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Innovation and Knowledge Management

Recognition of the key role of research and knowledge management in educational practice and policy making is in general recent. The volume of relevant educational research and development (R&D) tends to be low, despite education being so explicitly about knowledge, and there has been only weak capacity to develop and exploit the knowledge base on which to build improved practice and effective policies. A great deal of educational change is still shaped by short-term considerations despite education's fundamental long-term mission and nature. Improving the knowledge base and fostering innovation have been the aims of policy in a number of countries. Within the OECD, analyses of educational R&D systems, knowledge management, innovative practice including using technology, systemic innovation, futures thinking, and evidence-informed policy and practice, have all been prominent. Analysis has also focused on the so-called 21st century skills, seen as fundamental to innovative and creative societies.

INTRODUCTION

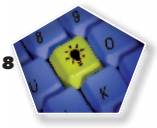
Innovation is a longstanding focus of educational work at the OECD - the Centre for Educational Research and Innovation (CERI) was founded over 40 years ago. This Centre has provided the educational contribution to the OECD-wide "Innovation Strategy", which focus continues. Recently-completed work on "New Millennium Learners" looked especially at how education systems can best use and develop the skills for technology, including through technology-rich innovation. *PISA 2009 Results: Students Online* complements this by providing a comparative insight into the digital competence of students. The "Innovative Learning Environments" project has compiled and analysed examples of innovations that reconfigure the way that learning takes place and in future will investigate effective strategies for scaling and sustaining 21st century learning environments.

Recognition of the key role of research and knowledge management in educational practice and policy making has been growing but still tends to be weakly developed. In many countries, there has been only limited capacity to develop and exploit the knowledge base on which improved practice and effective policies can be based. The volume of relevant educational research and development (R&D) tends generally to be low, despite education being so explicitly about knowledge. Similarly, a great deal of educational change is still shaped by short-term considerations despite education's fundamental long-term mission and nature. Educational R&D systems, knowledge management, futures thinking, and evidence-informed policy and practice, have all been prominent aspects of the research and innovation work of the OECD in education.

KEY FINDINGS

For a person, organisation, economy or society to be innovative requires wide-ranging skills, including "soft skills", raising questions about how effectively education systems foster them: Innovation covers a wide range of activities, from invention and breakthroughs, to implementation and minor improvements. It therefore necessitates a wide variety of skills:

- **Basic skills and digital age literacy:** Reading, writing and numeracy, and the skills to use digital technology, and to access and interpret information.
- **Academic skills:** Languages, mathematics, history, law and science, these skills are generally obtained through the education system and are transferable across different situations.
- **Technical skills:** The specific skills needed in an occupation, maybe both academic and vocational, as well as knowledge of certain tools or processes.
- **Generic skills:** Skills of this sort commonly are seen to include problem-solving, critical and creative thinking, ability to learn, and ability to manage complexity. A skill such as problem-solving may be considered as transferable, but some argue that it is also firm-specific.
- **"Soft" skills:** Working in teams and heterogeneous groups, communication, motivation, volition and initiative, the ability to read and manage one's own and others' emotions and behaviours, multicultural openness, and receptiveness to innovation.



- **Leadership:** Related to "soft" skills, these include team-building and steering, coaching and mentoring, lobbying and negotiating, co-ordination, ethics and charisma.

The OECD Innovation Strategy: Getting a Head Start on Tomorrow, 2010, Chapter 3

Schools are conventionally poor at using the key motors of innovation – research knowledge, networking, modular restructuring, technological advance: OECD work on knowledge management has identified four key "pumps of innovation":

- **The "science-based" innovation pump**: Education has not traditionally made enough direct use of research knowledge, and there is often cultural resistance to doing so. This is increasingly being targeted in reform.
- **The "horizontally-organised" innovation pump:** There are obvious benefits in terms of teachers pooling their knowledge through networks, but incentives to do so remain underdeveloped. There is need to tighten the "loose coupling" between the single teachers, individual classrooms and individual schools that so characterise school systems.
- **The "modular structures" pump:** This is about building complex processes from smaller sub-systems that are designed independently, but function together. Education is accustomed to working in modules, but much of it involves schools or teachers operating separately from each other.
- **The "information and communication technologies" (ICT) pump:** There is a powerful potential for ICT to transform education, but its use in schools remains underdeveloped, partly because the main *modus operandi* of school administration and instruction are resistant to change.

