditions and world view that originated in the Enlightenment: the world is 'machine-like'. Science now reveals that the world is not especially 'machine-like' — it is more connected, feedback-driven and reliant upon non-linear systems. As a result, with 'systems thinking' at its heart, a new scientifically based world view is taking hold: that of the 21st century Enlightenment.

¹³ » Professor Howard Gardner (26th April 2012) *OECD Education Today: Educating for innovative societies.*



¹¹ » www.thecirculareconomy.org

¹² » Aldersgate Group (June 2012) *Resilience in the Round: Seizing the growth opportunities of a circular economy.*

A paradigm shift

This is not additive but transformative. Skills suited to a linear, heavily 'siloed', specialist-led economy are not going to remain unaltered while other skills are added. Whole systems design demands a thorough rebalancing, making sure the specialist and general skills underlying systems design flow one into another, creating a richer understanding altogether.

Systems thinking emphasises that skills have to be broadly understood. Even something as laudable as 'problem solving' carries with it an assumption that a problem is capable of being fixed. This can be true but often it is not: problem contextualizing, looking for the systems and how to adjust system conditions might be more appropriate.

In dynamic systems there is no fix, just intervention and review, an iterative process. As a consequence, since most real life problems are contingent, it is much more likely to be a cross disciplinary effort – in business it would be decision-making units working as a team. In teaching and learning, the emphasis would be on opportunities for participatory learning and creative and critical thinking, above all.



A paradigm shift

Rebalancing Learning

The chart below summarises dimensions of education and training that need to be rebalanced. The headings in the left-hand column characterise the main approaches of the 20th century.

The right-hand column indicates the directions in which we need to travel if we are to develop the innovative and adaptable school leaver who is able to acquire new 'habits of mind'¹⁴.

20 th century	21 st century
problem solving	problem appreciation and reframing
analysis	synthesis
reductionism	whole system emphasis
closed and immediate cause and effect	multiple influences through time and space
individual learning	team or group learning
competitive	competitive and collaborative
emphasis on teacher transmitting pre-determined knowledge to the student	learning through enquiry
rooted in subjects or disciplines	meta-learning ¹⁵



¹⁴ » See Bill Lucas and Guy Claxton (2009) *Wider skills for learning*. Centre for Real World Learning and NESTA.

¹⁵ » Meta learning was originally described by Donald B. Maudsley (1979) as "the process by which learners become aware of and increasingly in control of habits of perception, inquiry, learning, and growth that they have internalized". (Source: www.tinyurl.com/c94kvct)

Scale

There needs to be a transformation of the whole economy to address emerging challenges and lay the foundations for long-term success. Every company will need to adopt new business models and every job will need to change to some extent.

At the heart of realising this opportunity will be harnessing Britain's genius for invention. We can combine our leadership in science and design to spark off new commercial innovations in materials science, advanced manufacturing and construction, amongst many other things.¹⁶

James Cameron
Chairman, Climate Change Capital and member of the Prime Minister's Business Advisory Group

The development of the new economy will not mean that everyone will be a wind turbine engineer or biotechnology scientist. The majority of jobs will not be entirely new in content but based on traditional occupations with enhanced skill sets.

A fitting analogy is the information technology revolution. The vast majority of jobs now require varying understanding of computer programmes, communications and the internet to maximise economic opportunities and increase market share. Similarly, each job in a new economy will require an understanding of emerging trends and the skills to translate the associated challenges and opportunities into their professional lives.

