Innovation and Change in Professional Education 20

Kathryn N. Huggett
Kelly M. Quesnelle
William B. Jeffries *Editors*

An Introduction to Medical Teaching

The Foundations of Curriculum Design, Delivery, and Assessment

Third Edition

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Innovation and Change in Professional Education

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This edition is dedicated to our esteemed colleague and collaborator, Janet M. Riddle, MD, who inspired countless learners and peers.

Preface

This book was conceived as a tool for the many varieties of medical teacher: the basic scientist, the clinical faculty member, the resident physician, and the community practitioner. Individuals from each of these groups often assume the responsibility for educating the physicians of tomorrow. However, the formal training of these teachers is usually not centered on the science of learning and instruction. Medical teachers often enter their careers ill-equipped to engage in a scholarly approach to teaching. As we developed the third edition, we were reminded that while the evidence for scholarly teaching has increased, faculty preparation still lags. Thus, we continue to offer this volume as a how-to guide for medical teachers who wish to gain an understanding of educational principles and apply them to their teaching. This volume is unique because it is an introductory text designed to provide medical and other health science teachers with a comprehensive introduction to the core concepts of effective teaching practice. There are other texts that cover singular topics in greater depth, and there are longer texts that cover multiple topics in greater depth. We aimed to provide a singular text containing introductory-level information about curriculum design, delivery, and assessment, as well as educational scholarship.

Although the third edition contains a wealth of new material, there are important similarities to the second edition of this work. The chapters were written by leaders in medical education and research who draw upon extensive professional experience and the medical and health professions literature. In keeping with the previous edition, there is a survey of the most common teaching modalities encountered by a medical teacher (lecture, flipped classroom, asynchronous electronic, problem-based, team-based, clinical, simulation, and laboratory). Similar to the previous edition, we encourage the reader to further investigate each topic. Many of the chapters conclude with recommendations for additional reading, and there is an appendix with resources for medical and health professions education.

Creating a third edition also offered us a special opportunity to recognize that there has been significant change in the world, and in medical education, in the intervening 6 years. Thus, the opening chapters reflect an expanded understanding of the science of learning and instruction, including increased emphasis on active learning, self-regulated learning, and the activities that enhance learning and performance. This edition also addresses the expansion of interprofessional education (IPE) curricula, the wider acceptance of technology to support asynchronous and distance learning, and greater attention devoted to teaching and assessing professional attitudes and behaviors. Throughout the volume, the authors have noted practices to promote diversity, equity, and inclusion. Finally, the new edition explores the growing recognition of the teacher as scholar, and the significance of the educator portfolio in documenting scholarly work.

The scope of educational scholarship continues to widen and draw from across the health professions and social sciences. Thus, no single author could adequately address the topics presented herein. We have assembled an exceptionally qualified and highly regarded team of authors who represent a diverse pool of teachers, clinicians, and educational scholars. We are extremely grateful to the authors, who generously devoted their time and talents to this project.

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Chapter 1
The Science of Learning

Cynthia L. Nebel and Megan A. Sumeracki

Abstract Much research on the science of learning has originated in the field of cognitive psychology, where researchers examine basic processes of attention and memory in order to develop strategies for effective learning. Cognitive psychologists have determined six strategies with considerable evidence supporting their use. These strategies include spaced practice, interleaving, elaboration, concrete examples, dual coding, and retrieval practice. These strategies can be used individually or together to adjust current practices and produce improved and more efficient learning outcomes.

Introduction

Over the past few decades there has been a surge of research into the science of learning. Much of this research stems from the field of cognitive psychology, where researchers investigate the underlying mechanisms of attention, perception, and memory and apply that understanding of basic processes to develop strategies for learning. Similar to the hard sciences, cognitive psychologists start in a laboratory environment, where they can carefully control the learning materials they use in order to understand effects and interactions. Instead of chemicals and beakers, cognitive psychologists are often instead working with simple materials like nonsense syllables and word lists. As we gain a better understanding of those mechanisms, we are able to move to more complex materials and eventually, out of the lab to actual instructional environments.

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The goal of the science of learning is to develop evidence-based practices for instruction and learning. Just as we want practitioners to use methods that have been developed, tested, and determined to be effective, similarly cognitive psychologists have developed, tested, and determined several strategies that are best for enhancing learning. In this chapter, we review overarching cognitive processes as well as six strategies that researchers have identified as broadly effective at producing learning (Dunlosky et al., 2013; Sumeracki & Weinstein, 2018).

Cognitive Processes

Learning can be defined in many ways, but for our purposes we are defining learning as the process through which knowledge and skills are acquired (with the purpose of retrieval and use in the future). As we take in new information, it moves through several different types of storage and processing before we can say that we have "learned" the information. In Fig. 1.1, you can see a simplified model depicting this process.

Raw sensory input first hits the system. This sensory input can take the form of auditory signals, olfactory information, or even the visual input as you read these words. Most of this information stays in the system only briefly, but information that we pay *attention* to moves into *working memory,* which is sometimes referred to as *short-term memory* (Atkinson & Shiffrin, 1968). Working memory is the active, conscious part of our memory system. This is where we hold information in mind, solve problems, reminisce, and is what most people call thinking (Baddeley, 2000). Working memory has limited capacity; we can only hold so much information in mind at any given time (Miller, 1956). We therefore have to be careful during instruction not to put too much *cognitive load* on the learner, so as not to overwhelm their working memory (Mayer & Moreno, 2003; covered in more detail in Chap. 2).

As we process information in working memory, we create neural traces associated with that information, a process that we call *encoding* (i.e., writing the neural code) into long-term memory (see Van Hoof & Doyle, 2018). Over time, the new knowledge combines with existing knowledge, which is called *consolidation*

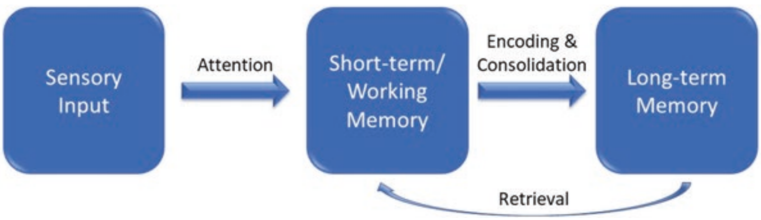

Fig. 1.1 A processing model of memory

(Stickgold, 2005). Later, when we need to access the consolidated information from long-term memory, we use *retrieval* to bring it back into working memory (see below).

Applying Cognitive Psychological Science to Teaching and Assessment

For the past few decades, cognitive psychologists have conducted research on the most effective and efficient ways to learn and apply new information, and from this work evidence-based practice recommendations can be made (Dunlosky et al., 2013; Weinstein & Sumeracki, 2018). The field has identified a variety of evidence-based learning strategies that are particularly effective (Pashler et al., 2007), and these are highlighted in the table below. In the following sections, we will introduce each strategy and provide applications of the strategy for use in medical and health professional education settings (Table 1.1).

Evidence-Based Learning Strategies

Spacing

Spaced practice refers to the way in which information is acquired and reviewed over time. Instead of learning information in a single long session (often called *massing* or *cramming*), spaced practice suggests that the single long session be

Table 1.1 Six strategies for effective learning, descriptions and application examples

Learning strategy	Description	Application examples
Spaced practice	Distributing learning and practice of information over time	Instructors can review topics after a delay within a single session or, ideally, over days and weeks.
Interleaving	Switching between topics during learning and practice	Instructors can review topics in different orders and assign practice in random order instead of blocked by topic.
Elaboration	Asking and explaining how and why things work, and making connections	Learners can prepare to teach information to others.
Concrete examples	Illustrating abstract concepts with multiple concrete examples	Instructors should use multiple, varied examples.
Dual coding	Combining visual and verbal representations	Instructors should provide multiple representations of information to all learners, regardless of their preferences.
Retrieval practice	Bringing learned information to mind from long-term memory	Learners can work in groups to explain concepts to one another from memory.

divided into several shorter sessions (Rohrer & Pashler, 2010). When learning takes place in a single session, the brain is continuously processing that same material. But when there is time, and ideally sleep (Cepeda et al., 2006), between the sessions, the associated neural networks have to be re-activated and this process strengthens and stabilizes the network (Van Hoof et al., 2021b). This method is sometimes referred to as *distributed practice* or simply *spacing*. As an example, imagine that you could schedule a learning experience in one of two ways; either you could schedule two four-hour workshops with a break in between for lunch or eight one-hour meetings over the course of eight weeks. While the latter will take longer (eight weeks longer to be precise), the actual acquisition of knowledge and ability to transfer or apply that knowledge to new situations will be higher for individuals with the spaced schedule (Moulton et al., 2006; Willis et al., 2013).

Researchers have found this *spacing effect* in many domains, including vocabulary learning (Kornell, 2009), concept-learning (McDaniel et al., 2013), problem-solving (Grote, 1995), and motor skill acquisition (Goedert & Miller, 2008). Within medicine, the spacing effect has been demonstrated for surgical residents learning microvascular anastomosis (Moulton et al., 2006), primary care providers using prostate-specific antigen testing (Kerfoot et al., 2010), surgeons acquiring laparoscopic surgical skills (Nakata et al., 2017), among others (see Cecilio-Fernandes et al., 2018). Given the breadth of domains and materials for which spacing improves learning, it is one of the most robust and strongly recommended learning strategies (Pashler et al., 2007).

There are many ways to incorporate spacing into instruction. These can include simple spreading apart of learning sessions as described above, but often we have limitations on the time we can spend with learners. Even within a single session, spacing can be achieved by introducing cognitive breaks into the session, revisiting material from the beginning of the session later in the session, or providing a means for individuals to review the material at a later date (for example, via an email or text reminder). If it is possible to spread the information over days, that is preferable, as sleep aids in consolidation (Stickgold, 2005), but any amount of spaced practice will improve learning over massed practice.

Interleaving

Interleaving is, in simplest terms, the process of switching the order in which material is reviewed. Often, material is reviewed in a *blocked* format, where all of the problems of one type or all of the material for one subtopic is reviewed before moving on to the next problem type or subtopic. Interleaving instead suggests that the materials should be mixed (Dunlosky et al., 2013). For example, if someone were learning different common chest radiographic patterns, they could view several of the same pattern in a row before moving on to the next or instead, they could shuffle the order and review one pattern at a time (see Rozenshtein et al., 2016). This method allows the learner to not just understand how to process information or apply a solution, but also how a specific problem or subtopic is similar and different than the other problems or subtopics. In the example above, the learner would more readily recognize differences between the patterns, allowing them to more easily distinguish between the patterns in the future.

