Preparation for future learning: a missing competency in health professions education?

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CONTEXT Evidence suggests that clinicians may not be learning effectively from all facets of their practice, potentially because their training has not fully prepared them to do so. To address this gap, we argue that there is a need to identify systems of instruction and assessment that enhance clinicians' 'preparation for future learning'. Preparation for future learning (PFL) is understood to be the capacity to learn new information, to use resources effectively and innovatively, and to invent new strategies for learning and problem solving in practice.

CURRENT STATE Education researchers have developed study designs that use dynamic assessments to measure what trainees have acquired in the past, as well as what they are able to learn in the present. More recently, researchers have also started to emphasise and measure whether and how trainees take action to gain the information they need to learn. Knowing that there are study designs and emerging metrics for assessing PFL, the next question is how to design instruction that helps trainees develop PFL capacities. Although research evidence is still accumulating, the current evidence base suggests training that encourages 'productive failure' through guided discovery learning (i.e. where trainees solve problems and perform tasks without direct instruction, though often with some form of feedback) creates challenging conditions that enhance learning and equip trainees with PFL-related behaviours.

CONCLUSIONS Preparation for future learning and the associated capacity of being adaptive as one learns in and from training and clinical practice have been missed in most contemporary training and assessment systems. We propose a research agenda that (i) explores how real-world adaptive expert activity unfolds in the health care workplace to inform the design of instruction for developing PFL, (ii) identifies measures of behaviours that relate to PFL, and (iii) addresses potential sociocultural barriers that limit clinicians' opportunities to learn from their daily practice.

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INTRODUCTION

Today's health care workplace requires clinicians who are capable of meeting increasingly complex challenges. To provide quality patient care, clinicians must be efficient with the knowledge they have gained previously, and be adaptive as they learn through both formal professional development and as a pervasive part of their daily work.[1] Current data suggest that as their careers progress, doctors do develop a strong body of case knowledge through their experiences with patients.[2–4] At the same time, doctors may not incorporate 'novel, conflicting information' as much as needed into their clinical problem solving,[5,6] suggesting that they are not adequately prepared to learn continuously through all forms of patient care.

A major challenge in preparing doctors for continued learning is that current assessments of clinician preparation tend to be retrospective. Educators and researchers often measure the efficiency that comes with mastery of past facts and skills. These assessments are not prospective, however, because they do not directly measure whether clinicians are prepared to continue learning beyond their formal training.[7] For instance, a large database study by Tamblyn *et al.*[8] showed that family doctors' medical licensure exam scores associated modestly with primary care outcomes (e.g. prescribing and consultation rates) up to 4–7 years following graduation. However, the relation between exam scores and performance gains was non-monotonic over time; higher exam scores did not predict a regularly accelerating advantage in primary care performance. Hence, how trainees scored on their exam did not have a consistent relationship with their future clinical performance. In a similar study, Asch *et al.*[9] found that accounting for obstetricians' licensure exam scores did not affect the robust relationship between location of residency training and birth complication rates in practice. Furthermore, obstetricians' initial complication rates upon graduating from residency associated more positively with future performance than did the volume of experience they accumulated during their careers, indicating that additional learning from experiences in practice was limited. The least optimistic interpretation of these two studies is that current medical licensure exams do not help us identify who will learn well on the job, and that enrollment in even the best residency programmes does not guarantee that doctors are comprehensively prepared for future learning. These two possibilities are related in that exams have a large influence on how and what schools teach, and current exams emphasise application of previously learned knowledge rather than preparation for future learning outside of the confines of direct instruction.

CONCEPTUAL UNDERPINNINGS OF PREPARATION FOR FUTURE LEARNING

Preparation for future learning (PFL) is 'understood as the ability to learn new information, make effective use of resources, and invent new procedures in order to support learning and problem solving in practice'.[10] For example, as clinicians work, particularly in situations of novelty and complexity, they often find that straightforward applications of their knowledge are insufficient to address patient needs. Instead, they are required to use their knowledge flexibly to develop an effective solution within the patient, social and system contexts in which they find themselves.[11] Those who are able to do so, work adaptively to provide optimal care for their patients, while gaining from the experience as part of their own continuous learning. By contrast, those who are not adaptive can still solve routine problems, but will likely not perform well in situations of uncertainty, novelty or complexity. Moreover, they may inadvertently apply their routine solutions to non-routine problems.[5] These two forms of expertise have been described as 'adaptive' and 'routine', respectively.[7,10] Routine expertise is useful for stable, recurrent tasks where there is a premium on efficient completion. Adaptive expertise is useful where there is a high degree of variability and change, and it is important to learn new ideas and ways of accomplishing outcomes. The imperative for developing adaptive expertise in health professions education is growing as the workplace increasingly causes clinicians to confront new challenges.