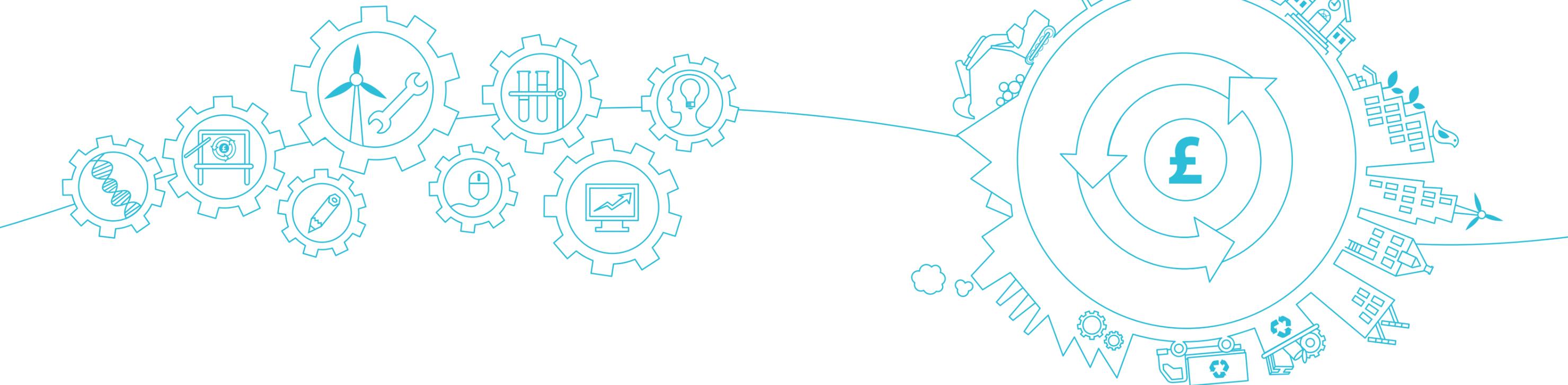
Scale

This is particularly necessary for the shift to a circular economy. A recent government report states that:

"All businesses will need to respond to the transition to a green economy, as they consider the impact on their goods and services and how they produce these. Increased resource efficiency can increase profits and competitiveness, making UK industries stronger and more resilient. All workers will need the abilities and knowledge to respond effectively to the shift to greener business practices. FE and HE [Further and Higher Education] both have a role in embedding skills for a green economy in their courses and ensuring teachers, trainers, lecturers and assessors have the necessary capabilities to undertake this widening role."¹⁷

However, the circular economy is not about incremental improvements in resource efficiency but redesigning and re-imagining the whole system. Each individual or organisation – whether across education, government or business – will need to adapt.

While high impact industries are addressing the challenges of resource scarcity to varying degrees of effectiveness, the requirement for knowledge, technical and practical skills must increasingly be addressed by all sectors of the modern economy. No job will be unaffected. This will require a general expansion in higher and intermediate level skills and an increased demand for generic skills such as project management, legal, financial and technology transfer, to exploit technology and commercial opportunities¹⁸.



16 » James Cameron (25th January 2012) *The Independent*: "If Britain is to survive economically, it must focus on low-carbon industry."

17 » HM Government (October 2011) *Skills for a Green Economy*.

18 » See the Edge Foundation (October 2010) *Taking Skills to a Higher Level in the Low Carbon Economy: Report of an Edge Foundation seminar*.

Coherence

While skills provision must target all pupils and professions, public and private sector interventions tend to be disjointed and businesses struggle to articulate future needs clearly due to a lack of certainty.

When we're talking about a circular economy we're not talking about specific subjects, we're talking about linking all these subjects together to re-design the whole system, the way we make things, the way we use things and the way we disassemble things.

Dame Ellen MacArthur at the Skills for a New Economy launch event (November 2011)

Ensuring a coherent approach that covers both general approaches and specific task-focused learning is a major challenge for embedding new economy perspectives across education and training. These vary for different actors and age groups.

Education (pre-19)

The circular economy, as an expression of a new organising framework, must extend across all disciplines and successfully map to the curriculum. This requires extensive engagement with subjects like design and technology, science, engineering, maths, geography, business, enterprise and economics rather than creation of new subjects, or reliance on a standalone 'sustainability' element.

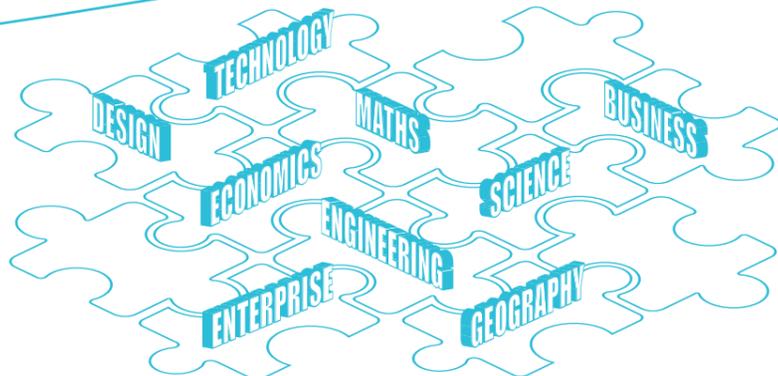
It also requires a fundamental paradigm shift in the way we think about intelligence. Far from being a fixed entity, the learning sciences are now showing us that how we see ourselves as learners really matters. We can all learn to be more resilient, more creative and better at solving problems.

An emphasis must be placed on embedding systems thinking as a framework, generating new perspectives and developing relational thinking skills that are broadly applicable to different situations and contexts.

As a direct result of this finding, the Ellen MacArthur Foundation has recruited a Development Field team that will be working with schools and education networks to disseminate resources and evaluate engagement and impact in teaching circular economy content and approaches.

