

Improving the professional knowledge base for education: Using knowledge management (KM) and Web 2.0 tools

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Brief Bio

Before returning to academic work at Brunel University, Marilyn Leask worked on knowledge management projects in two central government agencies in the UK. She was previously Head of Knowledge and Learning at the Improvement and Development Agency for local government (UK) with responsibility for developing a knowledge management strategy for local government and with developing and launching the successful online communities of practice for local government in the UK www.communities.idea.gov.uk. Prior to that she was Head of Effective Practices and Research Dissemination at the Training and Development Agency for schools, UK where she was responsible for using new technologies to make the evidence base for teaching available through the internet.

She is well known for her work on knowledge management and harnessing communication technologies in building the evidence and knowledge base for teacher education. [Her current work includes developing national and international models for scaling up promising small scale research.](#)

Her specialist areas are teacher education, change, improvement and development across large systems particularly through online networking and knowledge sharing, the development of approaches supporting evidence-informed policy and practice, and the use of ICT in education.

She has worked as an academic, researcher and manager in secondary schools, local authorities, universities and two national agencies.

She is co-editor of the Learning to Teach in the Secondary School series of text books which are widely used for teacher training and which cover all subjects. The fifth edition was published in 2009. She has led research projects in a number of countries as well as within the UK. At Brunel, she leads the Professional Development and Policy Research Group which includes teams working on Identities, Models of Teacher Education and Pathways to Learning as well as the use of ICT to support professional development and learning.

IMPROVING THE PROFESSIONAL KNOWLEDGE BASE FOR EDUCATION: using Knowledge Management (KM) and Web 2.0 ⁱⁱ tools

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ABSTRACT

Improving education systems is an elusive goal. Despite considerable investment, international studies such as the OECD Teaching and Learning International Survey (TALIS) project and the McKinsey Report *How the world's best performing schools come out on top* indicate that improving teacher quality is more important than increased financial investment. Both reports challenge governments, academics and practitioners to adopt new ways of sharing and building knowledge.

This paper makes the case for national education systems to adopt tried and tested knowledge management and web 2.0 tools used by other sectors and highlights the neglected potential of teacher educators as agents for improvement.

INTRODUCTION

“The challenges facing education systems and teachers continue to intensify. In modern knowledge-based economies, where the demand for high-level skills will continue to grow substantially, the task in many countries is to transform traditional models of schooling ...into customised learning systems that identify and develop the talents of all students. This will require the creation of “knowledge-rich”, evidence-based education systems, in which school leaders and teachers act as a professional community with the authority to act, the necessary information to do so wisely, and the access to effective support systems to assist them in implementing change...The results from TALIS [OECD’s Teaching and Learning International Survey] suggest that, in many countries, education is still far from being a knowledge industry in the sense that its own practices are not yet being transformed by knowledge about the efficacy of those practices. The 23 countries that have taken part in TALIS illustrate the growing interest in the lessons that might be learned from teacher policies and practices employed elsewhere.”

OECD, 2009a p.3

These statements from the OECD Teaching and Learning International Survey challenge national systems to consider the processes in place for building and accessing the knowledge base for educational practice and policy making and to consider the quality of key levers for change in the system i.e. the quality and extent of the knowledge base and the quality and training of teacher educators.

This paper makes the case for national and international policy makers to act to provide an e-infrastructure to support education becoming a ‘knowledge industry’, and to support knowledge transfer, collaborative knowledge building and sharing within education sectors in individual countries as well as worldwide.

Knowledge management (KM) tools and web 2.0 tools are being adopted widely by private companies and other public sector organizations as ways of improving practice. This paper presents a model for KM using web 2.0 in the education sector (see Figure 1). The paper challenges all educational stakeholders to adopt new conceptual models for improving the quality of education based on well tested online systems and knowledge management (KM) tools (Collison and Parcell, 2006; Davenport and Prusak, 2000; Davies et al, 2000; Henley, 2008 a, b; Howard et al, 2005; Newman and Holzman, 1997).

A review of policy papers and models for what constitutes high-quality education systems from a number of countries indicates that there is agreement that teaching quality and teacher education are key components in improving the quality of education (Australian government DEEWR, 2007, 2010; GTCE (UK) 2006, 2007; Indian government NCTE, 2010a, b; China Education and Research Network, 2000; Ming-yuan, 2006; OECD, 2003, 2007b,c; UNESCO, 2010 a, b.; U.S. Department of Education (2006), UK DCSF, 2006).

However, the quality of the professional knowledge base which teachers and teacher educators draw upon is rarely discussed nor are the training needs and qualifications of teacher educators.

Existing models for system improvement assume that teachers and teacher educators have easy access to a high quality professional knowledge base. Professional knowledge which provides the foundations of practice seems to be treated as a 'magic ingredient' which does not require discussion, systematic management, renewal, coordination, resources or support.

This paper draws on evidence from innovative national KM projects to challenge such assumptions and challenges key stakeholders – teachers, teacher-educators, researchers and regional and central government officers- to develop new ways of working which include the use of knowledge management and e-tools to support the development of and access to a high quality evidence-based professional knowledge base.

Such a professional knowledge base would provide practitioners with access to validated evidence in a usable form which would answer teachers' research questions and provide research to inform practice in classrooms, in initial teacher training (ITT) and continuing professional development (CPD).

This paper identifies opportunities for national and international provision of e-infrastructures which support access to evidence and building the evidence base for educational practice. The paper also identifies ways in which other public sectors are developing such provision leaving the education sector lagging behind by decades.

THE EVIDENCE BASE FOR THIS PAPER

The author has had senior positions in system improvement, research and knowledge management in two UK government agencies and has returned to academia to undertake research into the use of emerging technologies that support improvement in quality education systems.

The paper draws together research identifying factors which matter most in the improvement of education systems specifically in teacher development and discusses how e-systems and KM

tools could help improve quality for each of these factors (Becta, 2010, GTCE, 2006, 2007; IDeA, 2008, 2009). As well as research published by many others (see references), this paper considers the work of various national committees in England of which the author was a member when working for central governmentⁱⁱⁱ, the outcomes of projects she initiated while at the UK agency the Training and Development Agency for schools, for example with all major subject associations (see subject resource networks on www.ttrb.ac.uk) as well as research and development undertaken by the author (see Acknowledgements) over the last twenty-five years:

- into knowledge management practices when responsible for the knowledge management strategy at the UK national agency for local government - Improvement and Development Agency for local government (IDeA, www.idea.gov.uk)(IDeA, 2006, 2008, 2009)
- into the knowledge base underpinning teacher training whilst head of effective practices and research dissemination at the UK government agency, the Training and Development Agency for schools (TDA) (Leask and White, 2004; Leask 2004a, 2004b; Newman et al, 2004; UK TDA, 2002), and
- funded by the European Union, British Council, charities, Organisation for Economic Co-operation and Development (OECD) and the Department for International Development and various companies (Leask and Younie, 2001, 2002; Leask and Pachler, 1997).

