ISSN 2382-5855
Advances in Scholarship of Teaching and Learning, Vol.3, No.1, 2015.

MAINSTREAMING INNOVATION IN EDUCATIONAL TECHNOLOGY

Rosemary LUCKIN
Institute of Education, University College London

There is much innovation to be found in the field of Educational Technology, both in its design and in its use. However, this innovation is patchy and inconsistent and rarely informed by research evidence or effective research practice. When reviewing work from within academia, commerce and educational practice it is clear that vital information about the context of the innovative work is unrecorded and that the relationships between researchers, developers and practitioners rarely exist. The production of effective innovations in the design and use of educational technology will rely upon these key relationships being fostered and strengthened. Developers need to be aware of existing evidence and able to use sound research methods to evaluate their products, researchers need to work with developers to help them acquire the knowledge and skills, and educators must be part of the process through their input to the design and evaluation of the technologies being developed.

Keywords: *Educational Technology, Design, Evidence, Context, Environment, Innovation, Learning Acts*

INTRODUCTION

In 2012, I was involved in the production of the Decoding Learning report for Nesta (Luckin et al., 2012). The process of writing this report involved searching for and combining innovations arising from within the research community in universities and companies with the innovations that teachers were applying in their classrooms. The Decoding Learning report was commissioned to inform Nesta's digital education programme. It critically examined the evidence and asked how we might better exploit innovative technology to support learning. It investigated the *Proof*, putting learning first; *Promise*, for technology to help learning in new ways; and *Potential*, to make better use of technologies we already have. In writing the report, we considered over 1,000 research publications and 300 records of teacher innovation. From this pool of 1,300 innovations, 150 were selected for a further assessment by a panel of experts who ranked them according to their innovative qualities. In this paper, three years on from publication of the report, I explore how well these innovations have stood the test of time and how we might better support and mainstream innovation in educational technology.

LEARNING WITH TECHNOLOGY: THE EVIDENCE

No technology has an impact on learning in its own right; rather, its impact depends upon how it is used. In writing the Decoding Learning report, we rejected the lure of categorising innovations by type of technology employed. Instead, we identified the types of learning activities that we knew to be effective and explored how technology can innovatively support and develop these effective learning activities. The Decoding Learning report therefore categorised innovations into the following eight themes based upon the Theory of Learning Acts (Manches, Phillips, Crook, Chowcat & Sharples, 2010):

1. Learning from Experts
2. Learning with Others
3. Learning through Making
4. Learning through Exploring
5. Learning through Inquiry
6. Learning through Practising
7. Learning from Assessment
8. Learning in and across Settings

The eight learning themes can also be combined in interesting and effective ways. Linking learning activities within and across different learning themes enables learners to create a coherent learning episode. This orchestration of activity can support learning and create deeper understanding. It can also strengthen future learning by helping learners establish more versatile approaches to learning.

LEARNING WITH TECHNOLOGY: THE PRACTICE

In the report, we identified trends and opportunities grounded in effective practice and set out what we believed were the most compelling opportunities to improve learning through technology. In order for educators to become effective technology-enriched practitioners, we recommend that they start from the type of learning that they want for their learners and then explore which technologies can support this type of learning and how they can best be used. These six questions may help with the decision-making:

- Questions to ask when planning the technology-enhanced activity:

1. What type of learning do you want to support?
2. What is the environment for learning and how are the physical resources arranged?
3. What are the formal and informal rules that shape the behaviour of teachers and learners in the learning environment?

- Questions to ask after the technology-enhanced activity:

1. How do you know that the technology-enhanced learning has been successful?
2. Who else was involved and what skills and attitudes did they bring? Teachers, other learners, technicians and other less obvious people within schools, such as senior managers, teaching assistants, technical staff and network managers, all influence teaching and learning.
3. What technology was involved – how much did it cost, how complex was it, how much time did you need to invest in order to become familiar enough with it to use it confidently?

LEARNING WITH TECHNOLOGY: IMPROVING INTEGRATION AND INNOVATION

In addition to these practical pointers to direct teachers' thinking about teaching with technology, the Decoding Learning report also highlighted further activities that could support educational technology innovation and integration.

