



Speeding Up Clinical Skills Development in Accelerated Undergraduate Medical Education: Current Insights From Cognitive Science

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Abstract

There is an increasing need to speed up essential clinical skills development in accelerated undergraduate medical education, but there are concerns about developing the required competency in these skills. The aim of this article is to provide insights from cognitive science, with a variety of practical evidence-based strategies for speeding up clinical skills development that have a unique focus on both maximising skill acquisition and retention, with minimisation of their decay over time. These strategies include the need to ensure readiness for training and to provide opportunities for regular practice with assessment and spacing across a variety of situations.

Keywords: clinical skills; acceleration; education; cognitive science

1. Introduction

There is an increasing global trend to reduce the duration of undergraduate medical education to provide a cost-effective approach to the global healthcare workforce crisis [1,2]. For example, the General Medical Council (GMC) has recently called for a radical transformation of undergraduate medical education in the United Kingdom (UK), with a reduction in the current length of training delivered by a new multidisciplinary team of educators [3]. This proposal has raised concerns about the quality of clinical training and the future competency of graduates, especially in performing essential clinical skills [4]. Clinical skills are essential for providing high-quality and safe healthcare and include a range of physical examination, practical and procedural, communication, and diagnostic and management skills [5]. Developing competency in a clinical skill, which is defined as the ability to effectively apply the skills in real-life healthcare situations [6], requires repeated and varied opportunities to practice these skills across a variety of situations. However, there are concerns that these opportunities are often reduced in the increasing trend to reduce the duration of undergraduate medical education [7,8].

A challenge for all educators providing clinical skills training on undergraduate medical programmes that have reduced their duration is how to speed up the development of clinical skills to ensure that graduates have the required competency for clinical practice. In this article, we provide insights from cognitive science, with a variety of practical evidence-based strategies for speeding up clinical skills development that have a unique focus on maximising both skill acquisition and skill retention, with minimisation of their decay over time.

2. Insights From Cognitive Science

Cognitive science seeks to understand the mind and its mental processes, including how knowledge is developed, stored, retrieved and applied to situations [9]. Research has highlighted that similar mental processes occur for the development of any type of skill, including its acquisition and retention [10]. This important finding suggests that insights from cognitive science are highly applicable for informing clinical skills training.

An essential aspect of skill acquisition and retention is the development of a mental model for the skill, and this requires the integration of both declarative and procedural knowledge [11]. Declarative knowledge refers to facts that can be retrieved from memory, such as names of medications or anatomical structures, whereas procedural knowledge refers to how a skill is performed, such as the automation of the main steps in making a management plan or the key techniques for inserting a central venous line. Repeated practice with testing and feedback will lead to further development of the mental model for the skill since there is expansion and integration of declarative and procedural knowledge with each practice of the skill. This process leads to automation, and when this happens, it avoids the decay of declarative knowledge, decreases the number of errors and speeds up performance.

There is extensive supporting evidence for the effectiveness of a variety of strategies for maximising both skill acquisition and retention across a wide range of skills, from mathematical problem solving to sport performance. There is also increasing evidence base for the effectiveness of these strategies for clinical skills training.



3. Practical Strategies to Maximise Clinical Skill Acquisition and Retention

In this section, we present a variety of interrelated practical strategies informed by evidence from cognitive science-based research on skill acquisition and retention, with minimisation of their decay over time, with research in clinical skills training and the wider research in other skills. These strategies can enhance existing approaches that are being used by educators for clinical skills training.

3.1 Ensure Readiness for Training

In order to provide the most appropriate strategies, identifying the level of the learner's development of the mental model and the competency of the skill is essential at the start of any training [11]. For example, learners without sufficient foundational declarative knowledge may struggle with developing even the most basic skills without addressing those knowledge gaps beforehand.

The implication for clinical skills training is that training should be based on an initial assessment of the learner's foundational declarative knowledge and competency in the skill. Asking specific questions, either directly at the time of training or by a pre-training multiple-choice quiz, can identify deficits in foundational knowledge. Deficits in the competency of procedural skills, such as venepuncture or ultrasound, can be identified by watching individuals perform the skill, and this can inform further training in the use of appropriate strategies.

3.2 Provide Opportunities for Both Repeated and Spacing of Practice

Repeated practice has been shown to be more effective for clinical skills development than in a single session [12–15]. Research from cognitive psychology has also demonstrated that spaced practice can increase retention even when the spacing between sessions is only a few minutes, but this increases when the spacing is expanded to several days [16]. The optimal interval between training sessions varies depending on the type of knowledge required for the specific clinical skill. For skills that are heavily based on declarative knowledge, such as interpreting an electrocardiogram, the optimal interval between sessions ranges from 10% to 15% of the time over which the learner is expected to perform the clinical skill without having an opportunity to practice the skill [17].

The implication for clinical skills training is that providing training over more than one session is important for clinical skills development. A major consideration is the spacing between the training sessions. For example, a learner may have had initial training on venepuncture before their forthcoming clinical placement, but is not due to attend this placement for three months. In this circumstance, a further training session is recommended three weeks after the initial training.