Although interleaving also typically introduces some amount of spaced practice, interleaving does have an independent effect (Rohrer, 2012). Interleaving has been shown to improve learning of conceptual categories (Kang & Pashler, 2012; Wahlheim et al., 2011), mathematical problem-solving (Rohrer & Taylor, 2007), and motor skill learning (Lin et al., 2013; see Brunmair & Richter, 2019). An interleaving benefit has also been demonstrated for learning and application of laparoscopic skills (Goldin et al., 2014; Welsher & Grierson, 2017) and interpretation of radiographic patterns (Rozenshtein et al., 2016).

In order to implement interleaving, learning experiences should be designed to introduce a topic but then revisit that topic at various intervals and not in the same order each time. In situations where learners need to differentiate between categories, types of problems, or to develop motor skills (e.g., distinguishing between similar presentations of diseases and learning similar surgical techniques), learners should be encouraged to mix up the order in which they practice. One important caveat for interleaving is that the benefits of interleaving are reduced for novices. That is, learners should have some understanding of the content area before introducing interleaved review.

Elaboration

Elaboration involves making connections between pre-existing knowledge and new information (Weinstein et al., 2018). Ideally, the learner makes many connections among the content they are learning so that it becomes associated with a large number of contextual cues (Van Hoof & Doyle, 2018). Many memory theorists have claimed that elaboration is one of the most effective ways of improving learning (e.g., Anderson, 1983). However, the concept has become so broad within the field of cognitive psychology that it is difficult to claim elaboration will always improve learning (Weinstein et al., 2018). Still, there are two similar techniques making use of elaboration that can be useful in applied learning situations: self-explanation and elaborative interrogation.

Self-explanation involves generating an explanation about why information is important, and how it is related to pre-existing knowledge. Importantly, through self-explanation learners create their own personal understanding of the material (Dunlosky et al., 2013). In a randomized experiment with medical students, Larsen et al. (2013) showed that self-explanation improved performance on an essay test requiring both retention and clinical application six months after initial learning. Self-explanation was particularly effective when it was combined with retrieval practice, another strategy discussed later in this chapter.

Elaborative interrogation is a technique during which learners generate "how" and "why" questions related to the content that they are learning and then find the answers to those questions (Weinstein et al., 2018). The goal is to generate a number of these questions and explanations. Generating explanations helps the learner make connections between pre-existing knowledge and the information being learned. Elaborative interrogation has been found to improve learning compared to passively reading information (Pressley et al., 1987).

Instructors can encourage learners to engage in self-explanation and elaborative interrogation to develop their understanding of the material they are learning. For example, instructors can provide review sheets that highlight important concepts, and learners can use them to generate explanations that they believe will help them understand and retain the information. Requiring learners to prepare to teach concepts in groups can also encourage self-explanation (Weinstein & Sumeracki, 2018). One important caveat, however, is that learning strategies involving elaboration are often most effective when the learner has greater prior knowledge (Woloshyn et al., 1992). Thus, these strategies can be used to further develop understanding but may be less effective if used during initial acquisition.

Concrete Examples

Providing concrete examples alongside abstract content can help learners both understand and remember information (Weinstein et al., 2018). Examples can help learners to activate prior knowledge related to the topic, and concrete information is better remembered than abstract information. Moreover, research from cognitive psychology suggests that multiple examples should be used to facilitate learning and encourage learners' ability to apply the concepts in different situations later (i.e., transfer of knowledge; Gick & Holyoak, 1983).

Providing learners with multiple concrete examples encourages transfer of knowledge to new situations or contexts, an important learning outcome for medical and health professionals. One concern with using concrete examples is that learners may remember the specific examples, but struggle to remember the underlying principle or apply the example appropriately. Research has shown that novices, or those with relatively less prior knowledge in the topic area being learned, tend to remember surface details of examples rather than the underlying principle (Chi et al., 1981), while experts are better able to extract the underlying structure from an example, even when the surface features are different. Providing multiple concrete examples, especially a range of examples with different surface features, can help facilitate understanding and transfer.

It is likely that most instructors in medicine and health are already using concrete examples, such as clinical scenarios or case studies, to facilitate learning. Instructors can further encourage learning and transfer of knowledge in future situations by providing multiple, varying examples. For example, in a learning module on the general concepts of drug metabolism and pharmacokinetics, instructors can provide specific examples of acetaminophen, morphine, and antihistamines, and a variety of situations where understanding the general principle of pharmacokinetics would be necessary to solve a problem or understand drug interactions. It will be difficult, if not impossible, to determine the exact situations in which learners will need to apply specific knowledge in the future. However, by providing multiple varying examples, instructors can help improve the likelihood that learners will be able to apply their knowledge when necessary (Kaminske et al., 2020).

Dual Coding

Dual coding involves integrating verbal and visual representations of information. Broadly, dual coding theory suggests that providing multiple representations of the same information improves learning (Clark & Paivio, 1991). Adding visual representations to text makes the information more concrete and more memorable (Paivio & Csapo, 1969, 1973), and some theorists have broadened the concept to include additional representations, such as motor movements (see Weinstein et al., 2018 for a history). Some research has reported success with providing multiple representations to promote learning in health care domains (Hartland et al., 2008). Importantly, the visual representations should be both helpful and relevant to the topic being learned. If the visual detracts from the verbal representation of the information, and does not provide useful information, then it can harm learning (Harp & Mayer, 1997). Further, presenting too much information all at once can produce cognitive overload (see Chap. 2), which can harm learning (Mayer & Moreno, 2003).

The recommendation to combine visual and verbal representations often leads instructors to think of the debunked concept of learning styles. Learning styles is the theory that individual learners each have a style (or, in some cases, a few styles). According to the theory, in order to maximize an individual's learning, instruction must be matched to their individual learning style (Pashler et al., 2009). Indeed, learning styles is popular among educators; and, because many of us have preferences in learning formats (e.g., one learner may prefer to listen to information while another prefers examining diagrams), the theory makes intuitive sense to a lot of people. However, the need to cater to individual learning styles is a myth. The learning styles theory is not supported by experimental evidence (Pashler et al., 2009), and labeling learners with specific styles and restricting the modalities presented to them may be harmful (Weinstein & Sumeracki, 2018).

Consider an example: learning to perform a cesarean section. According to learning styles theory, those training physicians would need to diagnose and label each physician in training according to their learning style. Then, the trainees identified as "visual" would only learn the procedure by examining diagrams, and maybe watching someone else perform the procedure. Trainees identified as verbal would only be able to read about the procedure, or listen to someone else explain it (no diagrams!). Finally, kinesthetic trainees, or those who "learn by doing" would be the only ones able to attempt the procedure. Instead, dual coding, an evidence-based learning strategy, suggests that learners should be exposed to a wide range of modalities rather than focusing on individual preferences. Applying dual coding, or multimodal learning, the trainees would learn the cesarean section procedure by reading about it, examining diagrams, watching others perform the procedure, *and* practicing the procedure under supervision.

Instructors can promote dual coding by providing visual and verbal representations of information, such as texts along with diagrams, taking care to ensure that the visuals promote understanding and that learners have enough time to process all of the presented information (Mayer & Moreno, 2003). Instructors can acknowledge that students have format preferences, but should provide multiple representations and encourage all learners to engage with multiple representations of information to promote learning.

Retrieval Practice

Retrieval practice, put simply, is bringing information to mind from memory. Imagine answering a question during a board exam. The question serves as a prompt to lead you to, hopefully, retrieve specific information. The question may even require that you retrieve information and further apply it to some new context. Engaging in retrieval in this way is most often considered an assessment of knowledge, a neutral event that simply allows the examiner to learn what the test-taker knows. However, while one benefit of testing is assessment, answering test questions benefits the learner in a number of ways (Roediger et al., 2011). In fact, it is one of the most robust and widely applicable strategies learners can use to reinforce what was learned.

Retrieval practice benefits can be separated into two categories: indirect and direct (see Fig. 1.2). An indirect benefit is one that is caused through something else.

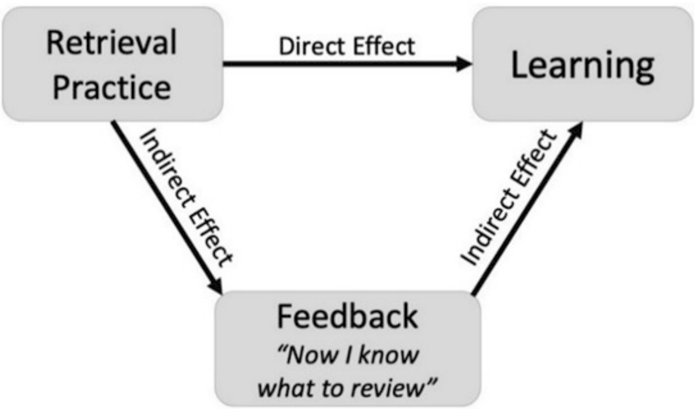

Fig. 1.2 Direct and indirect effects of retrieval practice on learning

In other words, retrieval practice produces some effect, such as getting feedback about what you know and what you do not know leading you to review the information you do not know as well, and this feedback and review leads to more learning. When learners utilize retrieval practice, it is most often to leverage these indirect benefits (Karpicke et al., 2009). In addition, retrieval practice also produces direct effects on learning. Something about actively bringing the information to mind makes it more durable, and increases one's ability to apply the information in new contexts, and cognitive psychologists are still trying to understand exactly how these benefits occur (Karpicke, 2017). Practically, however, the benefits of retrieval practice work together to make this a particularly effective strategy. Further, retrieval practice has been tested in randomized control trials with medical students (Larsen et al., 2012; Ramraje & Sable, 2011), medical residents (e.g., Larsen et al., 2009) and in a variety of continuing professional development (CPD) contexts (see Van Hoof et al., 2021a).

Learners can engage in retrieval practice to reinforce their own learning in a variety of ways, such as answering specific questions, explaining concepts to another person, or just freely writing or sketching everything they can remember. Requiring learners to also elaborate by generating explanations of the retrieved information can make retrieval particularly effective (Larsen et al., 2013). Medical students and residents are already engaging in retrieval during high-stakes examinations, and while some learning may occur during high stakes retrieval practice, adding in low-stakes or no-stakes tests or quizzes, or requiring the learners to engage in retrieval by explaining concepts to peers can further benefit learning. Continuing professional development (CPD) planners and those working with learners at later career stages can also implement retrieval practice. For example, Feldman et al. (2018) showed that online multiple-choice tests before and after a four-day conference improved retention compared to just attending the workshop alone in a randomized control trial with physicians, demonstrating successful use of retrieval practice to improve learning from CPD (see also Van Hoof et al., 2021a).