Systematic reviews of the evidence base for educational practice and other research commissioned by the author in her national role at the UK TDA (see EPPI reviews www.eppi.ioe.ac.uk; Oakley, 2003) showed that for the most part the current processes for generating educational research are not favourable to generating research significant enough for national policy makers to pay attention to the outcomes nor for practitioners to change practice. Clearly there are exceptions, but examples of weaknesses revealed through this work are as follows. These include:

- a lack of coherence in research into effective teacher education and classroom practice and the lack of research in subject specific pedagogy and special educational needs. The UK national SEN professional association, nasen, identifies more than 50 types of SEN the teacher may meet in their career yet knowledge about appropriate pedagogies for children with these needs is not easily available.
- considerable duplication particularly in generic topics within educational research, and systems which support the building of new research on the foundation of previous studies are underdeveloped. The Cochrane Collaboration in medicine provides an example of how this can be done.
- a huge volume of small scale research studies which whilst valuable for dialogue between academics and teachers involved, do not provide research findings substantial enough to warrant changes in practice nationally. For example 5000 articles, covering issues related to the teaching of primary modern foreign languages were found for one systematic review commissioned to inform the development of government policy. In these studies there was considerable duplication of effort and poor reporting of the evidence base for the findings presented. 18,500 articles relevant to autism have been identified by the UK charity dealing with this area.
- poor mechanisms exist to link up researchers working on the same topics.

- scaling up promising small scale research appears to need coordination. This could be a role for a recognised national/international professional body. Scaling up could be undertaken through using new technologies networking teacher educators and teachers.
- current publishing processes for academic research mean that it takes many years for outcomes to be published and for stakeholders in the sector to hear about new research findings
- current forms of reporting do not facilitate practitioners accessing research which answers the questions about effective practice they face on a day to day basis.
- the forms of publishing of research findings mean that the information required by users, policymakers, teachers or teacher educators is often inaccessible – see the later flow chart example from the international Map of Medicine.
- research rarely addresses the fine-grained questions teachers have about how to improve practice on a daily basis - with a particular child with a particular need in a particular subject, learning particular concepts or skills or acquiring particular knowledge and understanding or, overcoming needing to overcome particular barriers to learning.

These weaknesses probably exist because no organisations have responsibility for the strategic overview of the system for providing educational research related to practice. New technologies allow for low cost options for collaborative research across counties and indeed internationally. Outside of the education sector, organisations with KM strategies expect their staff to demonstrate four key KM behaviours i.e. to be able to find and use knowledge to build next practice and to create, share and manage knowledge for the benefit of the organisation or the sector (IDeA, 2008). Figure 1 shows national and international KM tools which could support these behaviours in education.

Insert Figure 1

In this paper the argument is made that well established e-systems and well known KM strategies used by other sectors and developing in some parts of the education sector have potential to remove major barriers which prevent educational research impacting positively on the professional practice of teachers and teacher educators.

IMPROVING THE QUALITY OF TEACHING – MOVING FROM EXHORTATION TO EVIDENCE

“Education reform is top of the agenda of almost every country in the world. Yet despite massive increases in spending ([in 2006], the world's governments spent \$2 trillion on education) and ambitious attempts at reform, the performance of many school systems has barely improved in decades.”

Barber and Mourshed, 2007, p.2

This statement is from the McKinsey report (2007) “How the best performing schools come out on top” which drew on a survey of top performing education systems around the world. (Detailed financial comparisons are available from the OECD (OECD, 2009b).

If, as the McKinsey report argues, money is not critical in improving quality, what are the components necessary for an education system to improve?

"The experiences of ... top school systems suggest that three things matter most:

- getting the right people to become teachers,
 - developing them into effective instructors; and,
 - ensuring that the system is able to deliver the best possible instruction for every child."
- Barber and Mourshed, 2007, p.3

Barber and Mourshed are not alone in identifying the quality of teaching as the single most important factor in improving outcomes for pupils. Improving the quality of teaching was stated as a high priority in the documentation from different countries analysed for this report (See for example the Australian government DEEW, 2007, 2010; Indian government NCTE, 2010a, b; China Education and Research Network, 2000; Ming-yuan, 2006; OECD, 2003, 2007a, b; UNESCO, 2010 a, b; U.S. Department of Education (2006), UK DCSF, 2006).

UNESCO makes a clear statement on behalf of UNESCO members on this issue:

"Teacher status and education are considered fundamental for the improvement of educational quality. This is the commitment of UNESCO State Members..."

UNESCO 2010a, p.1

Others make similar statements:

"Teacher education is the manufacturing machine for the Chinese education undertaking."

China Education and Research Network, 2000, p.1

"Teacher quality is essential for student achievement. In this modern era of global economic competitiveness, what teachers know and do to improve student achievement is of critical importance for maintaining America's economic strength."

US Department for Education, 2006, p.1

Knowledge transfer and ensuring universities engage with research users is also a priority in a number of countries (Proton Europe, 2007 (US overview); Australian government DEST (2005); Research councils UK (2010). E-systems and KM tools clearly have a key role to play in cost effective knowledge transfer. Yet in these reports, which identify the quality of teaching and teacher education as critical to raise pupil achievement and generally exhort teachers to improve practice, and university staff to work in knowledge transfer partnerships, there is little recognition of the opportunities provided through e-systems to support these desired changes. The quality and content of the professional knowledge base underpinning educational practice and teacher education, and the knowledge and training of teacher educators and the ways that knowledge transfer takes place, are taken as unproblematic as though these were magic static ingredients. There are of course many websites and documents giving teaching tips and advice to teachers (few giving advice to teacher educators). However a scrutiny of such advice as often as not reveals a lack of citation of any evidence. Yet in a number of countries policy documents set out an expectation that practice and policy will be evidence-based (OECD, 2007b, 2007c).

