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Technology in postgraduate medical education: a dynamic influence on learning?

Alison Bullock, Katie Webb

Cardiff University School of Social Sciences, Cardiff, UK

Correspondence to
Professor Alison Bullock, Cardiff University School of Social Sciences, King Edward VII Avenue, Cardiff CF10 3WT, UK; bullockad@cardiff.ac.uk

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ABSTRACT

The influence of technology in medical workplace learning is explored by focusing on three uses: m-learning (notably apps), simulation and social media. Smartphones with point-of-care tools (such as textbooks, drug guides and medical calculators) can support workplace learning and doctors' decision-making. Simulations can help develop technical skills and team interactions, and 'in situ' simulations improve the match between the virtual and the real. Social media (wikis, blogs, networking, YouTube) heralds a more participatory and collaborative approach to knowledge development. These uses of technology are related to Kolb's learning cycle and Eraut's intentions of informal learning. Contentions and controversies with these technologies exist. There is a problem with the terminology commonly adopted to describe the use of technology to enhance learning. Using learning technology in the workplace changes the interaction with others and raises issues of professionalism and etiquette. Lack of regulation makes assessment of app quality a challenge. Distraction and dependency are charges levelled at smartphone use in the workplace and these need further research. Unless addressed, these and other challenges will impede the benefits that technology may bring to postgraduate medical education.

INTRODUCTION

A central purpose of postgraduate medical education is to develop workplace practice. For the postgraduate trainee, work in the hospital, surgery or clinic is integrated with learning. Unlike formal, classroom settings, characteristic features of workplace learning include its often informal, social and collaborative nature and the opportunity to learn from reflection on practice. In the postgraduate arena, trainees and qualified practitioners are concerned to develop their clinical expertise which they acquire through active practice. The question posed for this article is what role technology has in this. The diversity of ways that technology might be employed to support learning makes this question complex. In the UK, the Department of Health[1] noted the 'unprecedented opportunities' that 'innovative education technologies' provide for trainees and practitioners 'to acquire, develop and maintain … knowledge, skills, values and behaviours needed for safe and effective patient care' (p.6). In this paper, we engage with this complex question by analysing key, significant uses of technology in postgraduate medical education. We choose to approach our exposition by focusing on m-learning (notably apps and 'adds'), simulation and social media. We selected these primarily because they are commonly encountered by trainees. Their use is increasingly prominent in formal and informal educational settings. They also represent diversity and they range in terms of how long they have been in use.

m-learning (apps and 'adds')

m-learning refers to learning via a mobile device such as a tablet or smartphone. Such devices are ubiquitous among doctors[2] and offer an array of potential benefits.[3] Downloadable applications (apps) give access to an assortment of materials to support workplace learning and decision-making for practitioners.[4 5] Examples include key medical textbooks configured for use on small devices,[6] medical calculators to assist in drug calculations, guidelines (both national and local) and checklists and score systems for diagnosis.[4] In their systematic review of healthcare apps, Mosa *et al*[4] reported that apps for disease diagnosis, medical calculators and drug reference were thought to be most useful. Similar findings were reported by Franko and Tirrell[7] where the most common apps were drug guides and medical calculators. A systematic review[8] of handheld computers in clinical practice concluded that, by providing access to information at the point-of-care, their use could improve healthcare professionals' clinical decision-making. Smartphones with point-of-care tools have also been shown to be valuable in resource-limited settings.[9]

In addition to apps, there are also 'adds' (or plug-ins) which are hardware extras that are attached to mobile devices. These include thermometers, blood pressure and heart rate monitors, breathalysers, stethoscopes and ECG monitors and are being used by clinicians and patients.[2 10]

Simulation

Simulations are widely used for educational development. In healthcare, examples in emergency medicine, surgery and anaesthetics are prevalent. For instance, in anaesthetics, virtual airway simulation (using freely available software on a mobile device) improved the speed at which dexterity skills were attained.[11] In another example, team training simulations of emergency situations have been shown to be effective.[12 13] A central feature of these simulations is the high-fidelity manikin which displays various physical signs. A notable illustration of the use of simulations to support training is in surgical procedures. Historically, novice trainees have developed their technical expertise through practise on patients. Such practice carried obvious patient safety risks but trainees benefited from learning in an authentic, real setting which