Further Education (FE)

A small number of FE colleges are leading the way in addressing new challenges but progress is fragmented and initiatives are localised.



Coherence

A significant barrier is that FE colleges are commercially driven (having previously been government-led) and generally provide courses in response to immediate business demand rather than future skills requirements. The Department of Education recognises that for vocational training, "perverse incentives, created by the performance and funding systems, encouraging teaching of qualifications which attract the most performance points, or the most funding – not the qualification that will support young people to progress."¹⁹

Business

The Government recognises that businesses generally lack the right level of understanding or awareness of the skills requirements to address the challenges of resource scarcity effectively and consequently the importance and potential benefits of integrating these skills into the business²⁰.

Business will instinctively react to acute skills needs, such as filling vacancies to deliver existing orders, rather than chronic skills needs created by the progressive but unrelenting change to a new economy not visible in day to day demands.

As a result, demand is generally not being clearly articulated to the employer-led Sector Skills Councils which seek to identify and articulate skills requirements at a sector level. For the system to be more effective there must be "informed" demand, which ensures that present and future skills needs are being addressed²¹.

Just as a circular economy perspective is required across subject disciplines in the school curriculum, the sector approach for skills provision must be complemented with broader, cross-sector actions and initiatives. The Government has recognised this by setting up a collaboration of Sector Skills Councils to address issues relating to the green economy. This approach must be built upon with further cross-sector initiatives.

The Aldersgate Group is leading an initiative on the Green Economy Council²² that seeks to address this challenge.



¹⁹ » Department of Education (July 2012) *Wolf Review of Vocational Education: Government Response*.

²⁰ » HM Government (October 2011) *Skills for a Green Economy*.

²¹ » As this model has its challenges there are professional body led initiatives which seek to address any shortfalls such as the competency framework developed by IEMA - IEMA Environmental Skills Map.

²² » The Green Economy Council is a group of high level business leaders from a cross-section of industries and sectors, that advises Government on green growth policies such as infrastructure, innovation, investment, and regulation.

Proficiency

Encouraging more pupils to study STEM subjects, emphasising trans-disciplinary working across the curriculum and enthusing a new generation of engineers, designers and business leaders will be vital to succeed in a new economy.

Over the past century the UK has stopped nurturing its poly-maths. There's been a drift to the humanities – engineering and science aren't championed... To change that you need to start at the beginning with education. We need to reignite children's passion for science, engineering and maths.²³

Eric Schmidt, CEO of Google

It is evident that demand for skills in the new economy will increase greatly over the next decade and beyond and there will be fierce competition between industries for workers with the right competences. Employers across the economy are stressing the need to overcome deficiencies in the quality and quantity of appropriately educated and equipped recruits and employees²⁴.

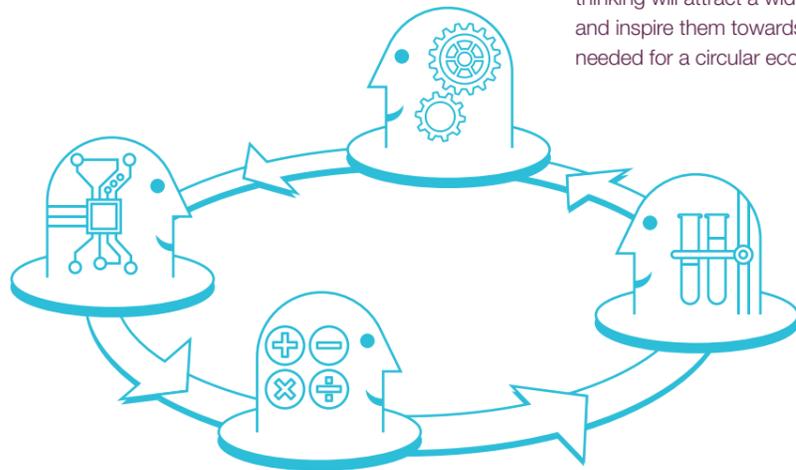
As such, it is widely recognised that young people must be further encouraged to study STEM (Science, Technology, Engineering and Maths) subjects and seek careers in related professions to mobilise a new generation of engineers, technicians and scientists. As demonstrated in the Aldersgate Group's *Mind the Gap* report, this is a policy of "no regrets" as it is a shortage of precisely these skills that has held back the UK economy for decades²⁵.

Demonstrating these growing skill gaps, Steve Holliday, CEO of National Grid, a founding partner of the Ellen MacArthur Foundation and member of the Aldersgate Group, said:

"The sheer scale of the changes, investment and challenges needed in my own industry, energy, means there are significant numbers of diverse and exciting jobs available that make a difference. They are mostly high-skill, STEM-based jobs. We need to not only equip our young people... we need to inspire them and offer them clear pathways into these jobs. We can't afford to fail... the responsibility sits with all of us."

