'Media will never influence learning': but will simulation?

Anthony R Artino Jr & Steven J Durning

In this edition of *Medical Education*, Norman, Dore and Grierson present a review of the association between simulation fidelity and transfer of learning.[1] The review addresses a practical question, references literature from several disciplines, and tackles important limitations in a manner that can enlighten medical educators. In this commentary, we expand upon some of the theories cited with the aim of including research and practical implications. Our goal is to begin a thoughtful debate among medical educators about what the findings might mean, how they relate to evidence from other lines of inquiry, and the direction research in this area might take in the future.

In the field of educational technology, there has been long-standing debate regarding whether or not media can influence learning.[2,3] Although not all scholars agree, many educational technologists accept Richard Clark's assertion that 'media will never influence learning'.[2] Rather, media are: 'mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition.[3] What influences learning, according to Clark,[2] is the *instructional method* underlying the medium employed. Just like Clark,[2,3] Norman and colleagues[1] argue that in cases in which different media (or simulations) yield similar learning gains, we must choose the less expensive way to achieve the learning goal. Medical educators are coming to similar conclusions[4] and, if one accepts Clark's argument[2] that method, not medium, affects learning, the question we should ask becomes: 'What are the key factors and instructional methods that positively influence learning and transfer?' To address this question, we begin with a brief definition of transfer and describe some of its important components. Indeed, we believe one key to moving forward is to better define the constructs we in medical education seek to study.

> *What influences learning is the instructional method underlying the medium employed*

The idea of transfer is central to understanding how humans develop expertise. The desire to understand transfer derives, in part, from the problem of inert knowledge, whereby an individual possesses the requisite knowledge but fails to put this knowledge to use in situations in which it is applicable. Thus, one definition of transfer is: 'the ability to extend what has been learned in one context to new contexts.'[5] Although a complete treatment of transfer is beyond the scope of this commentary, it is worth mentioning three of several key factors that seem to be essential for promoting transfer: (i) the degree of mastery of the participant and how that knowledge interacts with characteristics of the instruction; (ii) time and type of practice devoted to learning, and (iii) motivation for learning.[6] For a more inclusive view of transfer, we encourage readers to consult the classic text, *How People Learn: Brain, Mind, Experience, and School*.[6]

Cognitive load theory refers to limitations in human cognitive architecture that can influence learning and performance. Cognitive load theorists have known for some time that the effectiveness of any instructional approach is determined, in part, by the level of expertise (or degree of mastery) of the learner. Whereas a straightforward, clearly organised instructional video with lots of guidance might benefit a novice learner, this same video might be redundant for a more experienced learner. Evidence suggests that, for the more experienced learner, this redundancy can actually result in a high cognitive load that can hamper efficient learning. This so-called 'expertise reversal effect'[7] is important and may greatly impact the degree to which a medical simulation is or is not effective. From this perspective, if researchers fail to account for learner expertise, their results are likely to

Bethesda, Maryland, USA

Correspondence: Dr Anthony R Artino Jr, Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, Maryland 20814, USA. Tel: 00 1 301 295 3693; Fax: 00 1 301 295 0752; E-mail: anthony.artino@usuhs.mil

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be confounded. We believe that simulation fidelity (which may be a surrogate for instructional complexity) is likely to interact with learner expertise and so to truly understand its impact, researchers must measure both fidelity and learner expertise.

Transfer is the ability to extend what has been learned in one context to new contexts

Another important, but often overlooked, factor related to transfer is the amount of time it takes to learn complex subject matter and the type of practice learners employ. The '10 000-hour rule' suggests that the development of expertise occurs only after major investments in time and effort, and deliberate practice is shown to be a very effective strategy.[6,8] Do medical education researchers studying simulations account for these time and type of practice components? If so, how are they considered? Given the literature on expertise, we suspect the benefits of simulation fidelity may differ based, in large part, on *how* the simulation is used; that is, on the time invested by learners and the extent to which they employ a regimen of effortful activities (deliberate practice).[8]

Motivation is another important factor that is often ignored in medical education. Motivation affects not only the amount of time individuals are willing to devote to learning, but also the types of cognitive and metacognitive learning strategies they bring to the task.[6,9] Thus, whereas a high-fidelity simulation may not differ from a lower-fidelity simulation in learning outcomes, there may be differences in important *motivational outcomes* that are relevant for future learning and performance. However, these outcomes, such as learner self-efficacy, are often not assessed. Furthermore, there may be a tension between the first factor, learner expertise (and the resulting cognitive load), and the last factor, motivation. In our own work, we have found preliminary evidence that an instructional balance between these two, sometimes opposing, forces may result in superior learning.[10] Thus, we suspect the most valuable simulations are likely to be those that balance learners' cognitive load with their motivational beliefs about the value of the learning activity (e.g. the simulation) and their own capabilities to perform well.