Innovation in the Knowledge Economy: Implications for Education and Learning, 2004, Chapter 2

The growing focus on educational outcomes has resulted in both an explosion of evidence of different kinds and a policy thirst for the results of educational research: There is a mounting preoccupation with what happens as a result of educational investments and participation, rather than the primary focus being on these inputs. Outcomes cover not only course completion and qualifications, but also skills and competences (as with the PISA surveys), access to and success in the labour market, and wider social outcomes, such as health and citizenship, attributable to education. There has been a huge expansion of evidence resulting from the growing volume of testing and assessment activities. As policy increasingly focuses on what education actually delivers, so is there interest in the information coming from research, but we know too little about how this evidence is used and whether it is used effectively.

Evidence in Education: Linking Research and Policy, 2007, Chapter 1

For most OECD countries, it has become clear that *promoting* the use of evidence in policy making is not the same thing as *ensuring* its use: The limited time and capacity of policy makers, the need to build on consensus and incorporate public opinion, and

the interaction among different forms of knowledge when determining the best course of action are all limitations to the effective uptake of research. In addition, the analytical capacity of organisations to use complex and multiple sources of information is influenced by institutional culture and the importance given to using research (including the role of media). Governments committed to using research evidence in policy-making must address the individual and organisational barriers to doing so.

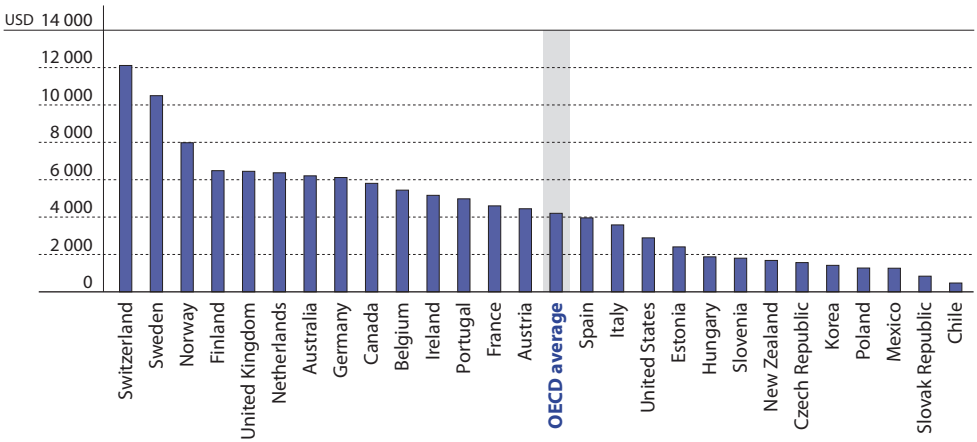
📖 "Exploring the Complex Interaction Between Governance and Knowledge in Education", *OECD Education Working Papers*, No. 67, 2012

On average OECD countries spend close to a third of their annual expenditure per tertiary student on R&D: In 2009, expenditure on R&D represents on average 31% of total expenditure per tertiary student across OECD countries. These levels vary widely: from 40% or more of total expenditure per tertiary student in Norway, Portugal, Sweden and Switzerland to less than 15% in Chile, Korea, the Slovak Republic and the United States. Even where R&D is less than 40% of expenditure at the tertiary level, this represents a considerable amount. For example in the United Kingdom, 39.5% of expenditure amounts to more than USD 6 400 per student. The OECD countries with highest R&D activity in tertiary educational institutions (e.g. Portugal, Sweden and Switzerland) tend to report higher expenditure per student than those in which a large proportion of R&D takes place in other public institutions or in industry (e.g. the United States).

📖 *Education at a Glance 2012: OECD Indicators*, 2012, Indicator B1

Figure 8.1.

Annual expenditure on R&D per tertiary student in OECD countries (2009)

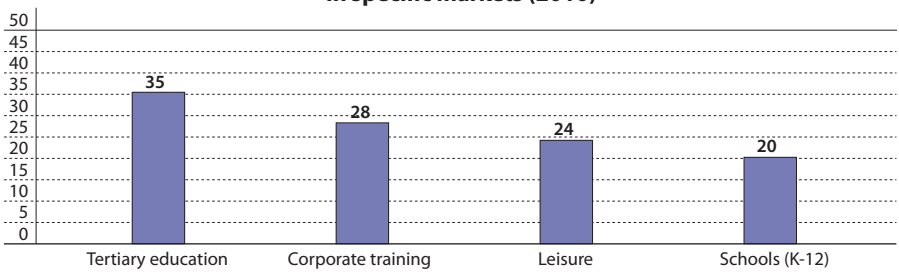


Source: OECD (2012), *Education at a Glance 2012: OECD Indicators*, OECD Publishing. Table B1.2. See Annex 3 for notes (*www.oecd.org/edu/eag2012*).