Summary

While each of the above strategies has research to support its use, instructors must be mindful of when it is appropriate to use each strategy. For example, interleaving is best used with specific types of materials, as when a new concept needs to be learned or when multiple solutions could be applied to a problem (as in diagnosis; Brunmair & Richter, 2019). Concrete examples are best utilized when there is an abstract concept to be learned (Weinstein et al., 2018). Retrieval practice is a robust strategy that works with most material, but there are limitations on the extent to which the strategy will allow learners to apply the material to new contexts (see Nebel, 2020).

In addition, these are not isolated strategies. Many of the strategies work well together. For example, you can create opportunities for retrieval that are spread out over time. This method involves spaced retrieval practice – a powerful strategy! Having learners teach one another in small groups could involve all of the strategies at once. Each strategy discussed in this chapter should be considered a flexible, guiding principle that you can use to adjust your current instruction to develop more effective, evidence-based learning experiences.

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Chapter 2
The Science of Instruction

Jesse S. Moore

Abstract Translating the science of learning into effective instructional techniques is a science unto itself. This chapter will describe active versus passive learning. It will discuss instructional strategies based on active learning and the modern trend for case-based presentation curricula in medical education. It will introduce the concepts of active learning across the methodologies and class sizes discussed in the remainder of the text. Finally, this chapter will describe the cognitive load theory and its application for the instructional design of medical education teaching sessions.

Introduction

Learning is defined as a change in knowledge, skills, and attitudes based on experience. The science of learning has been outlined in the prior chapter. Instruction is a teacher's manipulation of the learning experience and application of the science of learning, with a goal of fostering and promoting learning (Mayer, 2010). This chapter will define the instructional methods of active learning and review the evidence for their effectiveness. A brief overview of commonly used active learning methods will be provided as an introduction for subsequent chapters. Regardless of the method a teacher chooses to use, the design of the instruction itself must be carefully considered. Cognitive load theory will be introduced and reviewed, with examples of its application provided.

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Active Learning Versus Passive Learning

Active learning is grounded in the constructivist theory of learning (Dennick, 2016). Initially described by Piaget (1926), the constructivist view assumes that learning occurs through a process of connecting new information to existing knowledge. Learning occurs through an individual's interactions with new knowledge, discovering relationships through exploration and experience. The focus is on the learner *doing*, rather than *receiving*. This contrasts with the predominant, traditional, passive, lecture-based theories of learning in which the focus is on the teacher transmitting knowledge to the novice learner. A commonly used phrase that describes the different role for the teacher in passive compared to active instruction is "the sage on the stage becomes a guide on the side."

Much of the evidence for active learning comes from undergraduate education. The outcomes of active learning in undergraduate science, technology, engineering, and mathematics (STEM) courses are relevant to medical education. Freeman et al. (2014) performed a meta-analysis of exam performance and course failure rates in 225 STEM studies comparing lecture-based instruction to active learning. Exam scores improved by 0.47 standard deviations or an average of 6% in courses taught with active learning. Learners taught with lecture were 1.5 times more likely to fail a course. The effects were most pronounced in classes smaller than 50 but were seen across all class sizes. A subsequent meta-analysis (Theobald et al., 2020) examined the impact of active learning on exam scores and passing rates for underrepresented (low-income and racial and ethnic minorities) learners in STEM courses. Exam scores from 15 studies showed that active learning narrowed the achievement gap by 33%. The achievement gap for passing rates was examined in 26 studies and was narrowed by 45%. The authors highlighted that only studies with a highly active design were successful in narrowing achievement gaps for underrepresented learners; this is not work to be done half-heartedly.

Overview of Active Learning Methodologies

The flipped classroom is a broad category of active learning methodologies. In contrast to the traditional teaching model, information transfer happens prior to class time. Learners are provided with carefully curated materials (readings, presentation slide decks, interactive modules, websites) to digest and understand ahead of class. In class, learners are provided with problems to solve, models to construct, or theories to explore. These in-class activities create opportunities for the learners to apply their new knowledge, uncover misunderstandings and gaps, work together, and teach one another. The faculty role is to serve as facilitator and expert guide (Jeffries & Huggett, 2014). Flipped classrooms have been gradually taking up a larger and larger proportion of instructional methodologies in medical education. In 2012, only one article describing the flipped classroom in medical education was published. By 2015, that number was 21 (Chen et al., 2017).

Recent meta-analyses have proven the value of the flipped classroom pedagogy. A sub-group analysis of 14 studies from medical education that compared flipped classrooms to lecture found a pooled effect size of 0.527 for exam scores (Chen et al., 2018).

A large meta-analysis of 28 studies of comparing flipped classroom techniques to traditional classroom techniques in health professions education found a significant standardized mean difference (SMD) in achievement scores of 0.33, 95% CI 0.21–0.46, $P < 0.001$. Sub-group analysis of the 13 included studies from medical education found a similar SMD in achievement scores of 0.26, 95% CI 0.08–0.45 (Hew & Lo, 2018). An additional finding of this study is the significant impact (SMD 0.56, 95% CI 0.34–.078, $p < 0.05$) of having a quiz at the beginning of the flipped classroom on learner's achievement scores. This finding is likely a demonstration of the effects of retrieval-based learning in practice.

Within the broad category of flipped classrooms, there are specific types of well-developed and studied instructional methods. These include team-based learning, case-based learning, and problem-based learning. These will be introduced briefly here, with further details in subsequent chapters.

Team-Based Learning (TBL)

TBL was developed at the University of Oklahoma business school in the 1990s. It has applications in many disciplines. Learning objectives are set by the teacher. Learners are assigned preparatory materials to complete in advance. On arrival in the classroom, learners are placed in small teams (5–7). They individually take a quiz, the individual readiness assurance test (iRAT). This is followed by the team working together to reach consensus and complete the same quiz, the group readiness assurance test (gRAT). Both the iRAT and gRAT scores contribute to the individual's grade. Following completion of the RATs, the faculty leads a whole class discussion of any challenging questions. Subsequently, the teams work to solve challenging multiple-choice application questions, sharing their answers with the whole class simultaneously. The faculty role is to promote debate between teams, probe for understanding, and provide clarification as needed (Parmelee et al., 2020). Large groups of learners, physically working in smaller groups, can be led through TBL at one time. Flat classrooms with small tables greatly facilitate this. TBL is discussed in detail in Chap. 6.

Case-Based Learning (CBL)

In CBL, the teacher sets the learning objectives and learners prepare for class by completing assigned preparatory materials. Working in small groups during class, learners typically work through a clinical case that is designed to help them apply foundational knowledge from the preparatory materials, solve clinical dilemmas, or make connections between related concepts. Each step of working through the case can be presented as a multiple-choice question or as an open question. The primary distinction between TBL and CBL is the lack of structure around RATs and the conduct of teams simultaneously sharing their answers to multiple choice application questions. Though no RAT exists, a short quiz can be completed just before or at the beginning of the class. The faculty role is to use careful questions to keep groups away from tangents and to provide clarification as needed (Srinivasan et al., 2007). Like TBL, if the learners can be broken into small groups, a large group of learners can be led through CBL in a single session. See Chap. 8 for an in-depth discussion of CBL.

Problem-Based Learning (PBL)

Problem-based learning, which is the subject of Chap. 9 of this book, is an active learning method that has important differences from TBL and CBL. PBL is usually completed over multiple sessions. While PBL uses a case that will be solved by the learners, unlike TBL and CBL, the objectives are not set by the faculty. Working in small groups, learners begin the case and discuss what knowledge they lack to move forward. Knowledge gaps are assigned to each learner to explore. During a subsequent session, learners share newly acquired information to close the gap and move the case forward. The faculty role in PBL is minimal: they provide the case and may occasionally need to bring the learners back from a wild tangent. However, PBL is truly self-directed learning, where tangential exploration and discovery are considered important elements. PBL is particularly good at taking a learner-based, constructivist approach: it starts with what the learner knows, their existing ideas and scaffolding, and allows them to build knowledge (Dennick, 2016). A large group of learners (e.g., a class) needs individual meeting space for each small PBL group (Table 2.1).

Cognitive Load Theory

Cognitive load theory (CLT) was first described in 1988 by Sweller (Young et al., 2014). It describes the interaction between our different types of memory, cognitive loads, and learning processes.

Memory can be conceptualized as having three components: sensory, working, and long term. Sensory memory captures auditory and graphic/pictorial input. The capacity of our sensory memory is unlimited, but without paying attention to the input, we forget it within seconds. Our working memory has a limited capacity and can hold no more than seven items at a time. Our long-term memory is where information is stored in chunks for future retrieval.

Table 2.1 Comparison of characteristics of Team-based learning (TBL), Case-based learning (CBL), and Problem-based learning (PBL)

	TBL	CBL	PBL
Who determines learning objectives	Faculty	Faculty	Students
Assigned preparatory work	Yes	Yes	No
Assessment at beginning of activity	Yes	Possible	No
Ideal group size	5–7	5–7	5–7
Faculty required for session	1–2	1–2	1/group
Faculty role	Promote debate, probe for understanding, clarify concepts	Keep students focused with careful questions, clarify concepts	Provide case, keep students off tangents
Number of scheduled sessions required	1	1	2–3 per case
Space requirement (ideal)	Large, flat classroom with movable chairs and tables for group formation	Large, flat classroom with movable chairs and tables for group formation	Separate meeting space for each group

When presented with new information, our sensory memory collects it, but working memory must be engaged to hold it. Working memory draws relevant prior information out of long-term memory and compares it to the new knowledge, creating new patterns or schemas of knowledge, and then stores it back in long-term memory. With its limited capacity, our working memory is the rate-limiting step in this process. When overwhelmed, working memory fails and hinders learning.

There are three types of cognitive load (de Jong, 2010). Intrinsic cognitive load is related to the difficulty of the material. It is technically immutable: you cannot make the pharmacokinetics of chemotherapeutics any easier. However, through instructional design that employs appropriate sequencing, e.g., moving from simple to complex, or part to whole, one can mitigate the intrinsic load.