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provided them with experience of the complex and unpredictable environment of the operating theatre. Technological developments have enhanced the fidelity of virtual reality[14] and greater consideration is now given to using simulations to develop technical skills[15] and to simulate clinical contexts and team interactions. Context is important and growing attention is being shown to 'in situ' simulations which take place *within* the clinical environment.[16] Such simulations can better reflect the logistical challenges present in the organisational and physical environment and improve the match between the virtual and the real which will aid the transfer of learning into practice. The review by Rosen *et al*[16] reported that in situ simulation is most often used in the operating room (30%). Here the learners were always multidisciplinary and the learning or assessment objectives related to teamwork. About a third of the 29 papers in the review[16] reported the use of video review as part of the feedback process.

Social media

A review reported widespread use of social media by healthcare professionals and trainees, predominantly to facilitate communication.[17] The authors recognised that there is no agreed definition of the term 'social media' but helpfully distinguished five applications: collaborative projects (eg, Wikipedia), blogs or microblogs (eg, Twitter), content communities (eg, YouTube, which has been shown to be a valuable adjunct to more traditional methods of learning[18 19]), social networking sites (eg, Facebook) and social worlds or virtual gaming (eg, Second Life).

Social media has unshackled our approach to knowledge sharing and heralded a more participatory and collaborative approach to knowledge development. It has the capacity to empower learners to contribute content and build communities.[20] Social media has been used to develop virtual communities of practice, for example, to support discussion about clinical supervision among senior nurse leads.[21] In this Australian-based study, the virtual community of practice facilitated communication and information-sharing among respondents from geographically isolated rural areas.

PURPOSE

In this paper we aim to engage with the complex question: 'what role does technology have in workplace learning?' by analysing key, significant uses of technology in postgraduate medical education which we map to concepts in learning theory. As such analysis is lacking in the field, we offer a contribution to the intellectual understanding of the influence of technology on learning in the workplace. By discussing challenges or controversies which, unless addressed, will impede the benefits technology may bring to postgraduate medical education, our aim is that our paper will be an important reference point for medical educators and researchers in the field. We expect it to prompt thought and stimulate debate.

LINKING TO LEARNING THEORY

Educational uses of technology can be related to learning theory.[22] Different uses can be associated with stages in Kolb's[23] learning cycle. To illustrate, simulations offer opportunity to practise skills, thus providing a form of concrete experience; social media may support the learner's reflection on experiences and apps offer access to knowledge which can assist abstract conceptualisation. The trainee or practitioner may then apply the learning in future workplace practice (active experimentation).

These uses of technology may also be related to Eraut's[24] three intentions of informal learning: implicit, reactive and deliberative. Implicit learning is not undertaken consciously and Eraut[24] argued that most learning from experience will have some implicit aspects. Similarly, some learning from social media can be understood as implicit. Reactive learning is opportunistic, occurring in the middle of action. This might be supported by point-of-care apps. Deliberate learning has a goal and set time and encompasses what Eraut[24] calls 'deliberative activities'. Such activities might include work-based planning and problem-solving for which learning is a likely by-product. Simulation would be a form of deliberative learning, where the learner explicitly thinks about their actions. How educational use of technology might relate to learning theory is suggested in table 1. However, a feature of all these forms of learning with technology (m-learning, simulation, social media) is that they represent umbrella terms which encompass a range of different learning purposes and thus may be associated with different underlying education theories.

CONTENTIONS

Many of the debates about using technology in medical education are not about technology. Rather, they are about approaches to education or pedagogy. For example, debates about using simulation for team training are associated with much wider debates about the place of interprofessional education. One of the challenges of a paper which focuses on the place of technology in medical education is boundaries. Here we raise just some issues specific to current uses of technology in medical education.