The opportunity now is to articulate this need for STEM skills in the context of the new economy, opening up young minds to the excitement, growth and innovation that the future transition of our economy provides.

While the acronym 'STEM' is generally used as shorthand for four specific areas, at other times it is used as an approach to learning that is essentially trans-disciplinary, based on real-life contexts and usually involving teams of students searching for new and better ways of doing things. It is our view that this second approach combined with systems thinking will attract a wider range of students and inspire them towards acquiring the skills needed for a circular economy.



²³ » Eric Schmidt (26th August 2011) *MacTaggart Lecture: Television and the internet: shared opportunity.*

²⁴ » Edge Foundation (October 2010) *Taking Skills to a Higher Level in the Low Carbon Economy: Report of an Edge Foundation seminar.*

²⁵ » Aldersgate Group (November 2009) *Mind the Gap: Skills for the transition to a low carbon economy.*

Proficiency

Support for STEM education

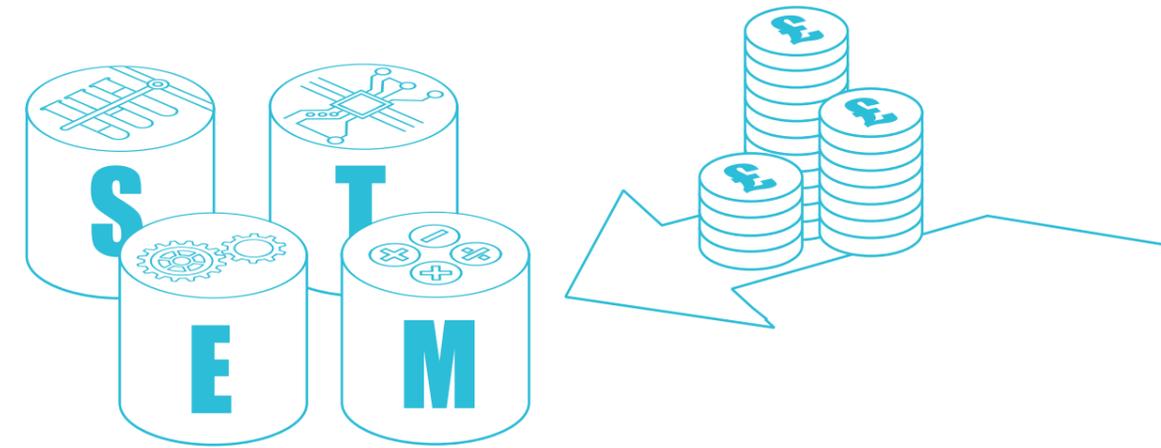
According to the Institution of Civil Engineers²⁶, STEM education must address both short supply gaps and opportunities for broader workforce development. Success requires Government to deliver:

- » appropriate funding and planning to ensure specialist maths and science teachers are in place in all schools;
- » genuinely impartial careers advice available to all school students;
- » developing a flexible funding arrangement for 14–19 provision so that collaboration is encouraged between schools, Further Education and University Technical Colleges; and
- » rigorous monitoring of the impact of the new HE funding arrangements.

This wider view of STEM is consistent with the 21st century direction of travel outlined in the *A Paradigm Shift* section. In approaching learning from a trans-disciplinary perspective students are more able to develop their creativity and ability to be innovative in real-life situations. It also generates greater interest from students and helps to raise attainment in the individual STEM subjects.²⁷

Hands-on experience in businesses such as site visits and work experience placements provide invaluable learning and inspiration for students. For example, the Ellen MacArthur Foundation runs an internship programme for students involving a real industry based challenge around the circular economy, specific to the industry of the host organisation, presenting their ideas to senior managers.

In the next two sections on Leadership and Communication we make the case that the aims of STEM education go beyond the simple acquisition of knowledge and skill in science, technology, engineering and mathematics, important though these are. To develop the leadership skills needed for the 21st century it is equally important to look at *how* students learn and the pedagogical strategies to achieve this. It is also important to recognise how education in the arts and humanities can provide a rich seam for developing creativity, the willingness to innovate and develop those dispositions and habits of mind that are needed.



²⁶ » Institution of Civil Engineers (February 2012) *Submission for the 2012 Budget.*

²⁷ » Specialist Schools and Academies Trust (August 2009) *Leading Practice in STEM.*

Leadership

Enhancing management and leadership skills at all levels will be essential for businesses to respond to emerging challenges and drive change.