Extraneous cognitive load is related to the instructional materials or delivery and does not contribute to the learning. Examples include providing material that has a graphic representation and the explanation is on a separate page; this requires learners to hold things in working memory as they move back and forth. Materials that provide redundant information increase cognitive load as learners are required to use working memory to compare the sources and determine where they may differ, rather than focusing on the key information or relating the new information to knowledge from long-term memory.

Germane cognitive load is the work of incorporating new information into existing schemas or creating new ones. This is done efficiently when working memory is not overwhelmed and can interpret, analyze, relate and organize new information

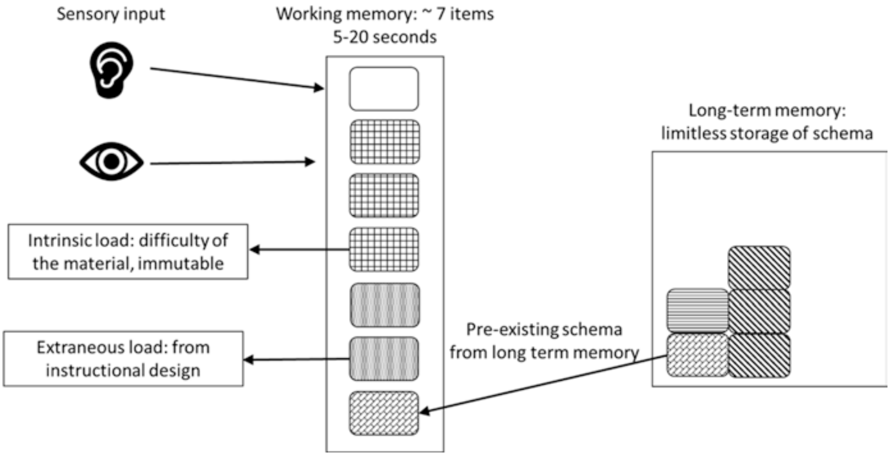

Fig. 2.1 The interaction between memory, storage, retrieval, and cognitive load

with existing knowledge. The goal of instructional design is to mitigate and manage intrinsic load, decrease extraneous load, and increase and promote germane cognitive load to encode new information and automate the future retrieval and application of schemas (Fig. 2.1).

Basic Steps in Designing Effective Instruction

Objectives

Teachers should be clear about the objectives of their teaching session. A set of well written objectives should clearly address the statement, "At the end of this session the learner will be able to…". Blooms taxonomy is the classic framework for creating learning objectives. Based on the constructivist theory that learners DO things with knowledge, it is appropriate to use Anderson's revision of Bloom's taxonomy that moves from nouns, e.g., synthesis, to verbs, e.g., evaluate (Taylor & Hamdy, 2013). When designing a flipped classroom session, it can be helpful to have objectives for the preparatory materials as well as the in-class portion of the session. These objectives should clearly align with the overall session and course objectives for students. The objectives for the preparatory materials should be written with verbs from lower in Bloom's taxonomy: define, classify, compare, recall, summarize. Objectives for the in-class portion should be written with verbs from higher in Bloom's taxonomy: construct, score, judge, appraise, predict, reorganize, develop. Having clear objectives decreases extraneous load because learners will not use working memory trying to determine what information they "really" need to know.

Manage Intrinsic Cognitive Load

Intrinsic load cannot be decreased, but it can be managed and mitigated. Sequencing of materials from low to high complexity, or from part to whole, can be effective. As an example: basic pharmacokinetics can be taught before specific drugs and their applications are introduced. For clinical skills, it can be helpful to move from lower to higher fidelity. Learners can start by working through paper or computer cases related to the evaluation of a specific complaint. They progress to working with standardized patients or peers following scripts. Finally, they work with real patients in a clinical environment (Van Merrienboer & Sweller, 2010).

Teachers must understand the level at which learners should be learning. This is a common challenge when clinicians or senior researchers are asked to teach medical students. The clinician may be accustomed to teaching residents or fellows, just as the researcher is accustomed to teaching post-doctoral students. The challenge lies in resetting their level of teaching. Conversations with a course director can be particularly helpful.

The course director provides critical information on what prior knowledge and objectives learners have covered. Without this information, a teacher may make false assumptions about what the learner has in their long-term memory that they can draw forth and build on. The other side of this conversation should focus on what follows in a course's sequence: what objectives are needed for the learner to be able to build on acquired knowledge in subsequent sessions?

In designing instructional materials, Mayer (2010) describes two important principles: segmenting and modality. Breaking a large volume of material into smaller pieces, or segments, allows the learner to move through them at their own pace and to easily go back and forth between segments. A one hour narrated slide presentation might be broken down into 6–8 segments and put together as a playlist. The modality principle is based on the theory that our sensory memory has two channels for inputs: visual-spatial and auditory-verbal. Either channel can be overloaded. A presentation that has large amounts of text and pictures or graphics can overload the visual-spatial channel. Replacing text with a recording shifts information from the visual-spatial channel to the under-used auditory-verbal channel and decreases intrinsic load.

Decrease Extraneous Cognitive Load

Intrinsic load in medical education is inherently high; therefore, every effort must be made to decrease extraneous cognitive load. This can start at the institutional level. Standardizing instruction at an institution will decrease the extraneous load for learners. When an institution sets the types of instruction to be used, creates guidelines for what that instruction will look like (e.g., volume of preparatory materials for a flipped classroom, impact of pre-quizzing on grading, how learners will access materials, session length, how questions will be answered after class etc.) and shares these with learners, students can devote working memory to new information and schema creation (de Jong, 2010).

Van Merrienboer and Sweller (2010) and Young et al. (2014) provide guidance on principles of instructional design that decrease extraneous load. When multiple sources of information are presented in separate places, either in space or in time, learners must hold information in working memory while searching for the other information. This is the “split attention” principle. An example would be a learner attending a teaching session and not having the slide deck. The learner’s working memory will be focused on taking notes, rather than comparing new information to existing schemas. Another example would be learners being asked to perform a skill for the first time when they were provided with the instructions not during the session itself, but before the teaching session instead. While this may be appropriate for advanced learners, novice learners will use valuable working memory recalling the instructions rather than performing the steps of the skill.

The “worked example” principle similarly applies to novice learners. Asking a novice learner to solve an open question, or generate a novel plan, will overload the working memory because it is unlikely that enough schema or knowledge exist in long-term memory. Providing a worked example allows the novice to begin constructing schema of their own based on the example. An example would be having a clinical learner review a teacher’s written encounter note prior to writing one themselves. The worked example principle is like the “completion principle” where conventional open problems are replaced with completion tasks that provide a partial solution the learners must complete. Learners in biochemistry can be provided an incomplete graphic demonstrating glycogenolysis and then be asked to fill in missing steps prior to being asked to draw the whole graphic themselves. Young et al. (2014) points out that some instructional techniques may be helpful for novice learners, yet counter-productive for expert learners. Once a learner has existing schema and knowledge in long-term memory, a worked example or completion problem, rather than open ended problem, is unnecessary and may increase extraneous load; this is referred to as “expertise-reversal.” An example would be the PQRST (provocation, quality, radiation, severity, timing) mnemonic for assessing abdominal pain. This mnemonic is helpful for the novice learner but becomes a distraction for the expert learner who has existing schema. Know where a teaching session lands in the curricular sequence, and what content has been delivered previously, to mitigate expertise reversal. This is the opposite of trying to solve a problem without any pre-existing schema or knowledge, which increases extraneous load. Therefore, in addition to being beneficial for mitigating expertise reversal and intrinsic load, understanding what your learner already knows is critical to decreasing extraneous cognitive load.

Presentations themselves, whether designed for asynchronous delivery or live, in-person, should also be thoughtfully designed to decrease extraneous cognitive load (Mayer, 2010). Presentations should exclude any extraneous material that is not related to the learning objectives; this ensures the learner’s working memory is only tasked with relevant information and tasks. Presentations can be simplified to ensure this focus: remove distracting animations, removing photographs when a simple black and white drawing would suffice, and avoiding interesting, but tangential stories or anecdotes. Text describing a graphic should be placed close to the part of the graphic it is describing. Teachers can improve presentations by signaling what is essential material. This can be done throughout a presentation with headings or with a brief summary at the conclusion of the session.

Maximize Germane Load

Thoughtful management of intrinsic load and reduction of extraneous load creates space for germane load and robust learning. Van Merrienboer and Sweller (2010) and Young et al. (2014) describe principles for maximizing germane load. The first is the "variability principle." Germane load is increased when the variability of the task or content is increased. When teaching about abdominal pain, learners are first tasked with a simple case of appendicitis. Keeping the signs and symptoms consistent, variation is added by changing the age and sex of the patient. This helps learners expand the applicability and relevance of existing schema from their long-term memory.

The "contextual interference principle" is related to interleaving and variability. Germane load is maximized when studying or practicing is done in a random order. If a task is like the one preceding it this is referred to as blocked practice (e.g., AAA, BBB, CCC) and germane load is low. By varying the task order randomly (e.g., CBABACCBA) germane load is maximized. The placement of a central venous line is a complex, multi-step task. Having learners practice the component steps in a random order prior to putting them together in the correct sequence would maximize germane load.

The "self-explanation principle," or imagination, builds on the power of elaboration (Parmelee et al., 2020). Learners will perform at higher levels when asked to explain or imagine a concept or skill versus simply studying and processing information. In the example of a central venous line placement a learner could be asked to explain each step or imagine themselves completing each step of the procedure. Asking a learner to explain why appendicitis presents with periumbilical pain that radiates to the right lower quadrant requires them to draw information related to embryological development of the gut from long-term memory and to distinguish between visceral and parietal pain. This creates deeper learning than simple memorization of the pain location.

Maximizing germane load often leads to learners perceiving the task as more difficult. Learners naturally translate this feeling of increased difficulty as less efficient, or worse for their learning. The opposite is true; desired difficulty is what makes deep learning possible (Brown et al., 2014). An undergraduate physics course compared active learning to traditional lecture with a well-designed crossover method. The outcomes were students' perceptions of learning and actual learning. Active learning methods generated lower perceptions of learning and higher test performance. Lecture had the exact opposite effect; students felt they had learned more but performed worse on tests (Deslauriers et al., 2019). Educators should anticipate this feedback from learners and their advocates. Strategies to mitigate this effect include introduction of the science of learning and instruction to learners at key points in their education (e.g. orientation to a program) and faculty development targeting educators at an institution.