Share, Adapt and Empower

In our own experience and as evidenced in the literature, it is clear that teachers have always been highly creative, designing a wide range of resources for learners. These include worksheets for learners to complete, wall displays and school trips. However, many teachers lack confidence when it comes to being creative in their use of technology. Teachers need to be given opportunities to develop the skills that will enable them to digitally "stick and glue" and create their own resources. To achieve this, teachers need to develop and share ways of using new technologies, either through informal collaboration or formal professional development. They also need to be given the chance to work with educational technology developers from whom they can learn and with whom they can share their expertise about teaching. However, teachers cannot be expected to build these communities and relationships without support and time. They also need the space to explore the full learning potential of the technologies they have at their fingertips. There is an important role for school leaders here in assisting teacher development and tapping into the expertise available in the wider community beyond the school.

Know the Learning Environment

Learners' contexts are important for their learning and they are also extremely complex. Context can be viewed as a multiplicity, with individual people experiencing the "exposure to multiple 'contexts' in time and space" (Cummins, Curtis, Diez-Roux & Macintyre, 2007, p. 1830). Context is "perhaps the most prevalent term used to index the circumstances of behaviour" (Cole, 1996, p. 132). It requires that we view the mind "as distributed in the artifacts which are woven together and which weave together individual human actions in concert with and as part of the permeable, changing events of life'' (p. 136). This is a perspective that has roots in the work of Vygotsky (1978; 1986) and echoes through the literature on the situated approaches to cognition and learning (e.g., Brown, 1990; Brown, Collins & Duguid, 1989; Lave, 1988; Lave & Wenger, 1991).

For educational technology to be effective, it will need to integrate into this complex context. Each classroom will have its own context with an established learning culture and whilst much is made of the potential disruptive power of technology, respect must still be paid to the context that already exists for learners and teachers. For example, a proposed technology may challenge how teachers perceive their own role, affect whether learners see their peers as competitors or collaborators, or undermine how the term "learning" is understood.

Think beyond the Formal Learning Environment

Technology offers enormous potential to breakdown physical boundaries and distances. It enables us to communicate across the globe and to reach out beyond the traditional confines of a classroom, for example. Educators need to embrace this new world of resources and consider how they might engage with those outside the school classroom, within the local community and beyond. In the UK, we are facing an unprecedented shortage of teachers, but perhaps this can be addressed by using technology to link up to experts in other countries who can provide the support that learners require.

Record and Disseminate

Spreading the word is vital for the integration of educational technology into any education system. If a teacher uses technology in a way that supports the teaching and learning process effectively, then this example must be communicated to colleagues, both locally and beyond. Teachers need to share practical examples of what works and how it works so that others can benefit from this experience. When it comes to recording how technology has been used, the following checklist can help:

Table 1

Checklist for Recording How Technology Is Used to Support Learning

1. What learning did you want to support?
2. How did you set up the activity, was it tightly structured or more free flowing?
3. How were learners organised and managed?
4. How do you know that it worked?
5. What was the environment for learning? How were the physical resources arranged? For example, the possibility of undertaking a new activity might be restricted by the size of a classroom or the location of particular technologies, while web-based interactions may mean that learners are now feasibly able to interact from different locations than in the past.
6. Whether formal or informal, there will also be formal and informal rules that shape the behaviour of teachers and learners in the learning environment – what are they?
7. Who else was involved and what skills and attitudes did they bring? Teacher/s, other learners, technicians and other less obvious people within schools, such as senior managers, teaching assistants, technical staff and network managers, all influence teaching and learning.
8. How did other people's rules and practices impact on how the technology-supported learning?
9. What technology was involved – how much did it cost, how complex was it, how much time did you need to invest in order to become familiar enough with it to use it confidently?

WHAT IS INNOVATION IN EDUCATIONAL TECHNOLOGY?

It is interesting to take another look at the 150 innovations that we had identified in the Decoding Learning report and see which of them stood the test of time. It is certainly true that the eight categories used to group innovations in the report are still relevant; they are based on a theoretical framework that has been developed from decades of research. However, what about the specific innovations themselves? These innovations are much more transient. Three years after the original report, there was evidence that 39 of the 150 innovations are still in active use. This included the innovation that was originally rated number one: I Am Creative (Ideas Foundation, n.d.). However, what happened to the other 111 innovations? There were a variety of reasons for an innovation to fall from use. For the innovations that arose from academic research, the specific projects no longer existed and the technology was therefore no longer supported. However, the research itself has been written up and had therefore informed future innovation. In the case of the innovations used by practitioners, some innovations had been bought up by another organisation. For example, the product Qwiki that had been used to support secondary and higher education learners with creating presentations about their learning by creating a personal narration of web material was bought by Yahoo! in July 2013. Other innovations that are no longer in use are "frozen" in the information about them can still be accessed (e.g., PennState, n.d.).