Action research is highlighted in the Australian government report 'Quality Teaching' as providing ways for teacher educators in universities and teachers in schools to collaborate over research. However, without more rigorous methods being used, action research will not have the impact it could have in providing structured and well written case studies which provide evidence for practice. Perhaps the legal profession's use of cases would have some lessons for education? Richards et al (2008) provide an interesting example of action research using structured replicable approaches. In the decades since the publication of Schon's (1987) and Stenhouse's (1975) seminal texts outlining how teachers and academics could collaborate on research, action research has become widespread but it would be hard to argue that it has made a major contribution to changing practice nationally. Unless models for action research are structured so that further studies can build on what has gone before (see Richards et al, 2008) the findings from this form of research will remain relevant just to the context in which it is undertaken and models for scaling up promising small scale research (Leask, 2010a) will remain undeveloped.

Few of the policy documents studied mention the crucial role of the quality of knowledge of teacher educators in initial and continuing professional development yet arguably this small group **provide key levers for change** in education systems influencing as they do the training of all teachers. A notable exception in the silences in documents about the key role of teacher educators is that the Indian Government (2010b) seems to recognise the role of teacher educators in whole system improvement through providing awards for leading teacher educators. Even the four year study on teacher education commissioned by the American Educational Research Association (Cochran-Smith and Zeichner, 2005) seems to gloss over the knowledge base of the teacher educators themselves. Sirotnik and associates (2001) among others identify a key role of teacher education in change in US schooling but don't question the extent and quality of the evidence-base for practice nor how teachers and teacher educators might access this.

THE PROFESSIONAL KNOWLEDGE BASE FOR EDUCATION - A MAGIC INGREDIENT IN SYSTEM IMPROVEMENT?

Treating the professional knowledge base of teachers and teacher educators in universities, local authorities and schools as a magic and unchangeable ingredient in the improvement of educational outcomes means that opportunities for significant improvement in the quality of teaching are missed. This attitude may be left over from the last century where the cost of research and the cost and time delay in print-based approaches meant that the development, testing and dissemination of ideas was a slow costly process. These constraints on expectations no longer apply: using e-tools such as online collaboration for the management of research projects over distance with co-researchers based in schools or other universities and communicating online through synchronous and asynchronous communication allows large scale research to be undertaken cost-effectively and in a timely manner – but this model of research and development requires changes in attitude and ways of working among all stakeholders (Leask, 2010a). Throwing technology at the problem however is not the answer. In the local government KM model discussed later in this paper (IDeA, 2006) proof of the online communities concept was gained through initial working with innovators and early adopters following Rogers theory of diffusion of innovations (1983) which has been found in other studies to be an effective way of introducing changes in practice (OECD, 2002).

Figure 2 (adapted from Leask and White, 2004) shows how new information technologies available in the 21st century provide a significantly different professional environment for research and for the generation, testing and publishing of new evidence based knowledge.

Insert Figure 2.

For most of the 20th century knowledge management practices in education were little different to those in the 19th century. Emerging models of action research and systematic reviews of evidence (EPPi centre www.eppi.ioe.ac.uk, Campbell collaboration, <http://www.campbellcollaboration.org/>) are attempts at providing an evidence base for educational practice but neither approach has, as yet, produced the evidence base required for practice nationally to be placed on a firm foundation. That e-communication systems have the potential to support knowledge sharing and knowledge creation between teachers, university staff, local authority staff as well as colleagues in central government agencies in new forms of partnership has wide recognition (Australian Government (2007); Becta (UK), 2010) but models for their effective use across an education system are as yet under-developed.

New ways of working between all partners in the education system are needed if the potential for e-communications to be used to support the development of a solid evidence base for practice is to be realised but developing these ways of working requires as Michael Barber says 'courageous steps' to be taken by those in national leadership positions (Barber 2009).

WHAT FORM OF NATIONAL E-INFRASTRUCTURE MIGHT SUPPORT IMPROVEMENT?

In this section, the key factors in system improvement identified by Barber and Mourshed (2007, p.3) are considered in the light of knowledge management strategies and e-communication opportunities: specifically

- teacher recruitment "getting the right people to become teachers" (and retention)
- developing effective teachers and providing the best possible teaching for each child.

Teacher recruitment "getting the right people to become teachers" (and retention)

UK research shows that a valued and valuable form of CPD for teachers is the opportunity to network with colleagues with similar concerns (Pickering et al, 2007; Bolam and Weindling, 2006) and evidence suggests this applies to e-networking (IDeA, 2009; Becta, 2010).

In research conducted in the UK in 2009 (Becta, 2010) teachers identified a 'professional' online environment as one allowing the individual teacher to find peers interested in similar issues, to work online to share ideas, documents, information, collaborate on projects with known colleagues rather than anonymous contributors and where academics, teachers, LA staff and policy makers might work together.

People being recruited to teacher training now in many countries will for the most part be familiar with “Facebook” type social networking technologies and will work in this way with colleagues using free and commercial environments if no professional networking software is provided. This means lost opportunities for networking with experts and peers and quality assured advice. Current commonly used free software such as Ning doesn’t allow connections across networks for peers, projects, experts and networks. See for example Classroom 2.0 <http://www.classroom20.com/> which at the time of writing has about 25,000 teachers registered, mostly in the USA. Oracle’s ThinkQuest (<http://www.thinkquest.org/en/>) is one of the large education networks and has around a million pupils registered but this focuses on projects rather than developing professional knowledge which is the focus of this paper. Some large commercial providers of social networking for teachers exist and a review of these by teachers (Becta, 2010) raised quality concerns particularly around anonymous advice and postings and the lack of private professional workspaces.

In knowledge management terms, these professional online networks facilitate the sharing of ‘tacit’ knowledge or knowledge held in people’s heads or being created through action of all participants as well as explicit or published knowledge. Taught CPD courses relying on explicit knowledge are always dealing with yesterday’s knowledge. Online networks which encourage collaboration can deliberately build next practice on the foundation of yesterday’s knowledge and incorporate tacit knowledge in the collaborative creation, sharing and testing of new knowledge. In evaluations of CPD programmes, teachers often cite ‘coffee break’ conversations as being particularly helpful – these professional conversations are an example of ‘tacit’ knowledge sharing.

An example of how e-communications and knowledge management strategies have been employed by the public sector as an aid to recruiting and retaining staff is provided by the local government sector in the UK. In local government, the need to provide a 21st century work environment to recruit the best graduates coupled with recognition of the power of networking as a form of CPD and improvement, led to the development of an online environment to support professional development and networking across local government.