Adaptive experts are able to see the 'old in the new' by using their past knowledge. They can also find the 'new in the old'[12] by reconceptualising and evolving their practice as necessary. As a simple non-medical example, imagine people who only learned to drive with a gearstick. When they first drive a car with an automatic transmission, they will transfer in their prior knowledge of steering, the rules of the road and other important driving efficiencies. They see the old in the new. At the same time, they would probably reach for the gearstick and press the floor where the clutch pedal used to be – they would mistakenly apply old knowledge to a new situation. Because cars offer clear controls and simple feedback, the people in our thought experiment will probably recognise the need to change their habits and adapt to what is new about driving with an automatic transmission. The feedback helps them learn the new in the old. In comparison, doctors may not always receive equally strong signals that there is something new that is worth learning in their practice. Moreover, the cues for how to adapt may not be self-evident. One way to help people recognise and act upon opportunities for new learning is to create environments that support adaptation. Medical trainees may, for example, complete their rotations with an expert doctor who may, directly or indirectly, indicate what is new about an otherwise familiar situation.[13]

Contemporary systems of instruction and assessment in health professions education are heavily focused on developing and maintaining routine expertise.[14–16] There are many skills that doctors must master before they graduate into practice, and for those skills that can be known in advance, standard assessments are adequate. However, to determine whether doctors are prepared to adapt to what is new, we need innovative instructional and assessment designs aimed at developing adaptive expertise.

PFL AS AN ASSESSABLE CONSTRUCT: DOUBLE TRANSFER

Currently, there is no easy way to tell if medical education is preparing trainees for future learning because current assessments do not measure PFL. Instead most assessments only offer a snapshot of the current state of learners' accumulated knowledge. Lev Vygotsky,[17] who coined the felicitous phrase 'zone of proximal development', proposed that it is important to measure, not just what people know, but also what they are prepared to learn:

> Like a gardener who in appraising species for yield would proceed incorrectly if he considered only the ripe fruit in the orchard and did not know how to evaluate the condition of the trees that had not yet produced mature fruit, the psychologist who is limited to ascertaining what has matured, leaving what is maturing aside, will never be able to obtain any kind of true and complete representation of the internal state of the whole development.

Feurstein,[18] building on Vygotsky, pioneered the idea of dynamic assessments that directly measure whether people can learn. In his work with the cognitively disabled, he taught them how to answer IQ questions as part of his overall assessment. He would then determine if they improved on subsequent IQ questions, when no longer receiving instruction. His assessments of patients' learning potential were more sensitive and useful for their treatment than traditional IQ tests, which presuppose a fixed ability (for more on the history of dynamic assessment and intelligence, see Ref. 19).

Critically, Feurstein's dynamic assessments included supervised instruction, but most doctors will need to adapt without overt cues to needs for new learning. Doctors must spontaneously recognise where their prior knowledge is applicable and when it needs to be adapted. Bransford and Schwartz[10] developed the 'double transfer methodology' to assess PFL in order to reflect the unique demands of learning when not being told exactly when and what to learn. These authors have used the methodology several times to compare whether one course of instruction or another yielded better PFL outcomes. Figure 1 provides a schematic of their logic.

In one line of research,[20,21] college students received different instructional treatments for their initial learning and were tested immediately using a 'standard' transfer problem (i.e. requiring students to apply what they learned to a related, yet distinct problem). Students then received a common learning resource (see Fig. 1), which included new information that went beyond their original instruction. A double transfer design was used to see how the respective learning treatments prepared them to 'transfer in' their prior learning to learn from the new resource. To find out, students were then required to 'transfer out' what they learned from the common resource to solve a target transfer problem. The authors found that the two instructional treatments led to similar performance on the standard transfer problem, but there were large differences in performance on the target transfer problem. Had the researchers not used a double transfer design, the two instructional treatments would have appeared equally effective, when in fact, one was superior in preparing students for future learning.