Realising it [shared value²⁸] will require leaders and managers to develop new skills and knowledge—such as a far deeper appreciation of societal needs, a greater understanding of the true bases of company productivity, and the ability to collaborate across profit /non-profit boundaries²⁹.

Professor Michael Porter
Harvard Business School
and leading authority on
company strategy.

Management and leadership skills are essential for businesses to respond effectively to the challenges of resource scarcity, as well as to address emerging legislation, consumer expectations and market opportunities. These include basic awareness of the ways in which the drive for greater resource efficiency and a circular economy will impact on existing businesses and industrial activities.



28 » The concept of shared value can be defined as policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates. Shared value creation focuses on identifying and expanding the connections between societal and economic progress.

29 » Michael E. Porter and Mark R. Kramer (January 2011) *Creating Shared Value*.

For more than one hundred years there has been recognition that there is more to successful learning than the acquisition of 'factual' knowledge. Educators such as John Dewey (1859 to 1952) emphasised the social, interactive nature of learning. He argued for an environment in which students interact with the curriculum and that they should be active participants in their own learning³⁰.

In Dewey's view, education should be a place for learning how to live and not just acquiring a prescribed body of knowledge and skills, noting that "to prepare him for the future life means to give him command of himself; it means so to train him that he will have full and ready use of all his capacities". Dewey saw teachers and students as partners in learning. He emphasised the importance of experience and reflection on that experience, and on hands-on learning³¹.

30 » John Dewey My Pedagogic Creed (1897), *The School and Society* (1900), *The Child and the Curriculum* (1902), *Experience and Education* (1938).

31 » See www.tinyurl.com/d88ujlz for a summary of Dewey's views on education.

More recently, insights from psychologists have enhanced this view. Lev Vygotsky³² (1896 to 1934) was a Russian developmental psychologist whose work has had increasing influence in educational circles over the last twenty years. In particular Vygotsky drew attention to the importance of the socio-cultural context of a child's development; through education wider society shares its goals with the learner who in turn shapes the learning environment. The teacher is a guide and mentor as well as a skilled practitioner in establishing the appropriate level of 'scaffolding' in any particular learning context. Again this emphasises the importance of partnership in learning and the development of skills, and in dealing with real-life contexts.

Carol Dweck is an American psychologist who has challenged the idea of people having a fixed intelligence – the idea that one is born with a given IQ and that is all there is to it³³.

32 » See for example Lev Vygotsky (1934) *Thinking and Speech*.

33 » Carol Dweck (2006) *Mindset: the New Psychology of Success*.

Leadership

Dweck argues that students can understand that they can extend their intelligence, talents and abilities through hard work, persistence and good teaching. Lauren Resnick is an educational psychologist who emphasises the importance of out of school learning. A recent study by Bill Lucas and Guy Claxton³⁴ brings the evidence together to make a powerful case for adopting different approaches. They make a case for reframing the discussion on skills in terms of developing dispositions and habits of mind³⁵.



34 » Bill Lucas and Guy Claxton (2010) *New kinds of smart*. Buckingham: Open University Press.

35 » The notes above refer to insights from research. There is also a long tradition of government reports that stress the importance of skills education, going back to the Hadow reports on *The Education of the Adolescent* (1926) and *The Primary School* (1931) which suggests that a good school 'is not a place of compulsory instruction, but a community of old and young, engaged in learning by cooperative experiment'. (1931: Introduction) It goes on to argue that 'the curriculum of the primary school is to be thought of in terms of activity and experience rather than knowledge to be acquired and facts to be stored'. (1931: Section 75). The Newsom Report, *Half our Future* (1963) looked at the education of pupils of less than average ability and argued that they should receive a greater proportion of educational resources. The Plowden Report's (1967) recurring themes are individual learning, flexibility in the curriculum, the centrality of play in children's learning, the use of the environment, learning by discovery and the importance of the evaluation of children's progress – teachers should 'not assume that only what is measurable is valuable.'

These research-based insights are complemented by the skills agenda that came out of the Qualifications and Curriculum Development Agency (QCDA). Recognising the importance of vocational education and that schools had a role far wider than the transmission of predetermined knowledge, the Government commissioned Mike Tomlinson to lead a review examining the ways that the offer to 14–19 year olds could be improved.

The review group proposed a diploma that would bridge the 'academic-vocational divide'³⁶. It recognised that youngsters needed to know what skills to deploy in what context and the diploma framework offered a wide range of contexts. Despite widespread support from industry, universities and the teaching profession, the diploma did not carry through into the English educational system. But it did give rise to a number of consultations with the various Sector Skills Councils as to the sorts of skills that were needed for 21st century citizens. The QCDA was charged to bring these together into a single framework.