The key question that arises from this situation is: Does it matter that many innovations were transient? If the innovations had been well-documented, then learning can still be gleaned from them. The nature of innovation is that it pushes and challenges boundaries, and success lies in this process of boundary extension as much as in the innovations themselves.

DESIGNING FOR INNOVATION: COLLABORATIVE EVIDENCE-BASED PRODUCT DESIGN

Our research for the Decoding Learning report highlighted the significant disconnect between educational technology's key partners – industry, research, teachers and learners. Too often, researchers and practitioners operate in isolation from the educational technology developers whose products grace our schools and homes. This situation makes little sense at a time when technology has become consumerised, even for the poorest families, and there is increasing evidence for the efficacy of technology as a learning tool. As a result of the work done for the Decoding Learning report and of work done with a growing number of educational technology developers, we have developed a proposal for a new way to design: collaborative evidence-based product design. The proposal is collaborative because it is clear that no one group can develop effective innovations on their own. Educators need to work with researchers and both need to work with educational technology developers.

The need for these collaborative relationships is increasingly recognised. For example, a leading educational technology provider commented:

> Anything that gives educators access to practical evidence-based advice, helps industry and educators co-create new products and services, and allows academia to get their work into the hands of practitioners has to be a good thing.

Similarly, the CEO of a company that brings together and supports educational technology startups observed:

> For all the hardware and software learning solutions flowing into the classroom (unlike the consumer market) the education sector is still very much a walled-garden environment. Access is controlled by a small number of decision-makers – so it's crucial for EdTech companies to reach these influencers if they are to build successful, classroom relevant resources.

Our proposed approach is also evidence-based and there are clear reasons why this use of evidence is important: educational technology development must learn from what has gone before and must find ways to evaluate the effectiveness of its products. For example:

- The OECD TALIS study (2013) reported that teachers who reported participation in professional development activities involving individual and collaborative research were more likely to report using active teaching strategies including the use of ICT. A number of studies pointed to the positive effect on learners of using active teaching strategies in the classroom.
- In an empirical study by Cooper (2010) of interventions on the use of research in practice, successful schools were shown to have facilitated the use of external research and the navigation of the world of academia.
- A study by Bell, Cordingley, Isham & Davis (2010) systematically reviewed the evidence on practitioners' engagement in or with research and its impact on learners. It revealed "strong evidence of links between teacher engagement in and with research and significant changes in practice with a positive impact on student outcomes" (p. 81).

Figure 1 illustrates the rationale for a collaborative evidence-based product design and shows how the three corners of the triangle represent collaborative evidence-based product design:

1. Educators and parents who may ask: How can I find what works when using technology in the classroom?
2. Industry/educational technology developers who may ask: How is research evidence relevant to me and how can I find out what teachers, parents and learners think of my product?
3. Researchers in academia and beyond who may ask: How can I better communicate my research to teachers and educational technology developers, and demonstrate that it has impact in the real world?

The co-ordination of these three groups of people around the subject of evidence leads to improved technology-enhanced learning for all in classrooms and homes by ensuring:

1. improved learning;
2. better teaching;
3. increased sales; and
4. better research.

These benefits are fundamental to the participants in the process, that is, educators and parents, educational technology developers and researchers. However, they are also of significant interest to policymakers, big and small businesses, and global leaders.