Box 8.1. **Innovative educational technologies**

Information and communication technology (ICT) is a source of innovation in education systems: ICT offers potentially a wide range of new tools and instruments to change the technological, organisational and institutional foundations of the education sector. Education has tended to be slow to generate and exploit innovations to improve practices but an educational tool industry is now emerging: the spread of small firms specialised in inventing and commercialising (mainly ICT-based) instruction technologies.

Number of top 50 companies with a specialised education patent portfolio in specific markets (2010)



Source: Foray, D. and J. Raffo (2012), "Business-Driven Innovation: Is It Making a Difference in Education?: An Analysis of Patents", *OECD Education Working Papers*, No. 84, OECD Publishing.

Analysis of education-related patents over the past 20 years shows a clear rise in the production of highly innovative educational technologies by businesses, typically building on advances in information and communication technology.

Yet, the emerging educational tool industry currently targets other markets than the formal primary and secondary education sector. An in-depth analysis of the top 50 specialised companies in patenting educational tools revealed that 35 out of the top 50 specialised firms operate in the tertiary education market, while only 20 operate in the schooling sector. Fewer companies commercialise their inventions in the formal primary and secondary education system than in the other market segments. This market does probably not satisfy most conditions for attracting and sustaining strong entrepreneurial activity. Could the public school system better exploit the opportunities offered by the development of a tool industry? Is there enough innovation friendliness in the public sector in terms of management practices, governance and culture, as well as funding and resource allocation logics? These are some of the issues for education decision-makers to address.

Foray, D. and J. Raffo (2012), "Business-Driven Innovation: Is It Making a Difference in Education?: An Analysis of Patents", *OECD Education Working Papers*, No. 84, OECD Publishing.

Over the past decade, many countries have implemented one-to-one computing initiatives in education to provide young people with ICT skills, reduce the digital divide, and enhance educational practice and achievement. OECD analysis shows that:

- Despite the large sums of money invested, **there is little evidence about the cost-effectiveness of these initiatives.** Every one-to-one programme should be evaluated from the beginning of the process in ways that are coherent with the goals and design of the initiative.
- The presence of ICT devices **does not necessarily change teaching and learning strategies,** and the use of ICT devices in 1:1 initiatives varies widely. Teachers need clear goals and specific support to incorporate learning technologies into innovative pedagogical practices.
- **Evaluations point to a positive impact of 1:1 computing on ICT skills and writing,** but more modest positive evidence regarding other academic domains such as mathematics.
- **Large-scale 1:1 initiatives could limit the first digital divide in the access to ICT at home and in school.** The globalisation of 1:1 initiatives could help reduce the digital divide between developed and developing countries.
- **A second digital divide emerges in school when all the learners have access to ICT devices.** More evidence is necessary about how ICT are used in class and its impact on achievement.

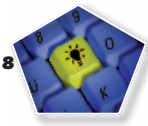
"1-1 in Education", *OECD Education Working Papers,* No. 44, 2010

There is widespread development and activity in open educational resources (OER): OECD countries are mostly active with OER by involvement with specific projects or programmes or through the initiative of institutions or engaged individuals. The most frequently-cited policy reason for OER activity is the desire to increase access to high-quality learning materials. Several countries, especially those with federal systems, indicate that they have insufficient knowledge about the OER activities in their educational institutions. In contrast to the understanding that situates OER mainly on the post-secondary educational level, OER activity was spread more widely across the educational spectrum.

"Open Educational Resources: Analysis of Responses to the OECD Questionnaire", *OECD Education Working Papers,* No. 76, 2012

OECD work on *New Millennium Learners* has provided insights into how best use and develop the skills for technology, including through technology-rich innovation:

- **The knowledge economy and society are permeated and supported by connectedness and technology:** This has important implications for education, firstly, because education has to equip younger generations with the range of skills that are demanded by a knowledge economy, and second, connectedness plays a crucial role in new forms of socialisation and identity formation.