The Improvement and Development Agency for local government (the IDEA^{iv}) created what has become a successful national online “Facebook” type environment improving communications and providing professional networking, (not just social networking) between local government employees regardless of location as well as to support knowledge and information sharing and the benchmarking of best practice (IDeA, 2006). Launched in 2007 and with, as at February 2010 50,000 members, 1000 communities, and around 2000 new members per month, local government employees can find peers or experts and professional networks within seconds. This initiative has won two e-government awards and continues to grow. Recent research (IDeA, November 2009) undertaken with a random selection of 1300 people registered to use the IDeA online communities shows a wide range of professional outcomes from engagement with these online communities. The research also identified key benefits as:

1. “Value through saving time
2. Keeping up to date with current thinking
3. Innovations
4. Sharing Good Practice / avoiding duplication of work

5. Developing Ideas
6. Carbon footprint reduction / environmental savings
7. Induction to new roles / staff development
8. Relationship Building”

IDeA, November 2009, p.5

The Education Network Australia (www.edna.edu.au) appears to provide similar functionality but an evaluation of the network was not found in time for inclusion in this paper.

Developing effective teachers and providing the best possible teaching for each child

Research indicates that effective lifelong learning for professionals requires access to knowledge, information resources and appropriate learning processes which allow co-construction of new knowledge through working with peers and experts (Pickering, 2007; Bolam and Weindling, 2006). Lave and Wenger (1991) Wenger (1998) and Wenger et al (2002) developed the concept of ‘communities of practice’ to describe this way of collaborative working.

The communications challenge for government departments responsible for improving the quality of education is how to identify and communicate latest practice to teachers in cost effective ways. A teachers' career may span 40 years or more so the need for updating can be significant. In addition, evidence about effective practice may not exist and may need to be created.

A test of whether sufficient and appropriate e-communication tools exist for the education sector is whether educators can

- keep up to date through accessing the knowledge they need to improve practice, at the time they need it and in the form they need it.
- work collaboratively with peers and experts to co-construct new knowledge as changing circumstances require.

But what kind of knowledge do educators need in order to prove practice? The types of professional knowledge required for teaching identified by Shulman and others is summarised in Table I and provides a useful reference for checking the quality of the education professional knowledge base.

The information in Table 1 illustrates the complexity, range and diversity of forms of knowledge a teacher requires. Different processes are used to access, renew and build different forms of knowledge with some types requiring interaction between experts and peers as professional knowledge is adapted for particular teaching contexts.

Table I Forms of Professional Knowledge for teaching (updated from Capel, Leask and Turner (2009, p.14) adapted from Shulman, 1987)

<p>1. (Subject) Content knowledge, i.e. the subject material that is to be taught. Schwab (1964) identifies two components of content knowledge: substantive: knowing what are the important concepts, and skills in the subject, and syntactic: knowing how the concepts and skills are</p>
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structured and organised within the subject.
2. General Pedagogic knowledge, i.e. the broad principles and strategies of classroom management and organisation that apply irrespective of the subject.
3. Curriculum Knowledge, i.e. the materials and programmes that serve as 'tools of the trade' for teachers.
4. Pedagogical content knowledge, i.e. the knowledge of what makes for effective teaching and deep learning that is the basis for the selection, organisation, and presentation of the content teachers want their pupils to acquire.
5. Knowledge of learners and their characteristics: knowledge of learners of a particular age range (empirical or social knowledge); and, cognitive knowledge of learners, comprising knowledge of child development and knowledge of a particular group of learners.
6. Knowledge of educational contexts, i.e. including a specific school, catchment area and the wider community and including the national and international contexts of current and emergent issues for education e.g. globalisation, citizenship, use of ICT to support learning.
7. Knowledge of educational ends (aims), purposes, values and philosophical and historical influences: both short and long term goals of education and of a subject.

Keeping up to date through accessing new knowledge

Prior to the internet, teachers typically initially acquired their professional knowledge through their initial subject specialist degrees and then through initial teacher training. Once they were in post, they may have had access to specialist colleagues within the school and formal CPD within the school, clusters of schools, the local authority or through a higher education provider or independent provider. Other providers of formal or informal CPD included organisations and people outside the school such as examination boards, professional associations, conferences, inspectors, local authority advisers, peers, print and video based sources including television, newspapers and specialist publications, government circulars and publications. These communication routes allowed explicit or published knowledge to be accessed.

Today, as well as these means of professional learning, online databases make access to published or explicit knowledge easier^v. However, much of the material is published in an academic form which is not easily usable for problem solving by professionals. New developments in the structuring of knowledge are demonstrated by for example, the Map of Medicine flow chart approach to providing practitioners with ways to access the knowledge they need in the form they need it (<http://healthguides.mapofmedicine.com/choices/terms.htm?next=/>). This provides an alternative way of constructing knowledge and communicating this which is not widely available in education. It was developed by doctors who were training doctors and although a private resource accessed through subscription, is now available to all doctors in countries where the health ministry takes out a national subscription.

Search tools need refining to provide access to fine grained knowledge teachers need to underpin practice and "text mining" pilot software looks promising in providing ways for practitioners to access more quickly, the knowledge they seek^{vi}.

Effective CPD: supporting collaboration and engagement in the creation of new knowledge

Co-construction of knowledge through online working is proving to be an effective way of creating next practice (Leask and Younie, 2001; Pickering et al, 2007). The importance of practitioner engagement in the creation of new knowledge and collaboration is confirmed in research on CPD commissioned by the General Teaching Council in England (Bolam and Weindling, 2006) which identified four characteristics of effective CPD that include elements of collaboration:

- Engagement in Research and Development: "Sustained interactions and interventions give more breadth and depth than short or one-off courses." GTCE, 2007, p.5
- Teacher influence: "The more influence teachers have over their professional development – and especially in tailoring CPD to meet their needs – the more likely they are to find it effective. More generally, the research lends support to the importance of designing CPD that holds teachers' professionalism and individual expertise as a central value." GTCE, 2007, p.5
- Personalisation: "Professional development programmes and opportunities should be designed to take account of the needs and priorities of teachers at different stages of their professional lives and careers." GTCE, 2007, p.5
- Collaboration and engagement through professional learning communities: "Schools should aim to become 'professional learning communities' in which there are opportunities for support staff and non-teaching professionals to learn alongside teachers in CPD and similar activities." GTCE, 2007, p.5

The Australian Government report on 'Quality Teaching' (2010) supports these findings and stresses the importance of collaboration between teachers and teacher educators in universities in communities of practice.