In medicine, double transfer designs are now helping to elaborate the impact of different forms of instruction on PFL.[22] For example, there is a longstanding debate in health professions education over the influence of basic science instruction on student performance and eventual clinical reasoning competence. The integration of clinical knowledge

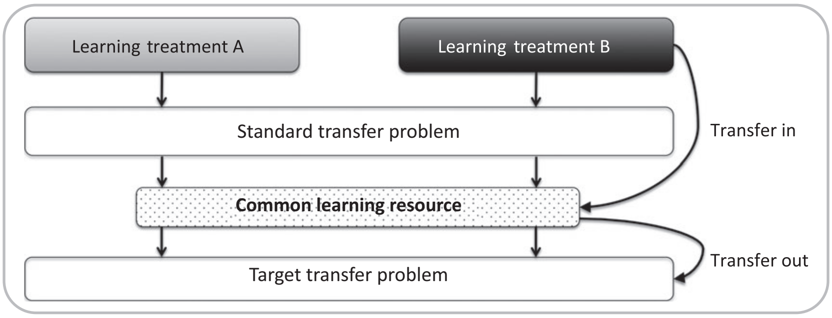

Figure 1 Depiction of one form of double transfer design. Adapted from Schwartz & Martin [20]

and basic biomedical knowledge has been shown to help novices develop a conceptually coherent mental representation that includes clinical features and underlying mechanisms.[23,24] This integrated mental representation creates a deeper understanding of disease categories, allowing novices to outperform their peers whose knowledge base is dominated by isolated clinical facts. However, this outperformance has been studied only using delayed 'transfer out' assessments of problem solving. Expanding this line of inquiry to determine if there is also an effect on future learning, Mylopoulos and Woods[22] used a double transfer design and found that medical students who received basic science and clinical instruction performed better at learning new content compared with those who received only clinical instruction. Specifically, students from the two instructional interventions looked similar in their immediate post-test performance, but there was a significant difference in how well they learned new material and transferred it out to a final assessment. Double transfer designs reinforce the point that not all assessments can make visible the impact of different forms of instruction. They also offer an opportunity for the health professions education community to explore whether curricula are developing all facets of expertise.

The double transfer paradigm is a relatively onerous test of the effectiveness of initial instruction, because it depends on cascading effects from the initial learning to later unsupervised learning and then to a final novel problem. From an education standpoint, feasibility becomes a potential limitation, given that so many learning and testing episodes are required and this may prevent double transfer designs from being accepted as a component of an already busy and time-constrained medical curriculum. Nevertheless, the overall design does reflect the situation facing many doctors, whose initial medical instruction not only influences how they handle new problems, but also whether they learn from those problems to improve subsequent practice. At the same time, PFL assessments provide an opportunity for additional learning, so that provides some savings. More importantly, if PFL-minded instruction is effective, then there will be additional savings down the line, because students have been prepared to learn more effectively in the future. Ideally, undergraduate and postgraduate medical curricula could provide innovative educational opportunities for trainees to learn and be assessed in their capacity for PFL.

PFL AS AN ASSESSABLE CONSTRUCT: MEASURING LEARNING PROCESSES

Although recent studies have used the double transfer design to demonstrate how prepared trainees are to learn from new material,[20,22,25] other studies have expanded how PFL is assessed by collecting data on how trainees interact with a common learning resource. Premised on the assumption that future learning depends on both skill and will, these assessments seek to capture trainees' willingness to use strategies that support learning in the future. One study, for instance, compared how non-medical graduate and undergraduate students engaged in a medical diagnosis task using a set of 10 cases as their initial common learning resource.[26] Here, the PFL measure was whether students took time to study the set of cases to develop their own representation of the information they could then use to diagnose additional cases. The researchers found that graduate students invested time in creating their own representations (e.g. a disease or symptom matrix) more often, and that this was associated with optimised diagnostic choices on two sets of test cases. By contrast, the undergraduates flipped through their stack of cases repeatedly for each new diagnosis. The experiences of managing complex information, probably obtained in graduate school, prepared graduate students to distill the diagnostic information in an adaptive way that led to superior diagnostic decisions. Such findings show that if PFL is the intended outcome of an intervention in health profession education, researchers must assess PFL-related behaviours, such as seeking feedback more strategically, creating an adaptive solution to patient care and teaching colleagues about it, and asking more pertinent questions during multidisciplinary rounds.