36 » www.tinyurl.com/c78mhsn

What emerged was the Personal Learning and Thinking Skills (PLTS)³⁷, the essential skills for work and general learning. The PLTS framework comprised six groups of skills that, together with the Functional Skills of English, mathematics and ICT would prepare learners to confidently enter work and adult life as confident and capable individuals.

These studies, reports and insights into skills education form the intellectual context for the recommendations that follow. In the same way that science has moved on from the Enlightenment, linear model of knowledge, so has 21st century education enjoyed a parallel shift. No longer do we see learners as recipients of pre-defined knowledge; rather they are the co-constructors of a diverse range of interconnected knowledge, habits and dispositions that empower them to operate creatively and effectively in the world outside school.

37 » These can be found on www.tinyurl.com/cwao2fm

Leadership

Below we lay out our future vision as to what skills development will look like as we move towards a new economy, to ensure the leaders of the future are skilled appropriately.

We need to support the learners of today to become:

Systems thinkers

At present much learning and training is specialist. Whilst specialist knowledge and technical skills will always be important it is essential to see the wood from the trees. Systems thinking at all levels enables people to take a broad, holistic view thus enabling them to make connections, see possibilities and to adapt in response to feedback. Systems thinking is at the heart of all learning.

Pro-active, independent enquirers

Small children are naturally inquisitive. As they progress through formal education and training this curiosity is burnished and encouraged. Learners and their teachers are rewarded for taking risks, for exploring issues from different perspectives and for making reasoned judgements.



Self-managers

Learners organise their own time, establish their own priorities and are able and willing to change in the light of feedback. They look actively for fresh opportunities, and manage their own learning to be able to rise to new challenges.

Creative innovators

No one has the monopoly of wisdom. As we explore the era post cheap oil and materials with its new and challenging predicaments, education and training aim to develop creative people who can reframe the way we think, come up with novel ways of optimising systems and creating multiple benefits for a wide range of stakeholders.

Team workers, effective participators and empathetic colleagues

People are social beings and formal education empowers learners to be empathetic, to respect the views of others and to contribute their own views, knowledge and skills clearly and with confidence. For this they need mastery of language and mathematics. They are able to work collaboratively and resolve disputes in which they are themselves a party.

Reflective practitioners committed to lifelong learning

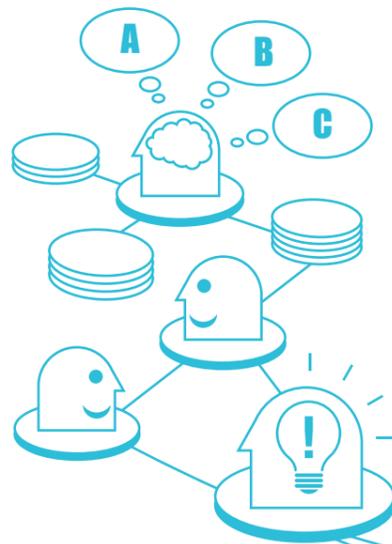
Feedback loops are essential to all meaningful learning. Learners develop the habits of self-monitoring and reflection, listening to and offering constructive criticism, and making changes. Learners also seek mentors who provide external perspective and counsel against tunnel thinking by providing context which may be missing from the learner's viewpoint.

Highly adaptive

The future is unknown and 21st century learners need to be flexible and to have wider strategies expanding their intelligence and for changing their habits of mind³⁸.

For businesses, the development of such skills will often require ongoing professional support (via a specialist training provider or NGO) at all levels of management, from directors through to customer-facing staff.

If businesses are to make long-term investments in the transition to a circular economy and to develop the corresponding skills of their employees, they require a high degree of certainty. The most important role that Government can play is to lead by example (such as through its procurement decisions) and by providing clarity on policy direction, avoiding sudden shocks or retrospective changes to regulations.



³⁸ » See Bill Lucas and Guy Claxton (2009) *Wider skills for learning*. Centre for Real World Learning and NESTA.

Communication

A new economy is emerging based on design and innovation with significant opportunities for those with the right skill sets. This must be communicated as a positive transition that inspires both the current workforce and the next generation of business leaders.

The world is facing a number of enormous challenges over the next fifty years as it tries to evolve from a consumption-driven economy, to a new, sustainable economy. The leaders of today are just starting to grapple with the challenges; it will be the leaders of tomorrow who have to deliver the solutions to overcome them. Our job is to inspire these new leaders to seize the opportunities these challenges present.