The McKinsey report on "How the best performing schools come out on top" (Barber and Mourshed, 2007) also notes the value of collaborative planning and processes which "enable teachers to learn from each other" and which are prevalent in Japan and Boston: "Unlike other professions, where professionals naturally operate in teams, teachers generally work alone, denying them natural opportunities to learn from each other. Several school systems employ strategies aimed to change this by creating schools in which teachers regularly observe each other's practice, thereby producing an environment which stimulates the sharing of knowledge on what works and what does not, encourages teachers to give each other feedback, and helps shape the common aspiration and motivation for improving the quality of instruction. These systems are some of the best performing of all the systems we studied." Barber and Mourshed, 2007, p. 31

Later Barber, who was one of the authors of the McKinsey report, highlights the importance of collaborative working across the education sector:

"It is not enough for teachers to learn only from within their own schools... online communities of practice have great potential. I see real potential, for example, in the Victoria (Australia) Ultranet and developments in Colorado and New York City where social networking platforms are being used to spread pedagogical knowledge and recognise teachers who demonstrate

pedagogical leadership. All this needs to be connected to really good data systems that connect individual teachers to individual students. The combination of the system improvement- and pedagogical knowledge we now have, with data and technology places on the brink of a breakthrough in improving education systems - **but as yet not many systems have taken the courageous steps to cross the threshold.**"

Barber, 2009, p.1

The vision that Barber and teachers contributing to UK ICT Futures research (Becta, 2010) have for an e-communications infrastructure supporting the education sector to improve goes beyond what seems to be currently easily available. It is not difficult to imagine teacher networks set up to problem solve in particular areas, using benchmarking data to identify problem areas and using data to monitor improvements but without an e-infrastructure accessible to all educators, this vision cannot be realized.

Another significant reason for educators to adopt online community of practice models of research and development is that the professional knowledge base for teaching is not static. The curriculum and pedagogic approaches to how it is taught need to evolve with society. E-communications tools which support collaborative working could produce significant improvements in the speed and quality of development of new professional practice and speed of dissemination.

Without the existence of mechanisms which support the systematic development, testing and then dissemination of new forms of professional knowledge, education systems cannot respond to modern demands. If no mechanisms exist to identify areas in which research is needed or to link university researchers with specialist expertise with system wide groups of school based teacher researchers then opportunities for rapid modernisation are lost. A major national research resource which is already funded by taxpayers is the research time of staff in universities who have research as part of their contracts. Developing new models of research which network these colleagues so that they can work together with the teachers and schools on large scale projects could provide substantial research outcomes for the education sector at little additional cost. The OECD Education Lighthouse (2010) provides a potential hub for connections between countries.

Millwood (2009) summarises the opportunities offered by new technologies to education system improvement as follows: "New technologies provide opportunities to facilitate professional collaboration through using technology as a catalyst, information source, venue and tool. Now that information recorded on the internet has become widely available, searchable and democratised in the sense of authorship and evaluation this has enabled a new relationship with knowledge which permits the authority of practitioners to be more directly, affordably and clearly heard alongside that of university researchers. In addition, new forms of collaboration, new ways of communicating, presenting and accessing knowledge are available. The development of social networking has led to the use of the internet as a venue for support, dialogue and meeting which in turn allows online learning to be informally and formally pursued. "(ibid, p.1).

Cassandra Davis (2010, p.1) [Communications and Online Collaboration Officer in the OECD Directorate for Education](#) identified “the need for teachers to be able to have an accessible international platform to interact and access knowledge” in a previous CERI project on brain science and learning (OECD, 2007a). “...the statistics showed a high percentage of teachers and parents using the project website forums, highlighting a need for a bottom-up diffusion of what brain science can offer to help teachers and parents to understand how the brain works.” The forum that was set up ended when the project ended. “...On this platform teachers were especially open and ready to incorporate and exchange new ideas emerging from recent scientific findings into their methods of teaching. It was brought to our attention at the time that teachers are not well informed about recent scientific research...and that teachers receive no or little basic training on how the brain works.”

Constraints and difficulties

Davis (2010, p.1) identifies a series of issues to be considered in the provision of online platforms at the national and international level “There are problems such as quality assurance, human and financial resources for monitoring.... Strategies are needed for developing collaborative platforms on a regional, national, or international level (including public-private partnerships, involvement of universities and other existing educational facilities).

These issues were all been in the development, launch and ongoing management of the IDeA online platform for local government mentioned earlier. Table 11 sets out some of the key issues considered in managing the quality of the IDeA online environment and ways in which an online environment can be cost-effectively managed.

Table II Key issues considered in setting up the IDeA national online environment

- 1) **QUALITY ASSURANCE:** The online environment is clearly marked as a professional environment provided for the local government sector to be considered an extension of the workplace. At least three ‘facilitators’ are required for an online community workspace and they normally have to have a public sector email address. It is then their responsibility as professionals to manage the environment and in case of any problems, their employer would be approached and asked to take action. Online communities can be lively or not work at all – web statistics software can pick up communities where there is no activity and the owners can be asked about closing them down. Isolated communities run by volunteers are more at risk than those where the requirement to work in this way is built into job descriptions such as for those whose jobs include a remit to work with others e.g. central government officers with teacher educators; local authority officers with school staff; university staff with staff in training schools.
- 2) **MONITORING:** Online workspaces can be open to all registered to the site or closed which means any applicant is vetted by the person responsible for the workspace. All using the site have to have a profile with contact details before being able to apply for or join an online workspace so workspace facilitators can check who a person is before acceptance. The owners of the workspaces can eject members and delete materials. These steps reduce the resources for monitoring. Additional software could be purchased to automatically search the materials on the site.

3) COSTS: IDeA quotes \$US80,000 as the rough cost for a clone of their software. Ongoing costs are for a help desk and training – the equivalent of two full time staff could manage a site with many tens of thousands of users and a 9am to 5pm help desk. Funds should however be put aside for publicity and training and \$US60,000 per year for technical upgrades.

CONCLUSIONS: IMPROVING THE QUALITY OF EDUCATION: THE CASE FOR A NATIONAL E-INFRASTRUCTURE

Few people would knowingly choose a doctor who does not keep up with medical research. Yet in education which affects life chances, with poorly educated people living shorter lives, there is not as yet a similar expectation.

On the basis of the evidence presented above of how professional practice in education improves, improving the e-communications infrastructure would appear to be a low cost and low risk option with the potential of providing significant benefits in improved teaching, improved educational outcomes for students, a more substantial research base for education and efficiency savings. Web based technologies which support collaboration and online communications between professionals have reached a stage of maturity where utility, impact and potential cost benefits are clearly demonstrable and where low cost support for collaboration and co-construction of knowledge between professionals can be provided.