PFL-related behaviours have not been systematically studied in health professions education. However, studies that explore whether and how trainees take action to gain the information needed to learn or seek to capture trainees' choices as they learn (e.g. How do they seek feedback? What kind?) have incidentally captured PFL-related measures. In these studies, the evidence tells a mixed story on whether curricula are preparing trainees to engage in effective future learning.[22,25,27–29] In one study, medical students completed a computer-based multiple-choice test of six clinical domains, followed by a period where they could selectively review a full list of questions and answers.[28] Participants allotted more time to reviewing questions they had answered incorrectly, and also spent more time on questions where they had misjudged their knowledge (e.g. expressed confidence, though answered incorrectly, and the converse). Hence, the PFL-related measure of how participants spent time reviewing the material revealed that they concentrated on how to correct errors in their performance as well as in how they self-monitored their performance (i.e. to better align confidence and performance). Conversely, Harrison *et al.*[29] studied medical students who completed a 12-station objective structured clinical examination (OSCE), followed by an 8-week period during which they could self-regulate their use of a website designed to provide feedback for further learning. Most students accessed the site at least once, with two major patterns of access: (i) high performing students mostly viewed pages showing how they compared with peers, rather than pages explaining the nature of their superior performance, and (ii) students who 'just passed' the examination viewed the website least often. Hence, the PFL-related measure of how students seek feedback revealed somewhat worrisome patterns suggesting students used feedback for positive affirmation ('I'm better than everyone' or 'Woo, I passed!'), rather than for identifying current learning needs.

In both examples, the researchers collected unique measures of trainee behaviours that explore whether trainees are being adaptive in how they access and use information to influence their learning. Rather than capturing PFL-related metrics incidentally, health professions education researchers need to systematically identify and use PFL-related metrics in their study designs.

WHICH INSTRUCTIONAL CONDITIONS PROMOTE PFL?

Knowing that there are study designs and emerging metrics for assessing PFL, the natural question for educators to ask is how to design instruction that prepares trainees for future learning. Although the answer is not definitive, evidence is increasingly showing the promise of combining guided discovery and direct instructional approaches.[30] Guided discovery does not mean that students must actually discover the solution or explanation, but rather that they need to engage in the attempt. Guided discovery learning activities stimulate trainees to develop their understanding of a problem to be solved, in contrast to copying a told solution for a task they never experienced as a problem. Evidence from a number of studies suggests that guided discovery helps trainees to identify and activate their own knowledge, to clarify the different forms of knowledge they possess (e.g. conceptual versus procedural), to experience variability as they try different strategies for problem solving, and to formulate a better understanding of problem features.[20,30–33] Evidence suggests that the result is trainees are more flexible in how they approach problems, and better able to learn the material subsequently taught to them by an instructor.

Although the benefits of well-designed discovery activities alone have been elaborated,[30] it seems that guided discovery is highly beneficial when followed by direct guidance from an instructor. For instance, much of the learning from military exercises occurs during the debriefing. Without the exercises, the debriefing would be hollow, but without the debriefing, soldiers would not learn the broader principles that apply to those exercises and others. Experimental education research has reached similar conclusions. For example, a study of primary school students showed that a discover-then-tell group displayed superior conceptual knowledge compared with a tell-then-practice group on both an immediate post-test and a 2-week-delayed transfer test of their abilities to adapt their learning to a novel problem.[31] Active learning can create a time for telling. Given that the conventional approach in most curricula is to lecture first and allow trainees to practise second, the increasing evidence supporting the discover-then-tell sequence is controversial. Initial direct instruction, which seems to be a more efficient use of both instructors' and trainees' time, brings with it the danger of overly narrowing a trainee's focus. Trainees pay attention to the told solution, which overshadows their attention to the nature of the problem to which the solution applies. Tell-first instruction often emphasises 'correct answers' without allowing trainees to activate their own knowledge and to experience multiple potential (albeit incorrect) pathways to comprehending and solving a problem. If the educator's goal is to enable trainees to 'see what is new' in future situations, then encouraging discovery or exploratory activities, which might appear inefficient at first, appears to pay dividends for future learning, whether that learning comes from direct instruction, a subsequent reading, or other less obvious opportunities.[20]

Overall, the literature relating instructional designs to PFL-related metrics suggests that training that permits 'productive failure' during open-ended learning activities creates challenging conditions that enhance learning.[32] For health professions education, these forms of instruction offer a powerful opportunity to train clinicians in a setting that authentically represents the conditions they experience during challenging patient cases in practice: they must recognise and define that they have a problem, they must relate the problem to their own knowledge, and they will likely, though not necessarily, fail as they create multiple potential solutions. Their experience of that process will help them understand how best to address old problems in new ways.