- **In OECD countries, a large majority of young people, starting at an increasingly early age, already benefit from connectedness:** Younger people have a greater range of digital technologies at home, have higher levels of Internet self efficacy, multi-task more, and use the Internet for fact-checking and formal learning activities.
- **Being more connected is not always a good thing;** what matters is what young people do while they are connected.
- **Young people's expectations and behaviours in relation to technology use or connectivity in education are not changing dramatically:** Learners are not always comfortable with innovative uses of technology in formal education despite their social practices outside of education. They **do** expect technology to be a source of engagement, to make school or academic work more convenient, and to make them much more educationally productive.

Connected Minds: Technology and Today's Learners, 2012, Chapter 8

POLICY DIRECTIONS

The OECD's horizontal "Innovation Strategy", in considering how people can be empowered to innovate, concluded with a set of "policy principles" about education and training systems, and innovative workplaces. These tend to parallel closely more general conclusions about education and training policy:

- **Equip people with skills for innovation:** Ensure that education and training systems are adaptable, and can accommodate the changing nature of innovation and the demands of the future. Curricula and pedagogies should develop the capacity to learn new skills and take full advantage of information and communications technologies.
- **Improve educational outcomes:** A considerable share of children still do not complete upper secondary education or leave schools with poor literacy and numeracy skills. While virtually all young people in OECD countries have access to at least 12 years of formal education, mechanisms are needed to ensure that solid educational foundations are universal.
- **Continue to reform tertiary education systems:** Public authorities should enable tertiary education institutions to become catalysts for innovation, notably in their local and regional settings. While the steering role should be reserved for government, institutions should have considerable room for manoeuvre. The tertiary sector also needs to retain sufficient diversity to respond to future needs in the innovation system.
- **Connect vocational education and training to the world of work:** This requires a good balance between occupationally-specific skills that meet employers' needs and generic transferable skills that equip graduates for lifelong learning and mobility.
- **Enable women to play a larger role in the innovation process:** Although female educational attainment tends now to outstrip that of men, the tax and benefit systems, and workplace practices and childcare are key to fuller engagement by women in the labour force and innovation.

- **Support international mobility:** Policies should support knowledge flows and the creation of enduring linkages across countries. Migration regimes for the highly skilled should be efficient, transparent and simple; enable short-term movements; and support connections to nationals abroad.
- **Foster innovative workplaces:** Employee involvement and effective labour management help to foster creativity and innovation, and employment policies should encourage efficient organisational change. Learning and interaction within firms are key to their innovation performance; governments may also shape national institutions to support higher levels of employee learning and training.

The OECD Innovation Strategy: Getting a Head Start on Tomorrow, 2010, Chapter 3

Effective decision-making means to be informed as far as possible by evidence, with educational professionals working in a "knowledge-rich" environment: There is need for better links between educational research, policy and practice, and for further progress towards making education a knowledge-rich profession. Greater access to web-based information goes hand-in-hand with less quality control, alongside a shift in most OECD countries towards more decentralised decision-making in education. Given greater information, less quality control, a more informed public and a greater diversity of policy-makers, the need for clear, reliable and easily available evidence on which to base decisions has become more important than ever before, as has the need to find mechanisms to obtain reliable answers to pressing policy questions.

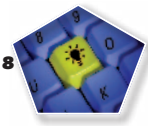
Evidence in Education: Linking Research and Policy, 2007, Chapter 1

Create and encourage knowledge brokerage in education systems: Brokerage agencies are increasingly important to encourage dialogue between policy-makers, researchers and educators, and to build capacity to evaluate what does and does not work. An important first step is to create a database of quality research on key topics of interest to policy makers, and to provide clear goals for conducting and evaluating educational research. A key component of these brokerage agencies is the transparent exchange of findings with their methodologies clearly defined, with commitment to update and maintain state-of-the-art syntheses on core topics. And, all centres should seek to disseminate to as wide an audience as possible in order to effect both top-down and bottom-up change.

Evidence in Education: Linking Research and Policy, 2007, Chapter 1

Governments can foster investments and stimulate the production of digital learning resources (DLRs) both by commercial companies/publishers and users by:

- **Offering seed money, supplemented with development and transition funds:** The production of DLRs can be stimulated by offering public tender seed money to publishers, supplemented by development project funding and support to help keep innovations afloat once the initial project funding has ended.