3.3 Provide Opportunities for Retrieval Practice With Testing

Retrieval practice is a more effective strategy compared with only providing multiple opportunities for learners to repeatedly practice a clinical skill [18,19]. This strategy has been shown to be effective for acquiring several clinical skills, including basic life support [20], cardiopulmonary resuscitation [21], radiograph interpretation [22], and clinical reasoning [23]. During retrieval practice, learners have to apply their mental model to the performance of the skill, and by receiving feedback from an educator, their mental model can be refined and developed.

The implication for clinical skills training is that opportunities for retrieval practice with testing are essential for clinical skills development. Simply offering learners repeated opportunities to independently practice their clinical skills without some additional support through retrieval practice with testing is unlikely to be effective for their clinical skills development.

3.4 Provide Opportunities for Practice Across a Variety of Situations

Although competency comes from practicing clinical skills across a range of different situations, there can often be little variability in the types of practice opportunities in conventional training. However, evidence from the wider literature suggests that variability of the practice minimises the effects of skill decay [24]. This variability has been shown to increase performance on lung auscultation [25], electrocardiogram [26] and radiology [22].

The implication for clinical skills training is that repeated opportunities for practice, with variability in patients and situations, are important for clinical skills development. For example, opportunities need to be provided for venepuncture on a range of patients (such as young and elderly, and thin and obese) and clinical environments (such as venepuncture clinics and emergency departments).

3.5 Provide Overlearning

Engaging in repeated and further practice after competency is achieved, increases retention and minimises skill decay by consolidating skills, with increasing automatisa-tion of the skill [27]. This is known as overlearning, and the overall effect depends on the type of skill and the extent to which learners engage in repeated practice [28].

The implication for clinical skills training is that repeated opportunities for independent practice once competency in the skill is important, but also that students appreciate the importance of continuing to practice the clinical skill once they have passed an assessment of competency in the skill, such as by workplace assessment. This continuing opportunity to practice the clinical skill also provides opportunities for the learner to obtain more feedback about their level of performance, as well as address any developing gaps in the performance of the skill.

4. The Challenges of Practical Implementation

We recognise that there are potential challenges in implementing the presented insights from cognitive science, especially the limitations of time. Our experience suggests that educators may have difficulty because of time constraints in implementing the opportunities for repeated practice, especially with retrieval practice with testing across a variety of situations, spacing of training and overlearning. In these circumstances, we recommend that educators focus on how they can practically implement opportunities for retrieval practice, especially since this strategy has been demonstrated to be one of the most highly effective cognitive science-informed strategies in other contexts [29].

An essential aspect of implementing the evidence-based strategies is recognition by educators of the importance of these strategies for speeding up essential clinical skills training. Educators may have opportunities to provide more time-tabled clinical skills training sessions, both in the medical school and on clinical placements. The typical undergraduate medical programme that has reduced their duration is unlikely to increase opportunities, and we suggest several practical approaches that can be combined for the implementation of the strategies:

(a) Consider the extent to which the recommended strategies are already being provided in existing clinical skills training. Educators may already be applying one or more of these strategies in their training, and it may be easy to integrate an additional strategy despite the time limitations. We recommend ensuring that retrieval practice with testing is included in all clinical skills training since it is highly effective.

(b) Peer-to-peer training may be an additional approach to educator-led activities. Research has highlighted the effectiveness of peer training for clinical skills [30], and this approach is widely implemented in medical schools, with evidence that demonstrates benefits in clinical skills development for both peers. An important aspect of peer-to-peer training is appropriate training and support to the peer teacher, with educators providing clinical skills training having a crucial role in advising the peer teachers in the importance of evidence-based strategies for clinical skills development.

(c) There are increasing opportunities for virtual reality simulation, which can offer time-efficient and cost-effective repeated opportunities that learners can access on demand [31,32]. These resources are constantly evolving and are provided by several commercial and non-commercial organisations.

Successful implementation of our recommended evidence-based strategies in the complex system of medical education programmes has no simple or easy answers. Educators will need to adopt a reflective approach to their practice [33], with consideration of the variety of enabling and constraining factors in the system so that they can nav-

igate the complexity and identify appropriate opportunities of implementation.

5. Conclusion

Speeding up the development of essential clinical skills is an increasing priority in undergraduate medical education. Evidence-based strategies from cognitive science can inform educators how to enhance the speeding up of clinical skills development by integrating strategies that maximise skills acquisition and retention, with minimisation of their decay over time.

Key Points

- Speeding up the development of essential clinical skills is an increasing priority in undergraduate medical education.
- Speeding up essential clinical skills development requires the implementation of appropriate evidence-based strategies based on insights from cognitive science.
- Key evidence-based cognitive science strategies include the need to ensure readiness for training and provide opportunities for retrieval practice with testing across a variety of situations, spacing of training and overlearning.
- Educators can enhance clinical skills training with time-efficient peer-to-peer training using cognitive science strategies, and also the increasing use of virtual reality simulations.

Availability of Data and Materials

Not applicable.

Author Contributions

JS and DCF made substantial contributions to the conceptualisation of the article and drafting the manuscript. Both authors contributed to the important editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

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Conflict of Interest

The authors declare no conflict of interest. John Sandars is serving as one of the Editorial Board members of this journal. We declare that John Sandars had no involvement

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