Terminology

'Technology-enhanced learning' (TEL) is an expression commonly used as an umbrella term which captures the diversity of

Table 1 Uses of technology for learning and links to educational theory

	Use of technology		
	m-learning	**Simulation**	**Social media**
Examples	Apps (eg, medical calculators and drug reference); 'adds' (eg, monitors)	Surgical procedures; team training	Wikis (eg, Wikipedia); microblogs (eg, Twitter); content (eg, YouTube)
Settings	Workplace, close to patients (point-of-care)	'In situ' or in simulation labs	Varied locations including home and public areas
Possible educational purposes	Decision-making, problem-solving	Skills development; task performance, team work	Communication, reflection, knowledge creation
Learning	Abstract conceptualisation (Kolb[23]); reactive learning (Eraut[24])	Concrete experience and active experimentation (Kolb[23]); deliberative learning (Eraut[24])	Reflective observation (Kolb[23]); implicit, reactive and deliberative learning (Eraut[24])

ways of using technology to support learning. It is a term we like but we are becoming increasingly aware of its inherent problems. Two recent papers have critiqued the use of each of the three words in the phrase 'technology-enhanced learning'.[25 26] We illustrate here the trouble with the term by considering the word 'enhanced'. We have already indicated difficulty with the broad scope of 'technology', and 'what is learning?' deserves more attention than we can give it here. The word 'enhanced' indicates a sense of adding to or improvement and as such, using 'TEL' to describe an approach clearly implies a value judgement.[26] Bayne[25] goes further and suggests that 'enhanced' implies that there is already acceptable practice which just need a little improvement rather than some radical overhaul. Mindful of these critiques, instead of replacing TEL with another problematic term, we argue that it should continue to be used but with care and due recognition of its implicit assumptions.

Professionalism and etiquette

Technology changes the way we interact with patients, colleagues and teams.[27 28] Technology can enhance connectivity or get in the way, and misconceptions about mobile phone usage in the workplace abound.[29] When doctors use handheld devices in front of patients and workplace colleagues, they need to be sensitive to the rules of etiquette.[3 28] Knowing that such devices carry a camera raises particular professionalism issues and recent cases have given cause for concern. Parkinson and Turner[30] cite the case of four nursing students being expelled from their US College for 'posting photos on Facebook of a placenta they were examining in an obstetrics and gynecology clinical course' (p.1561). The posting was viewed as 'unprofessional'. Determining the boundaries of moral turpitude within the professional community may not always be straightforward, especially for new doctors. Social media raises issues relating to trust, privacy and confidentiality.[17 30] In using a microblog such as Twitter, doctors need to understand the boundary between the professional and the personal.[30] But what is 'appropriate' is open to interpretation.

Ideas from Foucault might help us to think critically about educational technology and raise neglected questions.[31] For example, his concept of 'normalisation' provides a way to think about the changing acceptance of the use of mobile devices in the workplace.[32] What is 'normalised' practice, who gets to define it and how? Whose voices are privileged? These are questions that relate to power and relationships between players (doctors, patients). Based on an interpretation of Foucault, Hope[31] argues for a 'deconstruction of sometimes contradictory outcomes' of educational technology practice (p.7). For instance, we might consider the potential for contradictory outcomes from using social media in a learning context. On the one hand, it can facilitate the democratisation or coproduction of knowledge; on the other hand, it can lead to anxiety about probity and result in silencing. Anxieties about what might be unacceptable may limit social media's potential to transform and democratise.[33] Social media both challenges professionalism and empowers users. In relation to reflection, it can support reflective practice or degrade it to <140 characters of instant self-expression. Learners may thus need more educational input on what is and what is not reflection. Such input would have wider educational benefit too.

Distraction and dependency

Turkle[34] refers to 'continuous partial attention', which she says affects the quality of thought given to each task (p.129). She suggests that ever-present technology encroaches on time alone with your mind. Ellaway *et al*[29] found that some students thought their mobile device might 'distract them from the patient-centered approaches to patient care they aspired to' (p.134). To reiterate, technology changes our interactions with people and the key point is to be aware of its impact.

Another point of debate is whether the ever-present mobile device leads to dependence[29] and the impact this has on learning. Over-reliance on apps, for example, may have the unintended effect of stifling learning. This is clearly an area that demands further research to develop a better understanding of contradictory outcomes.