Motivation affects not only the time individuals devote to learning, but the types of cognitive and metacognitive strategies they bring to the task

Considering these three factors – degree of mastery, time and type of practice, and motivation – we are not surprised that the differences between high- and low-fidelity simulations reported by Norman *et al.*[1] were small, especially if these factors (and others relevant to transfer) were not included as variables in the studies reviewed. We would therefore anticipate that the success of any given simulation would depend on these (and likely other) contextual factors; like most things in education, a 'one size fits all' approach is apt to be unsuccessful.

A final point related to transfer is the issue of measurement. Different learning experiences (e.g. different simulations) may look equivalent when tests of learning focus only on remembering facts or reproducing a motor skill, but they can look entirely different when tests of transfer are used. Some learning experiences result in good recall but poor transfer; whereas others produce good recall *and* good transfer.[6] This begs the question: 'Were the studies reviewed really assessing transfer (i.e. the ability of learners to extend what was learned to a new context)?' If not, we have no way of knowing which simulations promote transfer and which do not.

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In light of the above points, plus additional arguments raised by Norman and colleagues, we agree with the idea that 'the relationship between simulation fidelity and learning is not unidimensional and linear'.[1] Accordingly, when it comes to simulation in medical education, we think it is important to conduct studies that enhance our understanding of transfer by considering the factors that are essential for *promoting* transfer (e.g. degree of mastery, time and type of practice, motivation). This is no small task; nonetheless, we believe findings from other fields could provide direction for future investigations. As our understanding accrues, carefully designed studies that manipulate and measure these key factors – as well as studies that actually *assess* for transfer – are far more likely to inform our practice. What is more, we believe evidence from disciplines outside medicine should be reviewed by medical educators as this knowledge has the potential to generalise to our growing field of medical education.

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Medical error: time to get real?

Victoria R Tallentire & Samanth E Smith

'I am indeed amazed when I consider how weak my mind is and how prone to error.'
René Descartes

In recent years, professional guidelines, legislation and patient safety initiatives throughout the developed world have mirrored the public's desire for increased disclosure of medical error.[1,2] Error training is now an integral part of many primary medical training programmes, and Varjavand *et al.*'s study,[3] reported in this issue of *Medical Education*, provides cause for celebration amongst those who have championed such teaching. The study used hypothetical clinical scenarios to investigate attitudinal change amongst cohorts of interns commencing professional practice in 1999–2001 and 2008–2009.[3] The results demonstrated that the proportion of individuals willing to fully disclose their mistake to the affected patient in each of the two scenarios (defined as explaining the error and admitting fault) in the 2008–2009 cohort was almost double that in the 1999–2001 cohort.[3]

However, like all good studies, this work raises many more questions than it answers. Echoing the results of previous research,[4] the error disclosure rate in this study was inversely proportional to the severity of the consequences for the patient. In other words, the more severe the patient's clinical sequelae, the less information was likely to be disclosed. In the 1999–2001 cohort, 70% of interns agreed that 'disclosure exposes one to litigation'. This proportion declined in the 2008–2009 cohort, although over half of respondents agreed with the statement.[3] Such a high level of litigious concern so early in an individual's career is disheartening, particularly in light of recent research demonstrating that early disclosure of error may actually reduce malpractice claims.[5] However, wider dissemination of the benefits of early disclosure policies is likely to have little effect on the overall problem in the presence of much stronger opposing forces. The attitudes and behaviours of all newly qualified doctors are heavily influenced by the prevailing culture of the organisation and their perception of the hierarchy within which they work.[6] Varjavand *et al.*'s finding that fewer than half of the interns in each cohort would discuss an error with their attending phyisicians[3] will make sobering reading for those ultimately responsible for the care of patients. It is the responsibility of senior clinicians to confront this challenge by creating a culture of trust and openness amongst their colleagues. They must attend to the power of role-modelling[7] by discussing their own errors, whilst taking care to exemplify the honesty and humility they seek to inculcate in their junior colleagues.

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Centre for Medical Education, University of Edinburgh, Edinburgh, UK

Correspondence: Victoria R Tallentire, Centre for Medical Education, University of Edinburgh, Chancellor's Building, 49 Little France Crescent, Little France, Edinburgh EH16 4SB, UK. Tel: 00 44 131 242 6368; Fax: 00 44 131 242 6380;
E-mail: Vicky.Tallentire@ed.ac.uk

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