MOVING FORWARD: PFL IN HEALTH PROFESSIONS EDUCATION

Although health professions education has a long history of being guided by theories of expertise to inform curriculum design and implementation,[28] the theories that currently underpin most educational programmes do not account for many of the competencies necessary for excellence in our changing health care context.[34,35] PFL and the associated adaptive behaviours that can be learned in and from educational and clinical experiences are key capabilities that have been overlooked in most contemporary training and assessment systems. One major step in developing new systems of health professions education will be research that identifies where in the curriculum to best integrate components of assessment and instruction that enhance trainees' and practising clinicians' PFL.

To identify which instructional designs encourage PFL, a foundational step will be to develop an empirically grounded understanding of adaptive expertise broadly and PFL-related behaviours specifically. In the classroom context, studies will need to explore which instructional designs result in improved performance on PFL assessments, as well as which behaviours and strategies observed during initial learning correlate with PFL assessment outcomes. In the clinical context, studies will need to explore how real-world adaptive expert activity unfolds in the health care workplace.[36–38] For example, a 2011 report found that 27% of doctors are aware of the NIH Public Access Policy and that 18% use the available research weekly.[39] These data reflect adaptive expertise in that these doctors are using and learning from a resource that may lead to a change in their practice. Once health professions researchers gain a sense of which domain-specific PFL-related behaviours should be fostered, the emphasis then shifts to how best to design instruction and assessment that promote those behaviours.

From a sociocultural perspective, evidence is building to suggest that assessments that map onto authentic learning opportunities are powerful educational catalysts.[40] If educators aim to develop such authentic assessments, then an area of inquiry will be to establish a clear understanding of the actual opportunities clinicians have to learn in and from their daily work. For example, one recent study showed that time for learning in the clinical context may be limited due to the emphasis on quality of health care and clinical efficiency (i.e. 'getting the patient out').[41] Other research has outlined the potential ways in which clinicians reify their practice-based learning, resulting in a rich resource for teaching and learning, but also risking the entrenchment of routines and standard practices that might not permit them to be responsive to situations of uncertainty and the need for change.[3] Research is needed to understand how clinicians perform effectively in situations of uncertainty,[42] especially in a busy world that values efficiency.

Finally, most, if not all, contemporary medical licensure examinations employ a form of snapshot, sequestered assessment, which emphasises demonstrating past knowledge and cultivates a static perspective of learning that can lead trainees to prioritise developing routine expertise alone. Double transfer designs have the potential to improve the sensitivity of current assessment systems by allowing researchers to systematically explore the efficacy of different forms of instruction through a dynamic approach to assessment. This requires interdisciplinary thinking about what it means to develop dynamic assessment across the spectrum of medical education.

CONCLUSIONS

Educators in the health professions have not rigorously assessed trainees' competencies using the concepts of 'transfer in' and 'transfer out', which means they may be missing either (i) PFL-related behaviours they are developing successfully in trainees, or (ii) evidence regarding important objectives the curriculum is not meeting. However, it is still possible to use simpler assessments than a double transfer design and still uncover and measure trainees' PFL-related behaviours.[28,29] The broader point is to encapsulate PFL as a desirable capability in new assessment systems, thereby expanding educators' abilities to assess all facets of expertise. Within this framing, there is an opportunity to be innovative as we think of different ways to measure PFL-related behaviours. Previous work to build on includes explorations of whether trainees use instructor-designed clinical approaches to organise their future learning,[25] which items from a previous test trainees will look up when given the opportunity to use Google search,[27] and whether and how trainees adapt and reformulate information to create their own representations for learning.[26]

The ultimate goal of any system of instruction and assessment is to enable trainees to see the old in the new by replicating previously useful strategies, and to see the new in the old by innovating and exploring new adaptive strategies.[12] Although PFL is critical to adaptive expertise, in some clinical practice settings learning is not always the goal and, likewise, in some education settings PFL is not always the goal. Not every problem requires innovation. A clinician who efficiently applies or replicates knowledge to solve routine problems is exhibiting a key aspect of effective practice.[43] Educators and researchers must attend to these multiple facets of expertise as they carefully consider how their instructional designs align with the desired outcomes of a learning experience (e.g. do we want to cultivate retention, transfer in or transfer out?). In health professions education, instruction focusing on routine problem solving is well established. Although research questions remain, there is an extensive body of literature on the ways in which individuals see the old in the new and the educational designs that support the development of this ability.[44,45] However, the forms of instruction that support trainees as they develop PFL-related behaviours are not well understood. Health professions education is poised to ensure trainees are prepared for future learning by identifying and developing instructional designs and dynamic assessments that support PFL.

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