Foster Intrinsic Motivation

There are two types of motivation: extrinsic motivation driven by external control (reward or punishment) and intrinsic motivation driven by engagement with an activity due to the individual's interest, curiosity, or enjoyment. When a student's drive to learn is intrinsically motivated, they will have better understanding and higher levels of academic achievement and performance (Ten Cate et al., 2011). Intrinsic motivation meets three basic psychological needs for growth and development: need for autonomy, need for competence, and need for relatedness to others.

Construction of a program, and the teaching sessions that make up a program, should be done with the goal of fostering intrinsic motivation. Learners in medical education tend to be a highly motivated group. They can also have a multitude of competing concerns (marriage or the prospect of life-long partnership, children, aging parents, financial considerations, etc.). Creating objectives and content that are clearly relevant to their future clinical practice not only ensures the learners will be stimulated and engaged, but also increases intrinsic motivation. Examples include making the clinical application of basic science readily apparent or introducing clinical contact early a program. These support learners' intrinsic desire to care for patients and to develop the skills and knowledge to be competent in doing so (Taylor & Hamdy, 2013; Ten Cate et al., 2011).

Having learners work in small groups (e.g., TBL, PBL, CBL) can increase intrinsic motivation. When working together and engaging in peer teaching, learners develop a sense of competence. Similarly, the small group learning environment builds the learner's relatedness, or social connection. This contrasts with a traditional, lecture-based model where learners study and struggle in isolation. Exams in the traditional, lecture-based model provide a score without feedback, a purely extrinsic reward leading to surface learning. Exams themselves can be used to foster intrinsic motivation. Creating items that test knowledge from a clinical perspective, rather than focusing on simple recall, will help the learner to see the connection between the current content and their future goal.

Summary

Lecture makes up less and less of the instructional methods used in North American medical schools; in 2012–2013 it accounted for 60% of all instructional methods. By 2018–2019 it was down to 51% (Association of American Medical Colleges, 2020). Lecture is being replaced by active learning methods grounded in the science of learning and the science of instruction. Medical educators should seek to create programmatic and session objectives that are clear and relevant to the learner's goals. Design of sessions should build on existing knowledge, decrease extraneous load, and foster intrinsic motivation.

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Chapter 3
Self-Regulated Learning

Anthony R. Artino Jr., Richard J. Simons, and Abigail Konopasky

Abstract In this chapter, we introduce readers to the definition and core features of self-regulated learning (SRL). SRL is a theory of how individuals function in complex learning environments, be those academic or clinical settings. In our collective experiences as medical education researchers, clinicians, and teachers, we have found that an understanding of SRL can benefit both educators and learners. In particular, by viewing learning and performance through the lens of SRL, medical educators are in a better position to help trainees develop the tools and strategies needed to manage their own learning, move deliberately into independent practice, and thrive as self-directed, lifelong learners. To achieve our goals in this chapter, we define SRL, review its central features, distinguish it from related concepts, and describe how to incorporate its tenets into evidence-informed educational practice. Ultimately, we hope to illuminate the core features of SRL and describe how an understanding of those features can be used to enhance learning and performance in medical education.

Introduction

On the first day of her clerkship in internal medicine, Monica struggles with her oral presentations, particularly the assessment and plan sections. By the end of the block, however, an attending notes that she has made remarkable progress. Her assessments are now much more detailed, including the prioritization of her differential diagnoses. Likewise, her recommendations for patient management are more

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specific and evidence based. When asked how she improved so much, Monica notes how her instructor helped her to create her own set of learning goals; self-monitor her progress on these goals as she moved through cycles of planning for, engaging in, and reflecting on her presentations; and maintain her motivation throughout the process. In other words, with the support of her instructor, Monica used self-regulated learning strategies to target her specific learning needs and adapted her approach, growing both as a clinician and a learner.

The growth of medical knowledge and the complexity of clinical practice continue to accelerate. This expansion means that some of what medical learners and post-graduate trainees learn during their initial training may become outdated soon after they enter independent practice. For example, beta-blocker medications were once contraindicated in patients with heart failure and now these agents are a mainstay of treatment in heart failure due to systolic dysfunction. To meet the demands of this evolving landscape, medical educators expect doctors-in-training, like Monica in the example above, to learn how to plan, manage, and adapt their own learning (Brydges & Butler, 2012). For instance, we expect medical learners, as they progress through their education, to learn how to diagnose their own knowledge deficits and seek help from faculty and other learners when they need it; and we expect post-graduate learners to monitor their own knowledge and clinical skills, with feedback from faculty, and then pursue activities to address shortcomings. But these expectations go beyond trainees: we also expect practicing physicians to engage in ongoing professional development to address gaps in expertise, learn new knowledge and skills, and maintain their clinical competence. In short, we expect medical professionals to self-regulate in their pursuit of academic learning and improved clinical performance.

Medical schools, residency training sites, and accrediting agencies recognize the benefits of self-regulated learning (SRL). Therefore, helping trainees grow their capacity to self-regulate has been an essential outcome in medical education for many years. Ultimately, medical trainees who learn to self-regulate across many different healthcare contexts have a distinct advantage over their less-adaptive colleagues: they habitually take action to expand their clinical competence and enhance their overall capacity to learn across a lifetime (Brydges & Butler, 2012; Durning et al., 2011).

The purpose of this chapter is to introduce readers to the definition and core features of SRL. We also aim to provide guidance for applying the tenets of SRL to medical education practice. We begin by defining SRL and reviewing its central features. We then differentiate SRL from two related constructs, including the more commonly known concept of self-directed learning. We end the chapter with a detailed discussion of how teachers, instructional designers, and curriculum designers can employ the principles of SRL to enhance learning and performance in medical education.

Defining Self-Regulated Learning

Medicine has long been considered a self-regulated profession, and the study of SRL in individuals has a distinguished history in the fields of psychology and education (Boekaerts et al., 2000). Self-regulation can be defined as the processes that individuals use to guide their goal-directed activities by controlling, managing, and adapting their thoughts, feelings, and actions (Sitzmann & Ely, 2011). In the case of Monica above, for instance, she engages in the *goal-directed activity* of improving her oral presentation skills. In order to accomplish this, she must monitor her *thoughts* (e.g., is she thinking about how patient answers to her questions might fit into a differential diagnosis?), her *feelings* (e.g., how can she maintain her anxious feelings, even when she experiences setbacks?), and her *actions* (e.g., does she incorporate the knowledge gained from patient-directed reading into her assessments and plans?). As she monitors these different elements, she must *control*, *manage*, and – ultimately – *adapt* them to become a more skilled presenter.

Theories of self-regulation are used to explain how individuals achieve a multitude of life goals, from eating healthy and staying fit to learning a new language and achieving competence in medicine (Boekaerts et al., 2000). Sitzmann and Ely (2011) said it well when they observed that "self-regulation enables people to function effectively in their personal lives as well as to acquire the knowledge and skills needed to succeed in higher education and the workforce" (p. 421). Thus, the capacity to self-regulate is considered by many to be an essential ingredient of a successful and productive life.

SRL is made up of several distinct self-directed *processes* that learners employ proactively – before, during, and after learning – to turn their cognitive abilities and goals into competence and durable performance (Zimmerman, 1998). When viewed through the lens of self-regulation, learning is not something that just happens to individuals; instead, learning is a process that individuals initiate, manage, and adapt to achieve their goals (Zimmerman & Schunk, 2011). Thus, it is important that, in addition to content knowledge and clinical skills, medical educators offer trainees the tools needed to direct their own learning as they move into independent medical practice.

SRL is a continuum, not an all-or-nothing phenomenon. An individual is said to be "self-regulated" to the extent that she is cognitively, motivationally, and behaviorally engaged in her own learning activities (Boekaerts et al., 2000). In addition, an individual can self-regulate to varying degrees across different settings and learning activities. For instance, a third-year medical learner who intends to become a surgeon might set goals, plan her learning activities, and monitor her progress toward goal completion during her surgery clerkship in a much more rigorous and focused manner than she would while navigating her way through the psychiatry clerkship. In other words, SRL is highly contextualized, and so, in addition to variations between individuals, a single individual can be exceedingly self-regulated in one context and much less regulated in another. In many cases, the individual's interest in and motivation for the topic or content area, and how the context relates to her personal or professional goals, are key variables that govern her level of self-regulation.

Finally, SRL is not an innate capacity, aptitude, or trait that learners either have or do not have. Instead, self-regulation skills are context-bound and can be learned by the motivated learner and facilitated by the skilled teacher (Zimmerman & Schunk, 2011). As Cleary et al. (2013) astutely wrote: "there are volumes of data demonstrating that forethought, performance, and self-reflection processes are not only malleable and teachable but that such processes improve performance across multiple domains" (p. 473). As such, the role of medical educators in *supporting and fostering* SRL is crucial.

Core Features of SRL

For medical educators to support SRL in trainees, they should understand the core features of the theory and how these features relate to learning and performance. There are actually a multiplicity of SRL theories that approach learning from a variety of perspectives. Each perspective takes a slightly different stance on the nature and role of motivation, the importance of the environment and its influences on action, and the role of thinking. For example, information processing theories of SRL emphasize cognition and how people think about their own thinking (i.e., metacognition). On the other hand, behavioral theories deemphasize thinking, focusing more on observable and measurable environmental factors, like rewards and punishments, to explain self-regulated behavior (Zimmerman & Schunk, 2001).

Despite these important theoretical differences, most SRL frameworks have at least five core features in common (see Fig. 3.1). First, theories of SRL articulate a *feedback loop* composed of a series of processes and sub-processes that learners use to achieve their goals. Self-regulated learners apply these cyclical processes to monitor their learning activities, gather information (both from self-testing and from teachers and peers), and use that feedback to evaluate their performance and progress toward goal attainment for the next cycle of learning (Cleary, 2018). Helping trainees to approach learning in this cyclical way can help them to be more productive and feel more competent, even when, for instance, an initial round of learning does not go as planned.

