Technology Enhanced Learning (TEL) – where are we?

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There has been increased interest in the use of technology to enhance learning in recent years with a variety of techniques being incorporated into education. Some of these, such as e-learning and simulation, are relatively widespread and well established. Other techniques are emerging and their roles still being explored. Appropriate access to technology-enhanced and simulation based learning is included in the new GMC standards for trainers effective from January 2016.

In general technology may enhance the pace, place or mode of learning by making the impossible possible or by making the possible easier, safer or more effective. This can be achieved in a number of ways:

- increased efficiency: cost, time, scalability or sustainability. This may lead to increased delivery, increased learning or both.
- enhancement of traditional learning: for example by making additional or alternative resources available.
- transforming how learning occurs: either by the introduction of new educational processes or a radical change in existing methods. Simulated exposure to uncommon events is one example of this.

Jisc, the main organiser of higher education digital services in the UK, describe the benefits of technology-enhanced education as:

- 24/7 access to learning resources
- greater choice over the time, place and pace of study
- alternative modes of study: distance, blended work-based, partially or wholly campus-based
- knowledge-sharing and co-authoring across multiple locations
- opportunities for reflection and planning in personal learning spaces
- rapid feedback on formative assessments
- more active learning by means of interactive technologies and multimedia resources
- participation in communities of knowledge, inquiry and learning
- learning by discovery in virtual worlds
- development of skills for living and working in a digital age

As befits a digital organiser, Jisc equates technology-enhanced and e-learning, and many of their benefits apply only to the latter. Much open access e-learning within anaesthesia focuses on content delivery, either standalone or as part of blended or flipped learning. As such it tends therefore to make learning more efficient or more accessible rather than being transformative per se.

What are we trying to enhance?

Learning has been described as a ‘a change in human disposition or capability that persists over a period of time and is not simply ascribable to processes of growth.’ This is manifest as a change in behaviour. There have been a number of attempts to describe how people learn and what happens when people learn. These have been summarised in the first article in this series. The choice of learning theory is often implicit but varies with:

- what we are teaching – knowledge, skills, attitudes
- to whom – learner styles, learner culture, stage of training.
- preferences of the educator

A number of learning perspectives emerge from this. They all utilise technology in different ways.

1 The first of these is associative or pre-constructivist learning. This focuses on the acquisition of knowledge by forming associations between different concepts or of skills by associating the components of the skill. Technology enhanced learning which concentrates on content delivery may fall in this category, or be used by students in this manner.

2 The constructivist theories of learning are widely held and are based on the work of Piaget and others. Each learner constructs their perception of the world around them, based on their knowledge, experience and worldview. These mental models need to be explored and discussed for change in understanding to take place. Learning and experience result in the formation of new or amended mental models. These then form the basis for the next learning encounter. The focus here is on achieving understanding via the construction and testing of new
ideas. One example is simulators based on pharmacological modelling which allow experimentation along the lines of ‘what happens if...’

One concept in constructivist theory is that of the zone of proximal development (ZPD). Vygotsky observed that there are tasks a learner can do alone, those that lie beyond their capabilities yet and those that they can manage with help. These latter are said to lie within the learner’s ‘zone of proximal development’. The role of the instructor is to provide the help which allows the learner to achieve the task or acquire the knowledge. This may involve teaching, guiding or acting as a springboard for thinking and ideas. This also leads to the concept of ‘scaffolding’ learning: offering a little extra support until the learner is able to do it alone, gradually dismantling the support as the learner progresses.

Technology can increase the range of experiences to which the learner is exposed, e.g. by simulating rare or atypical presentations or responses to action. It can also help people explore new ways of approaching a situation. These experiences are then incorporated into the learner’s mental models and influence future responses.