Paul Polman
Chief Executive, Unilever

The Government also has an important role. The new economy has the potential to be a major source of wealth and employment. These benefits will need to be communicated effectively to the general public, so that the transition becomes accepted as a positive change. Strategies must be put into place which address occupational shifts, facilitate upskilling at a local level and provide social protection.

To develop and share this vision we must rethink learning and pedagogy. *How* children learn is as important as *what* they learn. Based on the rationale outlined above in the Leadership section, we anticipate that learning in a circular economy will have inter alia the following characteristics:

Learning in real contexts

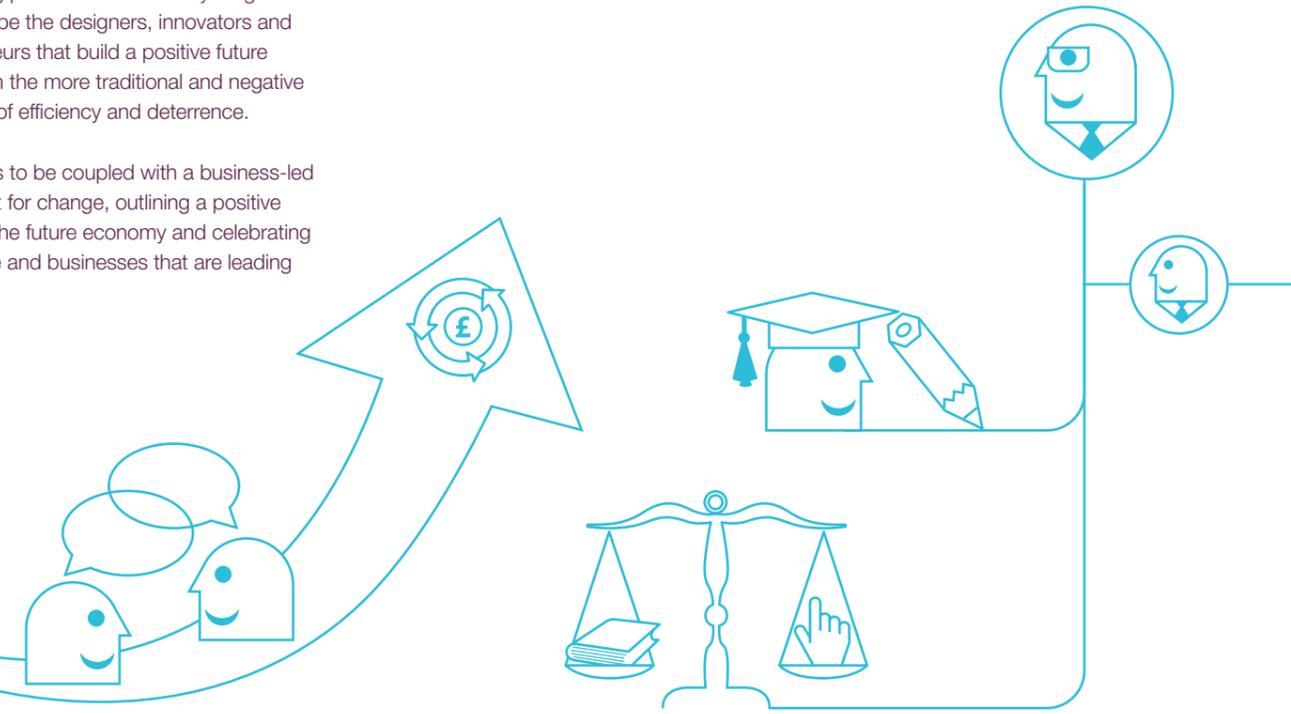
Real issues and problems are stimulating to learners of all ages. Ideally the learners are 'on site' engaging with the professionals; alternatively communication can be via video links or the professionals can come into the classroom. The whole distinction between the classroom and the outside world is breaking down. Theory takes wings as it is developed in real contexts.

Learning through doing

Current research is showing that the practical and cognitive develop hand in hand, each enhancing the other. When they are combined learning goes deeper. As Jacob Brownowski said, "The hand is the cutting edge of the mind." There is a synergistic interaction between theory and practice and neither is seen as prior to the other.

The opportunities associated with a circular economy and redesigning the industrial system are genuinely exciting. There needs to be much more focus by learning providers to enthuse young people to be the designers, innovators and entrepreneurs that build a positive future rather than the more traditional and negative concepts of efficiency and deterrence.

This needs to be coupled with a business-led movement for change, outlining a positive vision for the future economy and celebrating the people and businesses that are leading the way.



Communication

» **Problem-based learning**
Learners develop skills, knowledge and understanding through being confronted with open-ended problems or predicaments for which they are invited to search for ways of optimising the system or systems, thereby providing multiple benefits to a range of stakeholders.