A second core feature of SRL is *agency*. In order to regulate, we assume individuals have agency over their learning: the capacity and the intention to make choices regarding learning tasks (Zimmerman & Schunk, 2011). Personal agency over learning has become more important as our knowledge base – and our access to it via online resources – grows and learners must decide where and how to focus their learning activities. Yet, in clinical learning environments, the immediate concerns of patient care and safety often constrain a learner's agency. For instance, if a third-year medical learner sets a goal to refine her learning about the respiratory system, but encounters a string of patients with endocrine problems in the clinic, she cannot necessarily carry out that goal. Medical educators versed in SRL recognize

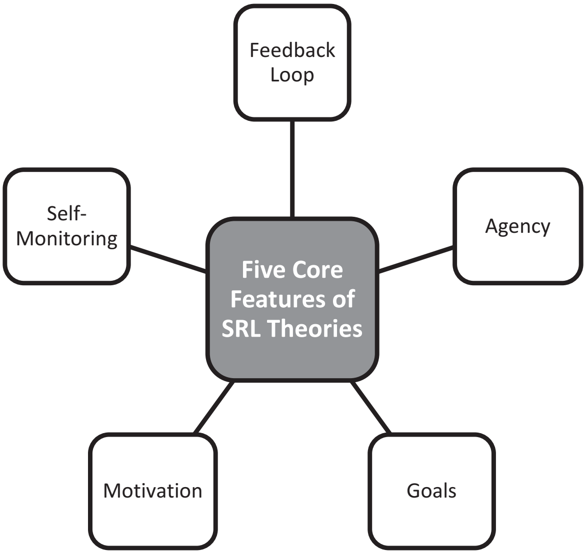

Fig. 3.1 Five core features of self-regulated learning theories

the importance of learners' sense of agency and can work with those learners to create opportunities for them to exercise it amidst their other competing priorities and clinical responsibilities.

Another core feature of SRL, which is closely related to agency, is the idea that learners have well-defined and personally meaningful *goals*. When individuals set goals, such as performing a surgical procedure with minimal errors, they benefit from both a motivational and self-regulatory perspective (Cleary et al., 2015). For example, learners who set a learning goal are energized to achieve the goal (a motivational benefit), and they also have a criterion or standard at which to aim (a regulatory benefit, as learners cannot efficiently regulate their behavior if they have nothing to aim for). Using their self-generated goals, learners can gauge their progress, determine whether their approach is succeeding, and make necessary changes. Medical educators can help learners to become more effective and motivated by teaching them this type of goal-directed approach to learning.

A fourth core feature of SRL is *motivation*, where motivation can be defined as a process through which individuals initiate and sustain behavior in pursuit of their goals (Schunk et al., 2014). SRL theories address not only *how* individuals go about achieving their learning goals but also *why* they choose to learn. Within a SRL framework, motivation can be thought of as a primary driver of self-regulated action; motivation helps to both initiate and sustain an individual's goal-directed behaviors across multiple learning cycles. What is more, along with being a key input to the SRL feedback loop, motivation can also be a beneficial outcome. For example, being interested in population health might motivate a medical learner to implement a number of high-yield learning strategies (e.g., self-testing and spaced practice) to learn epidemiology. Using these high-yield study strategies will not only enhance the learner's knowledge of population health (and likely result in a higher grade), but also provide a boost to the learner's interest and intrinsic motivation to engage with epidemiology in the future (Schunk & Zimmerman, 2008). Recognizing how to enhance and maintain learner motivation plays a critical role in SRL and is fundamental for medical educators, particularly in terms of understanding what distinguishes highly self-regulated learners from those who struggle (Durning et al., 2011). Facets of motivation are related, in some ways, to curiosity. The learner who is intellectually curious about a certain topic or clinical problem is often driven to seek information to better understand the underlying pathophysiology or treatment strategy.

A fifth core feature of SRL is its emphasis on *self-monitoring*. For goals to be beneficial, learners must monitor their performance on a given task by gathering information that can help them evaluate how well they are performing (Cleary, 2018). Simply stated, self-monitoring is a way for learners to keep track of how well they are progressing toward their goal. For instance, a surgical post-graduate learner practicing a fasciotomy procedure in a simulated environment might track the number of errors she makes on a leg model, comparing her progress to a mastery standard. Supporting this type of self-monitoring in trainees is a crucial part of SRL because it helps learners identify what they know or can do, what they do not know or cannot do, and where they need to focus their future efforts to improve.

A Social-Cognitive Model of SRL

One of the most influential models of SRL comes from the social-cognitive perspective (Zimmerman & Schunk, 2001). Emerging from the seminal work of Albert Bandura, social-cognitive theory revolves around the key idea of *triadic reciprocal determinism*, which states that a learner's *behavior* is determined by the reciprocal interactions between *personal factors* (e.g., beliefs, expectations, attitudes, feelings, and biological processes) and *environmental factors* (e.g., social supports and physical surroundings). Changes in one or more of these three factors – behavior, person, or environment – will influence the other factors in a dynamic and constantly evolving way. Take, for example, a post-graduate learner in a competitive clinical rotation full of aggressive peers and run by an attending physician who has no tolerance for mistakes. Such an environment will influence the post-graduate learner's personal factors (e.g., his confidence and emotions, and even his ability to recall relevant prior knowledge under stress) and also shape how he behaves in that environment and if he is able to learn effectively. Similarly, how he behaves will affect the environment (his peers, medical learners, and the attending) and may even modify some of his own personal factors (e.g., his confidence and anxiety levels). Ultimately, the degree to which the post-graduate learner is motivated to learn, perform, and regulate is determined by the reciprocal relationships between his own thoughts and feelings, the nature of the learning environment, and his actions (Cook & Artino, 2016).

Using the social-cognitive perspective, Zimmerman (1998) articulated a three-phase, cyclical model of SRL that can be wrapped around any learning task (see Fig. 3.2). This popular model includes *forethought*, *performance*, and *self-reflection*, and it has been widely applied and studied in medical education contexts (Artino et al., 2014; Cleary et al., 2015, 2019). During forethought, learners set goals, retrieve relevant prior knowledge, and evaluate the importance of the learning activity and their self-efficacy (i.e., their task-specific self-confidence) to be successful as they prepare to learn. During performance, learners enact specific strategies for learning, monitor their activities through metacognition (i.e., thinking about their own thinking), and judge their progress toward goal completion. Finally, when the learning task is finished, highly self-regulated learners reflect. Self-reflection typically includes an assessment of one's overall performance and an evaluation of what could be done better or differently next time. Learners also make causal attributions about why they performed the way they did (e.g., a learner might attribute his poor performance to insufficient effort rather than an unfair exam). Taken together, the social-cognitive model of SRL has generated a plethora of evidence on how learners enact many of SRL's core processes. In addition, the social-cognitive model has produced an assessment methodology called SRL microanalysis (Cleary et al., 2012). Over the past decade, this methodology has been used to study how medical trainees and practicing physicians regulate their own learning and performance in a

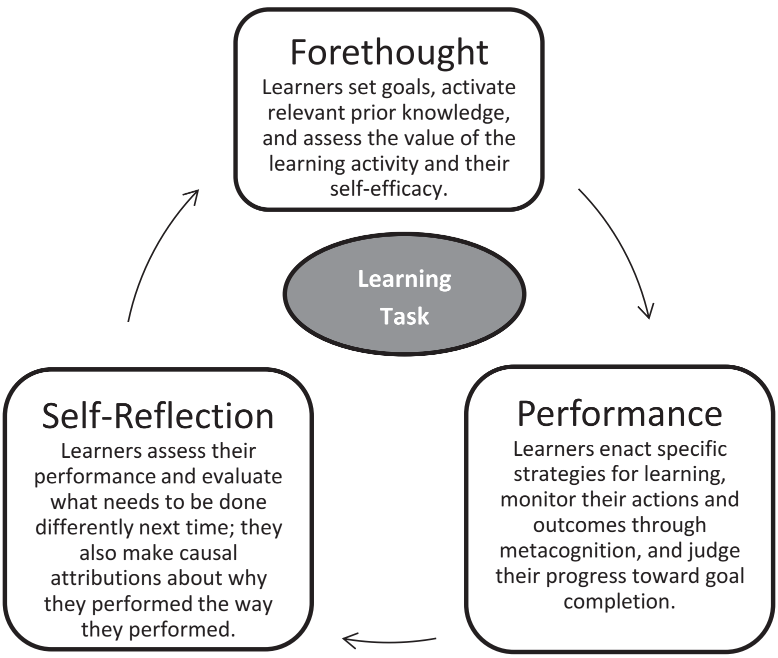

Fig. 3.2 Zimmerman's three-phase cyclical model of self-regulated learning. (Adapted from Zimmerman, 1998)

variety of patient care (Artino et al., 2014; Cleary et al., 2015, 2019) and assessment (Andrews et al., 2018) contexts.

Metacognition, Self-Directed Learning, and SRL: Distinguishing Between Concepts

Medical educators sometimes fail to make important distinctions between theories and concepts, especially those that are drawn from other disciplines, like psychology or sociology. An unfortunate consequence is conceptual confusion, with educators and researchers blurring important differences among terms and definitions (Lajoie, 2008; Loyens et al., 2008). The result is terms that sound similar but have different definitions (e.g., self-concept vs. self-esteem), as well as terms that sound like they might be different concepts yet they actually have similar or identical definitions (e.g., task goals vs. mastery goals). Here we briefly distinguish between SRL and two constructs that are often muddled in medical education literature: metacognition and self-directed learning.

Metacognition is the idea of an individual "thinking about his own thinking." Over the last 40 years, the concept of metacognition has been broadened to go beyond just metacognitive knowledge to include metacognitive monitoring and control strategies as well; that is, the degree to which individuals monitor and control their own thinking activities by, for example, slowing down and considering alternatives in response to unexpected events. SRL includes metacognition as just one component of self-regulation. Theories of SRL consider metacognitive knowledge, monitoring, and control strategies under the wider umbrella of self-regulation (Lajoie, 2008). SRL, however, is a multifaceted phenomenon; it includes more than just metacognition alone. It also incorporates ideas about learners' motivation and emotion and the ways in which they take control of their own learning behaviors (Zimmerman & Schunk, 2011). In summary, SRL is conceptually broader than metacognition.

Self-directed learning is a commonly used term in medical education. According to the body that accredits schools of allopathic medicine in the United States and Canada, the Liaison Committee on Medical Education (LCME, 2020), "self-directed learning involves medical students' self-assessment of learning needs; independent identification, analysis, and synthesis of relevant information; appraisal of the credibility of information sources; and feedback on these skills" (p. 8). Furthermore, as part of their accreditation standards (Element 6.3), the LCME (2020) requires that "the faculty of a medical school ensure that the medical curriculum includes self-directed learning experiences and unscheduled time to allow medical students to develop the skills of lifelong learning" (p. 8). The LCME's definition suggests their conceptualization of self-directed learning is similar to SRL and its component parts. Thus, practically speaking – for the average medical educator – the notions of self-directed learning and SRL are similar. Both concepts are about learners taking responsibility for their own learning (before), monitoring and evaluating how they are doing (during), and adjusting their approaches accordingly (after).