Technologies which support adaptive content can help the learners to work in their ZPD. This may be achieved by scaffolding, where either the complexity of the material or the support to the learner is increased or decreased in proportion to the needs of the user. There are the two approaches:

- The first is to start with a very simple concept that is easy to dive into and build layers of complexity. This concept is well established in the computer games industry. The role of serious games in medical education is increasing but they are not often used in anaesthesia to date.10
- The alternative is to start with full support, prompts and safeguards from making errors – this can be achieved in simulation (the use of a ‘pause button’ in scenarios) but is demanding of time and resources. This degree of support is more difficult to achieve in e-learning than in simulation.

Technology may ‘perpetually’ change educational material using ‘deductive’ modelling.11 For example this may involve a programmed understanding of cardiac electrophysiology so that a limitless number of ECGs can be produced to demonstrate whichever concepts or pathology required. These can then be structured in order of complexity or to illustrate various physiological principles.

This illustrates a major dilemma within TEL, that of balancing optimum learning with available resources. Whilst a fully responsive ECG generator programmed from the ground up on physiological principles may be optimal, clearly the resources required to produce this kind of tool are considerable. Is the educational advantage that much greater than using a comprehensive collection of ECGs arranged or sortable in a similar manner? If so, is it feasible to make it available at reasonable cost?

Another issue with both scaffolding and adaptive content is the difficulty of automating the assessment of competence, i.e. how does a TEL system understand when a learner is ready to move on to the next layer of complexity. Likewise, when a learner is pushed beyond their limits, how is simplification or increased support re-introduced? This is implemented, to various extents, in serious games but the ‘fuzzy logic’ behind advanced decision support is complex and difficult to implement.

3 Social constructivism, the philosophy underlying much of PBL, extends the constructivist approach. Its premise is that learning is facilitated by interaction between learners, reflecting on and responding to the contributions of others. Wikis or online ‘chats’ (whether face to face or written, synchronous or asynchronous) can contribute to this. This may be formal, in which a PBL-style learning event is facilitated online (via web-based fora) or locally (via Nearpod12 or similar technologies) by the educator. Alternatively informal arrangements abound, from Facebook-mediated study groups to resources made available via YouTube or App stores. The shift from students as consumers of information to creators of educational resources is predicted to be one of the major changes in learning in forthcoming years.13 This is already evident in the explosion of blogs and podcasts publicised widely in social media and with this comes a new challenge of quality control.
Deliberate practice

Erricson felt that continued exposure to a meaningful repetition of life event (real or simulated) leads to a true and detailed understanding of how to resolve the situation. In theory simulation has much to offer here, but in practice it is difficult for any individual to get sufficient exposure – in many simulation courses a given candidate may only get one chance to practice. Feedback is a key component of this model, to avoid the well-known trap of experience leading to confidence but not necessarily competence.

Learning styles

It is often suggested that people learn in different ways with the visual – auditory – reading/writing – kinaesthetic model being widely used. Technology may be used to increase the number of modalities available. Conversely the growth in certain forms of technology enhanced education may favour those who learn in some styles over those who learn in other ways. Thus kinaesthetic learners may find learning easier during simulation than those who prefer to learn via auditory or reading/writing modalities. There is no evidence that this affects learning outcomes, but different learners may feel more or less comfortable when utilising different technologies.

Failure to realise promise

The informal use of technological advances is usually ahead of their formal adoption, and may be more successful. Their introduction is often driven by enthusiasts and can potentially lead to problems when rolled out beyond this base. This is one reason why initially encouraging results fail to be realised. Another is the adoption of a technological approach which is not in alignment with the learning objectives. Examples include the use of simulation to justify the expenditure on a particular suite or facility, or the development of e-learning (often to reduce trainer demand) which delivers information but fails to engage or inform.

TEL is very much in its infancy. Our knowledge and understanding of how we teach, learn and assess competence in medicine has been in refinement since the days of Hippocrates. While individual TEL solutions should be expected to fail as we evolve to an ever more enlightened manner of delivering education, the ubiquity of technology in all areas of our lives means TEL is here to stay.

References

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