This paper challenges five major stakeholders in the education sector – government officers (policy makers and inspectors), regional officers, researchers, teacher educators and teachers - to review current ways of working, to abandon old ways of working where they can be replaced with more effective ways of working using e-tools and to embrace new ways of working which will yield a higher quality evidence base for educational practice to the benefit of future generations.

Ministries of education need to shoulder their responsibility to provide a national e-communications infrastructure for the education sector which could support co-construction of new knowledge, knowledge transfer, rapid publishing of research which is sufficiently soundly based as to warrant changes in practice nationally and dissemination of evidence-based best practice. Regional officers, researchers, teacher educators and teachers do not have the remit or resources to provide and maintain these systems alone. This advice comes however with a caveat. The e-communications infrastructure needs to be managed by an independent professional body so that those communicating this way are working in an online professional environment which is clearly separate to the national political environment. It is appropriate for government officers to be users and contributors to the environment including private professional workspaces by invitation.

Government officers, regional officers, researchers, teacher educators and teachers need to develop new models for researching and developing educational practice which provide outcomes which are substantial enough to warrant national changes in practice. Current models of action research on their own do not provide these outcomes but promising small scale research can easily and cost effectively be scaled up with outcomes tested systematically through networks of researching schools and universities.

There are of course well recognized barriers to change. Research consistently indicates that a key factor holding back the development of e-infrastructure to support improvement in education systems is the lack of understanding of e-communications opportunities by managers and those who hold the purse strings. In addition, there is resistance from some members of the academic community to the notion of an evidence base for educational practice. UK challenges to existing models of academic research have met with strong resistance from those who consider teaching is an art form and that contextual differences mean that generalisability is not possible (Hammersley, 2002). These barriers need to be acknowledged and strategies put in place to manage these limitations.

A major constraint in the UK which may apply elsewhere is that the plethora of government agencies militates against action as no single organisation feels they have the remit to provide the necessary national e-communications infrastructure. Other national systems may be better placed to take advantage of e-communication technologies to support national improvements in the quality of the knowledge base underpinning educational practice.

Improving professional practice and the education system is a complex undertaking and improving the quality of the evidence base is not something that teachers and teacher educators/researchers/academics can do effectively alone. Nationally co-ordinated solutions are required which include the necessity for a radical overhaul of the

- means of access to knowledge
- means of production of knowledge and
- forms of publication of knowledge.

Until national education sectors provide a service for teachers which enables them to keep up to date easily with research presented in an accessible form and sufficiently rigorous to merit changes in practice then teachers can rightly question the commitment of their ministry of education to supporting the improving of quality in teaching and improving the educational outcomes for pupils.

Readers of this article are invited to contribute to further discussions around this topic using some of the tools alluded to in this paper via the OECD Education Lighthouse forum devoted to this topic: <https://community.oecd.org/message/4520#4520>

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2002- 2006 development and implementation of Teacher Training Resource Bank concept www.ttrb.ac.uk Training and Development Agency for schools (UK TDA) funded. Providing

access to the evidence base for teacher training.
 2002-2006 Education Evidence Portal (www.eep.ac.uk) funded initially by a range of government agencies to provide an Education Google type resource.
 2002 Training and Development Agency for Schools: Evaluation of the New Opportunities fund for the ICT training of teachers and librarians
 2000-2002 DFID funded ICT for non-formal education (CERP project)
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 1997 – 1999 British Council New Images project
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 1995 – 2002 Development of TeacherNet concept www.teachernet.gov.uk Department for Children Schools and Families.

References

Australian Government DEEW (Department of Education, Employment and Workplace relations) (2010) Quality Teaching Canberra, Australia: Australian Government
<http://www.deewr.gov.au/Schooling/QualityTeaching/Pages/Qualityteaching.aspx>
 accessed 3 January 2010

Australian Government (2007) Quality teaching. Curriculum Corporation. Canberra, Australia: Australian Government
<http://www.deewr.gov.au/Schooling/QualityTeaching/AGQTP/Documents/QualityTeachers.pdf>
 accessed 3 January 2010

Australian Government DEST (Department of Education, Science and Training) (2005) The emerging business of knowledge transfer: creating value from intellectual products and services. Canberra, Australia: Australian Government

Barber, M. (2009) Email exchange with M. Leask to clarify data on collaboration between teachers used for the report McKinsey (2007) How the world's best-performing school systems came out on top.

Barber, M. and Mourshed, M. (2007) How the world's best-performing school systems came out on top. McKinsey
http://www.mckinsey.com/clientservice/Social_Sector/our_practices/Education/Knowledge_Highlights/Best_performing_school.aspx
 accessed 4 December 2009

Becta (2010) ICT tools for Future Teachers Report (a series of six research reports produced by Professor Marilyn Leask, Brunel University and Christina Preston, Mirandamet). Coventry, UK: Becta.

Becta, 2008, Harnessing Technology Review. Coventry, UK: Becta.
<http://publications.Becta.org.uk/display.cfm?resID=38751>
 accessed 3 January 2010

Bolam, R. and Weindling, (May 2006) Synthesis of research and evaluation projects concerned with capacity-building through teachers' professional development: Full research report.
http://www.gtce.org.uk/research/commissioned_research/cpd/synthesis_cpd_projects/
 accessed 4 December 2009

Capel, S., Turner, T. and Leask, M. (5th edition, 2009) **Learning to Teach in the Secondary School: a companion to school experience**. London: Routledge.

China Education and Research Network (2000) Teacher Education In China(II)Remarkable Results of Reform and Development Of Teacher Education.
<http://www.edu.cn/20010101/21924.shtml> accessed 3 January 2010
 accessed 3 January 2010

Cochran-Smith, M., and Zeichner, K. (2005) **Studying Teacher Education: the Report of the AERA panel on research and teacher education**. Washington D. C.: American Educational Research Association in conjunction with Lawrence Erlbaum associates, Mahwah, New Jersey.

Collison, C. and Parcell, G., (2006) **Learning to Fly**. London, Wiley.

Davenport, T. and Prusak, L., (1998) **Working knowledge**, Boston, Mass, Harvard Business School Press.

Davies, H., Nutley, S. and Smith, P. (eds) (2000) **What works? Evidence-based policy and practice in public services**. Bristol, UK: The Policy Press.