- **Promoting co-operation between public and private players for DLR development:** Governments can encourage companies to develop corporate social responsibility programmes and to increase co-operation with public authorities in education. Schools and local educational authorities will need guidelines on how best to approach such co-operation.

📖 *Beyond Textbooks: Digital Learning Resources as Systemic Innovation in the Nordic Countries,* 2009, Chapter 7

A systemic approach to innovation in VET is urgent: Precisely in times of economic crisis, innovation is increasingly a key factor, not only for economic growth, but also for social welfare. A recent study of systemic innovation in the VET sector suggested the following guiding policy principles:

- Develop a systemic approach to innovation in VET as a guiding principle for innovation-related policies.
- Promote a continuous and evidence-informed dialogue about innovation with the VET stakeholders.
- Build a well-organised, formalised, easy to access, and updated knowledge base about VET as a prerequisite for successfully internalising the benefits of innovation.
- Supplement investments in VET innovations with the necessary efforts in monitoring and evaluation.
- Support relevant research on VET according to national priorities and link these efforts to innovation.

📖 *Working Out Change: Systemic Innovation in Vocational Education and Training,* 2009, Chapter 10

Create an effective interface between innovation and higher education systems: Such an interface is needed in order to reap the benefits from public and private investments in research, and to ensure the vitality and quality of higher education systems. Directions for creating such an interface include:

- **Improve knowledge diffusion rather than commercialisation via stronger intellectual property rights (IPRs):** Innovation is not only a discovery process to then be commercialised but R&D is often problem-solving along a pathway of innovation. The diffusion capabilities and support activities of tertiary education institutions may thus be as important as discovery processes, and should be promoted by policy.
- **Improve and widen channels of interaction, and encourage inter-institutional collaboration**: Linkages between the tertiary education sector and other actors in the research and innovation system, such as firms and public research organisations, need to be actively developed to ensure effective knowledge diffusion. When programmes are designed, they need to consider the engagement of small- and medium-sized enterprises from all technological sectors as they tend to be under-represented in such collaborations.

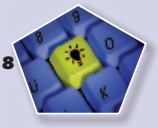
- **Foster mobility across the research and innovation system**: Inter-sectoral mobility is one of the main vehicles for knowledge diffusion; mobility between firms, tertiary education institutions and public research organisation should be actively promoted.

Tertiary Education for the Knowledge Society: Volume 2, 2008, Chapter 7

OECD work on ICT and education has provided policy pointers for educational systems looking to scale up technology-based innovations to improve learning, especially regarding knowledge needs:

- **Develop a systemic approach to knowledge about technology innovation,** with an evolving framework for sustaining both top-down and bottom-up technology-based innovations and appropriate capacity building.
- **Promote a continuous and evidence-informed dialogue about innovation with stakeholders in the field:** policy debate needs to be informed by evidence, presupposing that all stakeholders share a minimum capacity to engage in it.
- **Build a well-organised, easily accessible, and up-to-date knowledge base about technology in education, as a prerequisite for successfully internalising the benefits of innovation:** existing facilities or mechanisms may be used or else set up new measures to reflect the increased priority for technology-based innovation in education, such as dedicated research centres, networks or prioritised calls.
- **Supplement investments in technology-based innovations with the necessary monitoring and evaluation:** Public governance and accountability require mechanisms and procedures to critically approach both bottom-up and top-down innovations. Empirical assessments can contribute to informing decisions about scaling or diffusing innovations, instilling a culture of output-oriented innovation, getting value for money, and obtaining feedback on policy measures intended to foster innovation.
- **Support relevant research on technology in education according to national priorities and link these efforts to innovation:** Education systems would greatly benefit from a national system of educational research on technology.
- **Ensure that technology-based innovations do not reinforce existing digital divides or create new ones:** Computer use amplifies a student's academic skills and competences, and these competences are related to the student's social, cultural and economic capital. This becomes the more serious as access to computers and broadband internet connection has become quasi-universal.
- **Align or embed strategies for technology-based innovations with national policies for educational quality and equity:** Having a separate technology strategy for education can be valuable to signal its importance but to be sustainable it will need to be well aligned with national policies for quality and equity in education and become a means to the end of good learning rather than an end in itself.

Inspired by Technology, Driven by Pedagogy: A Systematic Approach to Technology-Based School Innovations, 2010, Conclusion



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