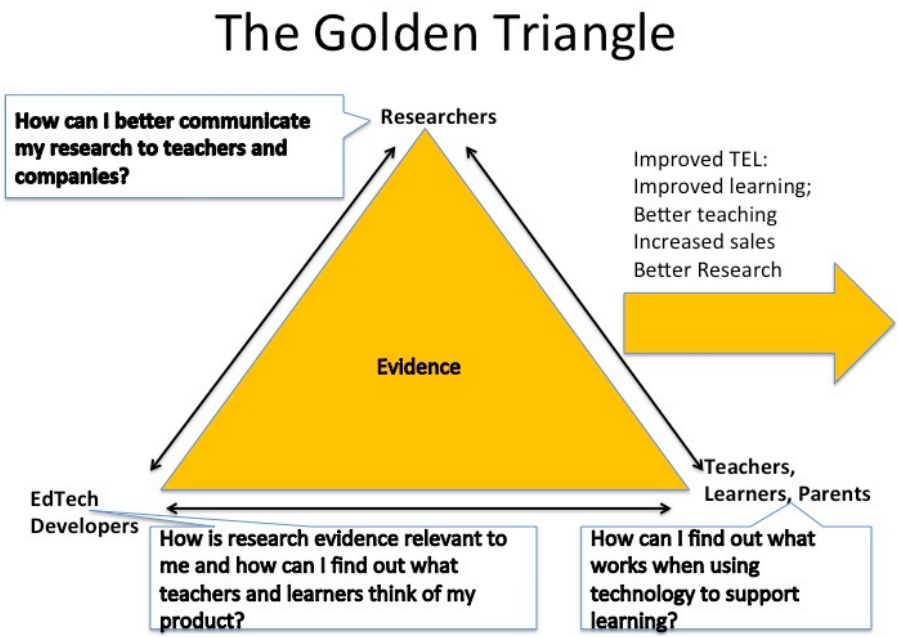

Figure 1. The Golden Triangle of Collaborative Evidence-based Product Design.

Figure 2 depicts a high-level overview of the process of collaborative evidence-based product design, illustrating how all parties can work together to combine research professionalism with work at the "the front line" of school, college, workplace or home, and how collaboration with developers/suppliers can be done so that we see a positive step-change in the design and use of educational technology. The figure illustrates a single iteration in what is a multi-iteration design cycle.

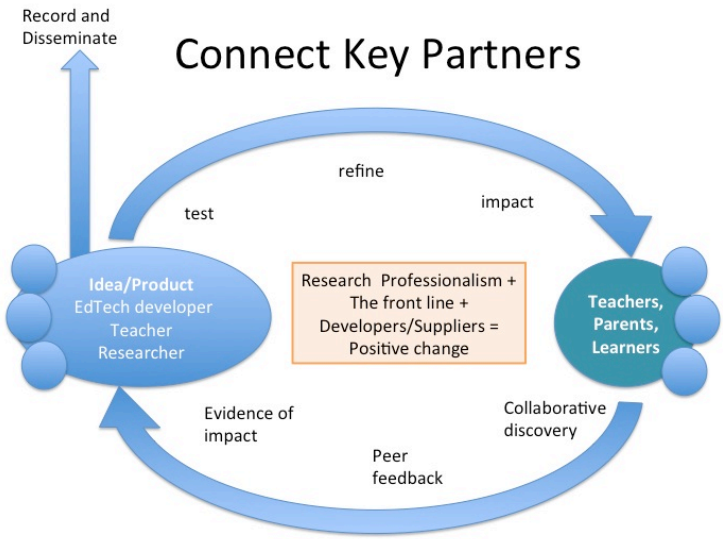

Figure 2. The Process of Collaborative Evidence-based Product Design.

There are, however, certain barriers to change of this sort and ways to address these barriers must be a priority if we are to reap the benefits of collaborative evidence-based product design. The inertia of the status quo manifested in the established practices in

schools/colleges and within companies is a key barrier that must be overcome. It is vital that we are able to demonstrate the benefits of collaborative evidence-based product design and show teachers that it can help them improve their classroom practice, and developers that it can improve their products.

There are large misunderstandings about the nature of evidence, with many in the commercial world believing that the only research they need is market research. Even within the academic community of researchers there are disagreements about methods, with some favouring the medical randomised control-trial model, whereas others prefer a more process-oriented analysis involving qualitative data and measures. In addition to these misunderstandings and disagreements, there is also a large amount of poor-quality research evidence gathered from small trials with unrepresentative participants and settings. By working together, we can all ensure that the highest standards of evidence are maintained and, as a consequence, that the research conducted is of high value.

There are some pragmatic and logistical difficulties with respect to getting researchers, teachers and commercial developers together. This will not happen on its own and significant effort and investment is required to bring these groups together. We are making great efforts in this direction organising "speed dating" style events and discussion forums for educators, educational technology developers and researchers. Linked to the pragmatic and logistical challenges are issues of cost and time, with a growing teacher shortage in the UK, it is hard to justify taking teachers out of the classroom to work with researchers and developers, and more work will need to be conducted within schools to make it easier for teachers to be part of the process.

The final challenge I want to mention here is that posed by the transience of technology innovation. For many educators, they want to feel that they have come to terms with educational technology because they have mastered certain products. However, the nature of technology innovation means that these products are likely to change within a short period of time. Teachers may need to re-learn some of what they thought they knew and to accept that their skills will need constant updating. This is a mindset issue and we must help teachers to feel comfortable with this. Engaging them in the design of educational technology can help them understand why and how products develop and change, and in this way they can become more accustomed to the transience of the innovations they use.