Davis, C. (2010) Improving the quality of education: email exchange with Marilyn Leask, January 2010. London: Brunel University.

GTCE (UK: General Teaching Council for England) (2007) Making CPD better - Bringing Together Research about CPD: Leaflet produced by Bolam, R. and Weindling, D from the full report GTCE, 2007b. London: GTCE. http://www.gtce.org.uk/publications/res_cpd/
 accessed 4 December 2009

GTCE (UK: General Teaching Council for England) (May 2006) Synthesis of research and evaluation projects concerned with capacity-building through teachers' professional development: Full research report. Report produced by Bolam, R. and Weindling, D..London: GTCE.
http://www.gtce.org.uk/research/commissioned_research/cpd/synthesis_cpd_projects/
 accessed 4 December 2009

Hammersley, M. (2002) **Educational Research: policy-making and practice**. London: Paul Chapman publishing

Henley Knowledge Management Forum (2008a) Building and sustaining communities of practice. Henley, UK: **Knowledge in Action**, issue 07. Henley Management College.

Henley Knowledge Management Forum (2008b): Sharing knowledge with other organizations. Henley, UK: **Knowledge in Action**, issue 08. Henley Management College.

Howard Partners (2005) **The emerging business of Knowledge transfer: Creating value from intellectual produces and services**, Canberra, Commonwealth of Australia, Department of Education, Science and Training.

IDEA (UK: Improvement and Development Agency for local government) (2009) **Internal research report: Communities of Practice**. London: IDEA.

IDEA (UK: Improvement and Development Agency for local government) (2008) Knowledge Management Tools and Techniques: helping you find the right knowledge at the right time, London: Improvement and Development Agency for local government.
<http://www.idea.gov.uk/idk/aio/8595069>
 accessed 4 December 2009

IDEA (UK: Improvement and Development Agency for local government) (2006) Knowledge management strategy: board paper. IDEA internal document. London: IDEA.

Indian Government National Council for teacher education: a statutory body of the government of India (2010a)
<http://www.ncte-india.org/> access 3 January 2010
<http://www.ncte-india.org/publicnotice/invitation.pdf>
 accessed 3 January 2010

Indian Government National Council for teacher education: a statutory body of the government of India (2010b) Awards to teacher educators in India
<http://www.ncte-india.org/teacheraward.htm>
 accessed 3 January 2010

Lave, J. and Wenger, E. (1991) **Situated Learning: legitimate peripheral participation**, Cambridge, Cambridge University Press.

Leask, M. (2010a) Occasional paper No. 8 A national and international model for scaling up small scale educational research: country wide HEI/school Collaborative Research Networks? London: Brunel University.
<http://www.brunel.ac.uk/about/acad/sse/ssestaff/educationstaff/marilynleask>
 accessed 7 February 2010

Leask, M (2010b) Occasional paper No. 5 Networking the education workforce – getting order from anarchy. London: Brunel University.

<http://www.brunel.ac.uk/about/acad/sse/ssestaff/educationstaff/marilynleask>
accessed 7 February 2010

Leask, M. (2004a) Using research and evidence to improve teaching and learning in the training of professionals - an example from teacher training in England. Paper presented at the British Educational Research Association Annual Conference, University of Manchester, UK. 16-18 September 2004.

<http://www.leeds.ac.uk/educol/documents/00003666.htm>
accessed 3 January 2010

Leask, M. (2004b) Accumulating the evidence base for educational practice: our respective responsibilities. Paper presented at the British Educational Research Association Annual Conference, University of Manchester, UK. 16-18 September 2004.

<http://www.leeds.ac.uk/educol/documents/00003665.htm>
accessed 3 January 2010

Leask, M. and Pachler, N. (1997) The Background & Rationale for the TeacherNet UK Initiative – harnessing the potential of the Internet for improving teachers' professional development & pupil learning. **Open Classroom II Conference Papers & Presentations**. Athens: European Distance Education Network/Lambrakis Foundation.

Leask, M. and White, C. (2004) Initial Teacher Training (ITT) Professional Resource Networks (IPRNs) - rationale and development . Paper presented at the British Educational Research Association Annual Conference, University of Manchester, UK. 16-18 September 2004.

<http://www.leeds.ac.uk/educol/documents/00003667.htm>
accessed 3 January 2010

Leask, M. and Younie, S. (January, 2009) Written Evidence submitted by Younie on behalf of the IT in Teacher Education professional association and Brunel University. London: House of Commons Children, Schools and Families Select Committee

<http://www.publications.parliament.uk/pa/cm200809/cmselect/cmchilsch/memo/teactrai/teatr3702.htm>

accessed 3 January 2010

Leask, M. and Younie, S. (2001) The European Schoolnet. An Online European Community for Teachers? A Valuable Professional Resource? **Journal for Teacher Development**, Vol 5 No 2 pp 157-175

Leask, M. and Younie, S. (2002) Communal Constructivist Theory: information and communications technology pedagogy and internationalisation of the curriculum. **Journal of Information Technology for Teacher Education**, Vol.10, Nos 1 and 2, pp.117-134.

McKinsey (2007) How the world's best-performing school systems came out on top . Report produced by Barber, M. and Mourshed, M..

http://www.mckinsey.com/clientservice/Social_Sector/our_practices/Education/Knowledge_Highlights/Best_performing_school.aspx
accessed 4 December 2009

Millwood, R. (2009) Contribution to Digital Public briefing paper on E-communications in education. London: Digital Public (Ruth Parkinson ed.)

Ming-yuan, G. (2006) The Reform and Development in Teacher Education in China Beijing Normal University <http://www.ictc.ecnu.edu.cn/EN/show.asp?id=547>
accessed 3 January 2010

Newman, F. and Holzman, L., (1997) **The End of Knowing**. London, Routledge.
Newman, M., Elbourne, D., and Leask, M. (2004) Improving the usability of educational research: guidelines for the reporting of empirical primary research studies in education. Roundtable discussion paper presented at the 5th Annual Conference of the Teaching and Learning Research Programme, Cardiff, 22-24 November 2004.
http://brs.leeds.ac.uk/cgi-bin/brs_engine
accessed 3 January 2010

Oakley, A., (2003) 'Research Evidence, Knowledge Management and Educational Practice: early lessons from a systematic approach', **London Review of Education**, Vol.1, No.1, pp 21-34.