Quality issues

Which apps are useful and safe? Assessing the quality of app content is challenging and the lack of evidence and professional involvement has raised questions around their reliability and accuracy.[35–37] For instance, medical apps designed and developed by pharmaceutical companies pose concerns about conflict of interest.[35] Furthermore, it has been suggested that the reliability of app reviews is questionable.[38 39] Users are advised to seek advice from clinician colleagues and check the trustworthiness of the app source; is it from a known medical society or the National Institute for Health and Care Excellence, for example?[40] How recently was it updated?

Apps, and more certainly 'adds', may be classed as medical devices and as such might be required to comply with the Food and Drug Administration in the USA or the CE mark in Europe or be registered with the Medicines and Healthcare Products Regulatory Authority in the UK,[41] if they are used in the diagnosis or treatment of patients. Such registration offers the consumer some security but it is questionable whether all apps and 'adds' have appropriate registration. There is clearly an argument for better regulation.[7 10]

CONCLUSION

Technology is not neutral in its effects[42] and it is important to consider *why* we use technologies.[43] Reasons may relate to convenience, efficiency, habit, novelty or the potential to enhance learning and pedagogy. Judging the place and value of technology is difficult since technology is often used in combination with other learning tools or activities. Thus, for example, the value of a YouTube video for enhancing learning cannot be judged on face value as it depends on the content and purpose of the learner's engagement. Similarly, we cannot argue that the use of Twitter per se has educational value as it depends on content and purpose. Likewise, we should not dismiss apps as having limited educational worth without knowing something about purpose. Without knowing something about the 'why', statements about the value of technology for learning are as useful as some global statement about the value of books. The educational value of the technology is bound to content and purpose. It needs to be judged on its appropriateness to purpose: what is it being used for and why?

What advice should be offered to trainees and experienced practitioners about the role and value of technology in postgraduate medical education? Beyond the central questions of purpose and content quality, it is useful to consider the impact technologies have on the relationship between learners and knowledge and how some applications of technology can shift the emphasis to an understanding of knowledge as cocreated. Consideration too needs to be given to its effects on how explicit knowledge is accessed (remotely, away from the site of action or at the bedside) and the scope it has to impact positively on the learning environment (safe practice in simulation). Trainee

doctors need the real workplace experience with patients to develop their skills and professionalism. Technology is an aid to but not a replacement for such experience and should not be judged as if it were a substitute for that contact.

Simulation has been around for some considerable time now. The area of greatest change and transformation is apps which, together with social media platforms, tend to be used on mobile devices. The contentions that we have identified are important and warrant further discussion and research. Postgraduate medical education is about acquisition of knowledge and also a process of social participation.[44] There is no doubt that technology can facilitate both knowledge acquisition and participation, but there remains a need to better understand the value it adds, and not just in terms of efficiency. We need to study how it facilitates the transformation of learning outcomes and interprofessional relationships, and where it can be best used in conjunction with or to complement other approaches to learning. Research in this area is lacking.

Main messages

- Learning theory can help to explain the educational potential of technology.
- Terminology, professionalism and etiquette, distraction, dependency and lack of regulation are problematic.
- Such challenges need to be addressed if technology is to fulfil its educational potential.

Current research questions

- Can technology facilitate the transformation of learning outcomes?
- Why is it difficult to judge how technology contributes to learning?
- Do benefits outweigh the disadvantages of using technology to support point-of-care learning?

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Self assessment questions

Please answer true or false to the below statements.

1. 'Technology-enhanced learning' is a problematic term.
2. Eraut describes three intentions of informal learning: implicit, reactive and deliberative.
3. There are contradictory outcomes associated with using mobile devices for learning in the workplace.
4. Currently, apps and 'adds' are appropriately regulated.
5. We cannot divorce use from purpose when making judgements about the value of using technology in postgraduate medical education.

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Contributors AB and KW discussed the content of the paper which was drafted by AB and developed by KW. Both identified and read the referenced literature.

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Answers

1. True
2. True
3. True
4. False
5. True