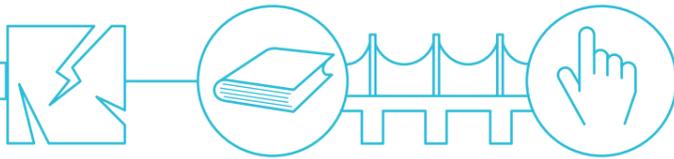
» **Project-based learning**
The normal form of skills development is through projects that can be individual or team. Project management is the responsibility of the learners, who plan and work to deadlines. Staff act either as consultants or mentors. Learners develop and apply their own assessment criteria as well as recognising external criteria.

» **Peer-to-peer learning**
In most groups there is a large amount of knowledge which when pooled can be a community asset. In developing skills for the circular economy the learners share knowledge, insights and techniques and look to each other for support rather than expecting the teacher or instructor to supply everything.

» **Trans-disciplinary learning**
Learners recognise that all areas of knowledge and skill are inter-connected. They seek useful and relevant information from a wide range of disciplines and train themselves to look for insights from areas that are not immediately obvious. Knowledge is synthesised from a variety of sources.

» **Learning to bridge theory and practice**
The strands above are based primarily on experiential learning methods. Yet systematic knowledge remains crucial and students need to reflect on their experiences to extract meaning and to relate their learning to the relevant theory behind it. This is achieved through models and explanations to get a handle on the theoretical underpinnings³⁹.

» **Learning through the 'flipped classroom'**
Combining the best of digital technology and the best of learning students will increasingly learn through virtual environments. This is an overarching approach that is helping to redefine the relationship between teachers and learners⁴⁰.



³⁹ » See Bill Lucas and Guy Claxton (March 2010) *New Kinds of Smart How the Science of Learnable Intelligence is Changing Education*.

⁴⁰ » See for example www.tinyurl.com/66bdt4r

⁴¹ » Taddei, F. (2009) *Training creative and collaborative Knowledge Builders: a major challenge for 21st century education*. Paris: OECD.

Conclusion

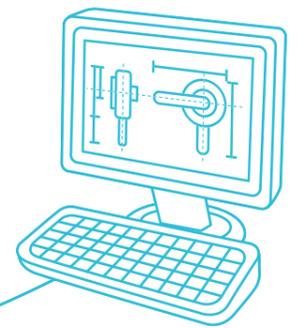
Systems thinking must lie at the heart of education and learning.

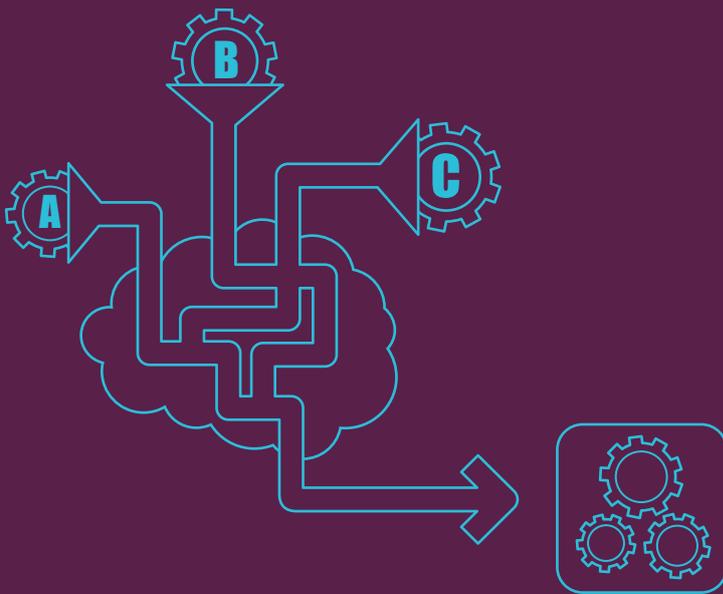
It is a platitude to assert that change is omnipresent, rapid and challenging. It is both the character and depth of this change which is of interest in the early decades of this century.

In this short paper we argue that we must not mistake changing technologies and their impacts on employment, skills and certification needs – significant that they are – for changes which are more deeply rooted, which speak to what we mean by a 'worldview.'

This bears on our frameworks for thinking; about science and the rise of dynamic systems perspectives; and the consequent need for 'creative, collaborative knowledge building'⁴¹. It bears on changing societal narratives around notions of progress and prosperity.

Skills changes which are implied by a transition to a new economy in turn must profoundly shape thinking around the most appropriate arrangements for education and training as we move on into the century.





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