OECD (2010) (Organisation for Economic Cooperation and Development) (2010) Education Lighthouse website
http://www.oecd.org/document/61/0,3343,en_2649_33723_42992189_1_1_1_1,00.html
accessed 3 January 2010

OECD (2009a) Creating Effective Teaching and Learning Environments: First Results from Teaching and Learning international Survey (TALIS)
http://www.oecd.org/document/54/0,3343,en_2649_39263231_42980662_1_1_1_1,00.html

OECD (2009b) Education at a Glance 2009: OECD Indicators
http://www.oecd.org/document/24/0,3343,en_2649_39263238_43586328_1_1_1_1,00.html
accessed 1 February 2010

OECD (2007a) Understanding the Brain the Birth of new learning science. Paris. OECD/CERI
http://www.oecd.org/document/60/0,3343,en_2649_35845581_38811388_1_1_1_1,00.html
accessed 1 February 2010

OECD (2007b) Taking Stock of Educational R&D: Joint OECD-CORECHED International Expert Meeting
http://www.oecd.org/document/36/0,3343,en_2649_35845581_39379876_1_1_1_1,00.html
accessed 3 January 2010

OECD (2007c) Evidence in Education: Linking Research and Policy
http://www.oecd.org/document/56/0,3343,en_2649_35845581_38796344_1_1_1_1,00.html

accessed 3 January 2010

OECD (2003) *New Challenges for Educational Research*

This report has two of the five reviews of educational R&D which CERI conducted in five countries: New Zealand, England, Mexico, Denmark and Switzerland.

OECD (2002) *ICT and whole school improvement – various reports*. Paris: CERI.

http://www.oecd.org/searchGoogle/0,3547,en_2649_201185_1_1_1_1_1,00.html?cx=012432601748511391518%3Axzeadub0b0a&cof=FORID%3A11&ie=UTF-8&q=ict+and+whole+school+improvement&sa=Search#1300

Accessed 7 February 2010

Pickering, J. Daly, C. and Pachler, N. (eds) (2007) *New Designs for Teachers' Professional Learning*. **Bedford Way Papers**. London: Institute of Education, University of London.

Proton Europe (2007) *Experiences on the US knowledge transfer and innovation system*. Proton Europe Innovation from Public Research

http://www.proinno-europe.eu/NWEV/uploaded_documents/US-knowledge-transfer-innovation-system.pdf

accessed 3 January 2010

Research Councils UK (2010) *Knowledge Transfer Portal*. Swindon UK: Research Councils.

<http://www.rcuk.ac.uk/innovation/ktportal/default.htm>

accessed 3 January 2010

Richards, R., Rivers, I. and Akhurst, J. (2008) A positive psychology approach to tackling bullying in secondary schools: A comparative evaluation, **Educational & Child Psychology**, 25 (2), 72-90.

Rogers, E. M. (1983). **Diffusion of innovations** (3rd ed.). New York: Free Press (see also

http://en.wikipedia.org/wiki/Everett_Rogers)

accessed 3 January 2010

Schon, D., (1987) **How Professionals think in Action**, New York, Basic Books.

Schwab, J.J. (1964) 'The structure of the disciplines: meanings and significance', in G. Ford, and L. Purgo (eds) **The Structure of Knowledge and the Curriculum**, Chicago: Rand McNally.

Shulman, L. (1987) 'Knowledge and teaching: Foundation of a new reform', **Harvard Review**, 57: 1-22.

Stenhouse, L. (1975) **An Introduction to Curriculum Research and Development**. London: Heinemann Educational Books. See also The UK Tradition of Teacher Research

http://www.teachernet.gov.uk/research/Learning_about_research/uk_tradition_for_teacher_research/

accessed 3 January 2010

UK DCSF (2006) 2020 Vision: Report of the Teaching and Learning in 2020 Review Group chaired by Christine Gilbert, Chief HMI. London: DCSF. accessed 3 January 2010

TDA (UK: Training and Development Agency for schools) (2002) Evaluation of New Opportunities Fund ICT training for teachers and librarians. Report produced by Leask, M. London: Training and Development Agency for Schools.

UNESCO (2010a) Qualifying and training teachers in Brazil
<http://www.unesco.org/en/brasilia/education/other-education-themes/teacher-education-and-training/>
 accessed 3 January 2010

UNESCO (2010b) The Teacher Training Initiative for Sub-Saharan Africa (TTISSA)
<http://www.unesco.org/en/teacher-education/>
 accessed 3 January 2010

U.S. Department of Education (2006) The Secretary's Fifth Annual Report on Teacher Quality: A Highly Qualified Teacher in Every Classroom. Washington DC: U.S. Department of Education
<http://www.ed.gov/about/reports/annual/teachprep/index.html>
<http://www.ed.gov/teachers/nclbguide/improve-quality.html>
 accessed 3 January 2010

Wenger, E. (1998). **Communities of Practice: Learning, Meaning, and Identity**. Cambridge, Mass: Cambridge University Press.

Wenger, E., McDermott, R. and Snyder, W. (2002) **Cultivating communities of practice: a guide to managing knowledge**. Cambridge, Mass: Harvard Business School Press.

ⁱ Web 2.0 websites allow users to read and to write to the web site e.g. to post documents and comments and to work collaboratively with others. Web 1.0 websites are read only.

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ⁱⁱⁱ UK National Education Research Forum committees, cross-government agency research committees, the national Research Assessment Exercise judging university-based research (<http://www.rae.ac.uk/>), Social care institute for Excellence steering group (<http://www.scie.org.uk/>), Teacher Training Resource Bank committees (www.ttrb.ac.uk), and now the Coalition for evidence-based education and 21st century learning Alliance (<http://www.21stcenturylearningalliance.org.uk/>).

^{iv} The UK Improvement and Development Agency for local government, the IDeA, is the improvement arm of the Local Government Association (LGA) -- a national body, funded by subscription from local authorities and representing the interests of local authorities to central government.

^v In England for example, the Education Evidence Portal (EEP)(www.eep.ac.uk) and the Teacher Training Resource Bank (www.ttrb.ac.uk) complement the material on the ministry site www.dcsf.gov.uk, the Training and Development Agency site www.tda.gov.uk, TeacherNet (www.teachernet.gov.uk) and the Qualifications and Curriculum Development Agency (www.qcda.gov.uk) websites with Teachers TV (www.teachers.tv) providing complementary video material.

^{vi} A prototype of text mining software being tested by the UK Educational Evidence Portal can be found on: <http://www.eep.ac.uk/dnn2/AboutEEP/Portaldevelopment/tabid/151/Default.aspx>