CONCLUSION

Teachers, researchers and developers are being innovative with technology to support learning, but this innovation is patchy at best and not scaled across a whole education system. In addition to this lack of consistency, these innovations are very often poorly recorded and disseminated, so that when an effective way to use educational technology is found it is not shared with other practitioners to fuel a scaling process. The issue of recording is complex and important, because the evidence that technology can support learning also demonstrates that learners' context matters to learning and what works with one group of learners may not work with another.

The innovations we identified in the Decoding Learning report were largely short-lived and three years later many were no longer in use. This is not necessarily a negative reflection about the innovations, because each innovation can be seen as a stepping-stone to the next innovation for the future. The constant development of technology is something that teachers

need to come to terms with so that they can accept the reality that their skills with technology will require constant development.

There is poor use of evidence in the development of educational technology products and services, both in terms of existing evidence and evidence about a product or service in use. There is also a lack of communication between educational technology developers and teachers, parents and learners who use the technologies under development.

Our proposal for collaborative evidence-based product design addresses these issues, that is, the need for developers to better communicate with teachers and to make better use of evidence in their design of products and services. It offers the potential to mainstream local innovation so that the wider community can reap the benefits.

Author

Rosemary LUCKIN is Professor of Learner Centred Design at the UCL London Knowledge Lab. In 2012 she worked with Nesta to produce the influential 'Decoding Learning' report. Rose works closely with the Education Technology business, in particular SMEs, with whom she collaborates to enable them to integrate research evidence and methods into their products. She has successfully managed more than a dozen substantial research projects involving multiple partners, and has published widely in academic journals, conferences and books. Her research applies participatory methods to the development and evaluation of EdTech. This work is interdisciplinary and encompasses education, psychology, artificial intelligence and HCI. Email: r.luckin@ioe.ac.uk.

REFERENCES

Bell, M., Cordingley, P., Isham, C., & Davis, R. (2010). Report of professional practitioner use of research review: Practitioner engagement in and/or with research. Coventry, UK: CUREE, GTCE, LSIS & NTRP. Retrieved from http://www.curee-paccts.com/node/2303

Brown, J. S. (1990). Toward a new epistemology for learning. In C. Frasson & G. Gauthier (Eds.), *Intelligent tutoring systems: At the crossroads of artificial intelligence and education* (pp. 262–286). Norwood, NJ: Ablex Publishing.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*, 32–42.

Cole, M. (1996). Cultural psychology: A once and future discipline. Cambridge, MA: Harvard University Press.

Cooper, A. (2010). *Knowledge mobilization intermediaries in education*. Retrieved from http://www.oise.utoronto.ca/rspe/UserFiles/File/CSSE2010KMIntermediariesFinal.doc

Cummins, S., Curtis, S., Diez-Roux, A., & Macintyre, S. (2007). Understanding and representing 'place' in health research: A relational approach. *Social Science and Medicine, 65*, 1825–1838.

Ideas Foundation. (n.d.). *I Am Creative*. Retrieved from http://www.iamcreative.org.uk

Lave, J. (1988). *Cognition in practice*. Cambridge, MA: Cambridge University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, MA: Cambridge University Press.

Luckin, R., Bligh, B., Manches, A., Ainsworth, S., Crook, C., & Noss, R. (2012). *Decoding learning: The proof, promise and potential of digital education*. London, UK: Nesta. Retrieved from http://www.nesta.org.uk/publications/decoding-learning

Manches, A., Phillips, B., Crook, C., Chowcat, I., & Sharples, M. (2010). *Year 3 final report: Shaping contexts to realise the potential of technologies to support learning*. Retrieved from http://www.icde.org/filestore/Resources/Reports/CAPITALfinalreport.pdf

OECD TALIS. (2013). *TALIS 2013 results: An international perspective on teaching and learning*. Retrieved from http://www.keepeek.com/Digital-Asset-Management/oecd/education/talis-2013-results_9789264196261-en#page1

PennState. (n.d.). Into the words with first and second grade scientists. *EDTAP: Exemplary digital teaching archive project*. Retrieved from http://edtap.psu.edu/video/outdoors

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. (M. Cole, V. John-Steiner, S. Scribner & E. Souberman, Trans.). Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and language*. Cambridge, MA: MIT Press.