From a theoretical and historical origins perspective, however, there are several important differences between self-directed learning and SRL that are worth considering. First, theories of self-directed learning have been applied most widely in adult education and non-traditional learning contexts, including, for example, medical education and workplace learning (Loyens et al., 2008; Saks & Leijen, 2014). In the early adult learning literature, Malcolm Knowles defined self-directed learning as "a process in which individuals take the initiative, with or without the help from others, in diagnosing their learning needs, formulating goals, identifying human and material resources, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (Knowles, 1975, p. 18). On the other hand, theories of SRL were developed within cognitive psychology and have been applied widely in educational psychology, which tends to focus mainly on primary, secondary, and higher education (Loyens et al., 2008; Saks & Leijen, 2014).

In addition, helping learners to develop self-directed learning skills is often identified as an important outcome of problem-based learning approaches. This latter idea raises an important distinction between self-directed learning and SRL. When medical educators discuss self-directed learning, they are often referring to both design features of the learning environment (as in problem-based learning) *and* learner factors (i.e., a learner's thoughts, feelings, and actions during a learning activity). Thus, although self-directed learning and SRL are closely related concepts, they have emerged from different literatures, and self-directed learning is a somewhat broader concept (Loyens et al., 2008; Saks & Leijen, 2014). To that latter point, Loyens and colleagues have argued that "self-directed learning can encompass SRL, but the opposite does not hold" (Loyens et al., 2008, p. 411). In this chapter, we focus primarily on SRL because, from our perspective, it has a more robust theoretical and empirical foundation which permits more diverse educational approaches that can and have started to be empirically tested in medical education.

Applying SRL to the Practice of Medical Education

SRL provides several concrete tenets for medical educators. These tenets can help to make the learning *process* more visible so that learners can change that process, improving themselves not only in medicine but as lifelong learners who can manage their own learning. Yet, application of SRL in medical education can be challenging due to "the complexity of the clinical setting, which exerts competing intellectual, emotional, and environmental demands on the learner" (Sandars & Patel, 2015, p. 554). Medical trainees in the clinical setting must balance the competing priorities of learning, patient care, and – for graduate trainees – teaching other more novice learners. In a study of third-year clerkship learners, Larsen et al. (2017) found that learning goals had to be "thrown out" when patient volume picked up, thereby disrupting the learning cycle. Another challenging issue for both medical trainees and medical educators is the way in which assessments can often “drive” behavior (only sometimes actually fostering learning; Lineberry, 2020). For example, if there is too much emphasis on standardized examinations (particularly, knowledge assessments) at the conclusion of the clerkship, medical learners may focus excessively on accumulating medical knowledge to the detriment of learning and practicing core clinical skills.

The complexities and contradictions of the clinical learning environment, then, can make it difficult for trainees to be effective self-regulated learners. This increases the importance of the educator who, as a more experienced navigator of clinical contexts, can support learners in applying SRL principles (Brydges et al., 2015). In the sections below, we discuss how medical educators can help learners develop self-regulation through goal setting, motivation, strategy use, help seeking, and the concept of *co*-regulation with others (see Table 3.1).

Goal Setting

Goal setting is a critical part of SRL because it is only through movement towards some particular goal that learners can gauge the effectiveness of their learning strategies and know whether or not to make changes. In addition, goals can help learners think about the specific behaviors they need to enact to be successful at a given task (Cleary, 2018). But not all goals are created equal (Locke & Latham, 2017). The most effective goals are those that are: *specific* (e.g., focusing on a particular clinical skill such as interviewing or, even more specifically, using open-ended questions during interviewing; or focusing on a portion of the physical examination that needs refinement such as the neurological exam rather than just improving clinical skills); *proximal* in time (e.g., focusing on learning certain organ systems such as endocrinology because of perceived knowledge gaps rather than trying to learn the entire domain tested on nationally normed clinical knowledge examinations); and oriented to *process* rather than outcome (e.g., improving hand positioning in suturing rather than improving the product of the sutures themselves; Brydges et al., 2015). A study of suturing skills, for instance, found that those who set process goals (e.g., maintaining appropriate tension on the tie) rather than outcome goals (e.g., creating equally spaced sutures) did better when the suturing simulator was transferred to the more realistic context of an abdominal simulator (Brydges et al., 2015).

When learners are faced with the competing demands of the clinical environment, some may tend towards broad outcome-based goals that are perhaps easier to conceive of and set. Going back to the hypothetical example from the beginning of the chapter, for instance, Monica may be tempted to set a goal like “work on my communication skills.” Monitoring progress towards a goal like this will be difficult and take years of practice. With guidance from her clinical teachers, however, Monica can be supported in setting more helpful goals like “improve my patient-centered communication skills through use of motivational interviewing

Table 3.1 Medical educators can help learners develop SRL skills through goal setting, motivation, strategy use, help seeking, and co-regulation

Feature	Mechanism of Action	Teacher Supports
Goal Setting	Movement towards a goal can help learners gauge the effectiveness of their learning strategies and know whether or not to make changes Goals help learners think about the specific behaviors they need to enact to be successful at a given task	Support learners by helping them set goals that are: *Specific* to the learning task *Proximal* in time to the learning activity Oriented toward *process* rather than outcome
Motivation	Motivation is the process whereby goal-directed activities are instigated and sustained Motivation not only influences learning behaviors and academic performance, but it also plays an important role in choice of learning activities	Support learner motivation by addressing learners' feelings of: *Competence* ("Can I do it?") *Value* of learning ("Do I want to do it?") *Autonomy* over their learning choices, where possible *Controllability* of learning outcomes, linking learner effort and strategies to success
Strategy Use	Highly self-regulated learners use strategies that are specific to the learning task Some strategies are adaptive and enhance learning, while others do not	Gain an understanding of learners' current strategy use via self-report surveys or microanalytic assessment techniques Help learners determine the most appropriate strategies for a given learning task Build in time for learners to monitor their own progress and reflect on their performance
Help Seeking	Highly self-regulated learners seek help from others to accomplish their goals Those who need help the most are often the least likely to ask for it Help seeking requires learners to recognize when there is a problem and, if help is needed, determine what type of help to seek	Create a learning environment where help seeking is not only acceptable, but expected Model help-seeking behaviors by explicitly reaching out to colleagues when needed Provide help-seeking resources to learners that are "low cost" from a social perspective (e.g., online materials that can be accessed without having to ask for help)
Co-regulation	Self-regulated learners are part of a system of reciprocal interactions among their own behaviors, personal factors, and the environment In co-regulation, learning support is distributed across people in the environment, thereby acting as a bridge to more socially shared regulation in teams and also to more independent self-regulation as a lifelong learner	Make time and space for groups of learners to work collaboratively on projects and share learning strategies Help to create connections between learners and other faculty members from whom they can learn

techniques" or "improve my oral presentation skills by refining and practicing my assessment and plans." In this way, educators are not just helping learners to *reach* goals, but also to develop the goal-setting skills they will need to continue to improve.

Motivation

Most medical educators can probably recognize highly motivated learners (and those who are not sufficiently motivated), but might find it difficult to *define* the concept of motivation. Motivation is a key ingredient across a range of theories (even *within* the SRL literature) and, in each one, its role in learning is slightly different. As described earlier in this chapter, we prefer Schunk and colleagues' definition of motivation as, "the process whereby goal-directed activities are instigated and sustained" (Schunk et al., 2014, p. 5). Thus, motivation is an active *process* that requires sustained effort with specific goals in mind. Motivation not only influences learning behaviors (e.g., how one studies and for how long) and academic performance (both preclinical and clinical), but it also plays a key role in choice of a medical career at the outset and what specialty to pursue after medical school.

It is important for medical educators to realize that motivation is not a consistent, all-or-nothing phenomenon. Instead, a given learner's motivation will wax and wane as they move through various cycles of learning, and motivation can be strongly influenced by the actions of the teacher. For example, Cleary et al. (2015) used a social-cognitive view of SRL to study within-group shifts in medical learners' self-efficacy beliefs (i.e., their task-specific confidence) as they tried to generate a leading diagnosis during a paper case scenario. The authors found that when learners reported an incorrect leading diagnosis, and then received negative, *outcome*-oriented feedback from the instructor (i.e., "Sorry, your most likely diagnosis is incorrect"), the learners experienced large declines in their self-efficacy for successfully completing the task on the next attempt. The authors concluded that, "When medical educators engage students in practice activities involving clinical skills, it is important for them to be cognizant of how quickly student motivation and thinking can change and how providing outcome-oriented feedback about poor performance can push some students toward a maladaptive path of self-doubt and potential withdrawal or disengagement" (Cleary et al., 2015, p. 623). Based, in part, on these findings, Cleary and colleagues recommended that medical educators carefully consider their feedback, aiming toward *process*-oriented over outcome-oriented feedback. It is worth noting, however, that feedback need not be always "positive feedback," per se. In fact, honest "negative feedback" is often warranted. What is important is that the feedback be specific to the learning activity and the specific *processes* or actions the learner can improve upon.

Medical educators can support learner motivation in a variety of ways (see Cook & Artino, 2016 for a detailed list in their supplementary online materials). First, they can support learners' feelings of *competence* underlying motivation by creating opportunities for them to succeed and drawing attention to their incremental progress. Next, they can emphasize the *value* of learning tasks, connecting those tasks to learners' own personal goals and providing *autonomy* over learning whenever possible with flexible tasks. Finally, they can help learners to interpret learning outcomes as *controllable*, linked to their effort and strategies rather than intelligence or luck (bad or good). Monica's instructor could support her motivation by selecting, at first, patient interviews for her that he knows will be less challenging and where she will be able to perform well. Likewise, a senior post-graduate learner could assign Monica patients who have common diagnoses and are less complex, which will allow her to present patients whose diagnoses and management plan are straightforward. As the rotation progresses, she can be assigned more complex patients that will require more effort to organize and prioritize the differential diagnosis and management plans in her presentations. And, as she experiences ups and downs, the attending physician can help her to see the connections between these ups and downs and her strategy use, maintaining her sense of control over the learning process.

Strategy Use

SRL is grounded in specific learning contexts, so broad "generic" strategies that learners might have used previously in their undergraduate studies may not work, particularly in the complex clinical setting. Thus, developing and deploying strategies is an area where teachers play a key role. Some strategies are adaptive (e.g., positive self-talk to improve motivation, tracking performance), while some are not (e.g., highlighting text, procrastinating, broadly reviewing information without self-testing). Therefore, teachers who gain an understanding of a learner's *current* (possibly ineffective) strategy use will be in a good position to help learners to *change* those strategies (Cleary, 2018).

To understand strategy use, teachers can use a standardized assessment tool like the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1993). The MSLQ is a self-report survey that measures aspects of motivation and strategy use and can give teachers an overall sense of how trainees approach learning tasks. However, such survey tools are of limited value because they are prone to recall bias, may not map accurately onto a learner's particular experience, and often fail to capture the dynamic, context-specific nature of SRL. Another approach that is gaining traction in medical education is called SRL microanalysis (Durning et al., 2011). SRL microanalysis is a structured interview technique that uses specific assessment questions to target a learner's thoughts, feelings, and actions as they occur in real time (Cleary et al., 2012). The primary benefits of SRL microanalysis are that it is customizable to specific learning tasks, and it allows instructors to home in on a learner's real-time approach. Because the technique is closely linked to SRL theory, teachers familiar with SRL principles can easily interpret the results. For example, Andrews et al. (2018) designed a test-taking intervention for high-stakes exams that was developed around SRL microanalytic techniques. Meant for one-on-one use by a teacher and learner, the intervention identified test-taking deficiencies and provided a learning plan based on identified SRL deficiencies. Results from their small-scale study with internal medicine post-graduate learners suggested that post-graduate learners with low in-training examination scores could improve their performance significantly by using this novel method (Andrews et al., 2018).

Because many self-regulation strategies are task-specific (e.g., strategies for improving one's diagnostic abilities in radiology might look quite different than those appropriate for internal medicine), the role of the instructor and the learning environment in determining the most appropriate strategies is critical (Artino et al., 2012). Research with medical learners completing an internal medicine diagnostic task has indicated that, while they have developed strategies for monitoring themselves *during* the learning process (e.g., identifying and integrating symptoms), they are less adept at planning and setting task-specific goals (e.g., becoming more skilled at comparing and contrasting diagnoses; Artino et al., 2014). Instructors can encourage SRL across various tasks by simply asking learners what their learning goals are and helping them to develop specific plans, particularly plans that are focused on *process* (e.g., determining how the symptoms relate to each other; Artino et al., 2014). Instructors can also encourage SRL strategies by providing time for learners to stop and reflect on these goals after completing a task, noting what went well, what could be improved next time, and – perhaps most importantly – making plans for *how* to improve upon the performance the next time. Thus, Monica's instructor can support her in her goal of improving the quality of her assessment and plans for her oral presentations by simply asking her about current strategies for improving her oral presentation skills and working with her to develop more effective strategies, including scheduling time to reflect on her progress and change strategies if needed. In addition, the attending physician might provide Monica with the opportunity to demonstrate her oral presentation skills in the context of rounds and other relevant clinical activities.

Help Seeking

Seeking help from others in order to accomplish one's goals is a sign of adaptive SRL (Karabenick & Berger, 2013). Unfortunately, it may not always be perceived that way by high-performing medical learners who have always done well and may not have needed to seek help in the past. In fact, across learning contexts, it is often those who need help the *most* who are *least likely* to ask for it because they do not want to appear ignorant (Karabenick & Berger, 2013). Help-seeking is a complex *process* that requires learners to recognize when there is a problem and, if help is needed, determine what type of help to seek. Asking for support in solving the problem *oneself* (instrumental help-seeking) helps learners build skills to solve future problems, but less adaptive learners may ask others to simply solve the problem for them directly (executive help-seeking; Karabenick & Berger, 2013). Moreover, unlike some other SRL skills, help-seeking has a considerable *social* component requiring the learner to determine whom to ask for help, frame the problem for that person, and then, once help is received, evaluate the feedback given (Karabenick & Berger, 2013). Finally, as leaders and role models, medical educators should create an appropriate clinical learning environment in which learners feel safe to reach out for help. Creating a safe space for help seeking is particularly important during learner transitions, like when medical learners enter the clerkship phase (Artino et al., 2012).

Despite its complexity, the process of seeking help is a critical one for medical trainees, who must manage an ever-changing body of knowledge across multiple care contexts. Artino et al. (2012) found, for instance, that avoidance of help-seeking behaviors in medical learners was associated with lower grade point averages in medical school. Additionally, Nguyen's (2015) research group found that medical learners who sought help were less likely to develop depression. The role of the medical educator, then, is to create a learning environment where help seeking is not only acceptable but expected. Monica's instructor, for example, might model help seeking by reaching out to colleagues herself and praising and supporting Monica when she asks for help. The instructor can also provide Monica with a bevy of help-seeking resources that are "low cost" socially: online or other reference materials she can consult without having to ask faculty. Finally, Monica's goals are a critical component of help seeking as well, since specific and proximal goals are the easiest to monitor, cueing Monica and her instructor as to when she might need help and what kind.

Co-regulation

As the above section on help seeking suggests, SRL should *not* imply learning by oneself, in isolation. Rather, the self-regulated learner is part of a system of reciprocal interactions among their own behavior, personal factors and, crucially, environmental factors. These reciprocal interactions take on a heightened importance in clinical learning contexts, where learners must regulate their own learning amidst the ever-shifting realities of patient care and administrative work. One way researchers have made sense of this complexity is through the concept of *co-regulation*: the regulation of cognitions, motivation, and behavior together with others in the learning context (Bransen et al., 2019). In co-regulation, learning support is distributed across people in the environment (e.g., the learner, her peers, instructors, patients) and can act as a bridge to more collaborative, socially shared regulation in teams and to more independent self-regulation as a lifelong learner (Zimmerman & Schunk, 2011). A recent study by Bransen et al. (2019) found that co-regulation and self-regulation strategies shifted as learners progressed through clerkships, moving, for instance, from more of a task orientation (e.g., setting learning goals around checking all the boxes in a list of recommended professional competencies) to a professional competence orientation (e.g., identifying faculty who can serve as models for professional development). This study also found that novice learners engaged in more co-regulation with their peers while more experienced learners engaged faculty more often (Bransen et al., 2019). One way Monica's instructor might support her in co-regulation would be to make time and space for her group of learners to work collaboratively on projects and share learning strategies. As Monica moves further along, her instructor might help create connections with other faculty members, encouraging her to ask them about *their* learning and the kinds of goals they set as working professionals.

Summary

A limitation of SRL is that its conception of agency as autonomous management of the self's feelings, beliefs, and actions does not necessarily fully account for the *social* aspects of agency: the ways agency is dependent upon one's social and historical context and social interactions with others in learning spaces. One consequence of this is that SRL places all learners on the same footing with the same tools, when some learners and health professionals – like those who are Black, Indigenous, or people of color; those who are lesbian, gay, bisexual, transgender, queer, intersex or asexual; or those with a disability – are often planning for and managing different barriers than other learners with differing levels of autonomy (Serafini et al., 2020). Therefore, medical educators should consider attending to the different identities learners bring with them and how these identities may not make it possible for those learners to manage their actions, dispositions, and emotions in the same ways as more privileged learners.

Despite these and other limitations detailed in the literature (Bransen et al., 2019; Brydges et al., 2015; Larsen et al., 2017; Sandars & Patel, 2015), we believe SRL theory can help medical educators *support* and *guide* trainees as they work to grow their capacity to self-regulate. In this chapter, we presented a key theory of how individuals grow this capacity to regulate their own learning. We introduced the definition and core features of SRL and aimed to provide guidance for applying the tenets of SRL to medical education practice. In addition to defining SRL and detailing its central features, we also differentiated SRL from related phenomena. Finally, we ended the chapter with a detailed discussion of how educators can apply the principles of SRL to enhance learning and performance across the continuum of medical education.

As the complexity of medical knowledge and clinical practice continues to grow, the need for medical learners, post-graduate learners, and practicing physicians to self-regulate in their pursuit of academic learning and improved clinical performance will only grow. Ultimately, medical professionals who learn to self-regulate – with support and guidance from others – will have a clear advantage over their less-well-regulated colleagues.

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Chapter 4
Lectures

William B. Jeffries

Abstract The one-hour lecture is a standard delivery mechanism for medical knowledge. In its traditional format, it has been shown to have serious limitations for domains of learning outside of knowledge transfer and students have difficulty maintaining attention throughout the delivery period. In this chapter I examine some of the root causes of inattention and suggest ways to enhance learner engagement. In addition, the steps for organizing and delivering a large group session are outlined and discussed. Important steps in an effective large group presentation include development of a lecture plan, use of a delivery style that enhances enthusiasm and optimization of pacing and content density. Other factors that increase lecture effectiveness include optimal audiovisual materials and the effective use of handouts. Finally, student learning and engagement can be enhanced through the incorporation of active learning methods within the session. Any lecture can be improved through the careful use of effective teaching methods and reflective use of student feedback.

Introduction

Despite many innovations in teaching and learning methods, the one-hour lecture remains a mainstay of medical education. For many faculty, the lecture is an irreplaceable way to inform students about essential aspects of important subjects. However, the lecture format creates visions of students sitting long hours in their seats, passively listening to an expert expound on an esoteric topic. A large body of educational research has cast doubt on the amount of learning that actually takes place during a traditional lecture (Jeffries et al., 2021). The data show that while this format can be an effective way to transfer knowledge to students, it is not more

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effective than other methods (Bligh, 2000). Further, the lecture is usually not the optimal way to teach skills or change attitudes compared to other methods. In addition, accumulating evidence is revealing that lecture efficacy is skewed toward white males, and that course "performance gaps" among underrepresented groups can be eliminated by introducing active learning (Freeman et al., 2014; Ballen et al., 2017). These aggregated findings are at the root of the movement to reduce the number of hours of lecture in the medical curriculum and replace them with the more "active" learning methods. For a more detailed discussion, see Chap. 2.

Despite these arguments, it has been reasoned that the lecture remains an effective and valuable format in medical education (Matheson, 2008). There are several compelling reasons why lectures have not disappeared from the curricula of most medical schools. First, lectures offer a great economy of faculty time since other formats (e.g., small group teaching) require a larger number of faculty per activity. Second, since this format can be as good as any other for the simple transfer of information, it still makes sense to lecture. Third, many faculty automatically think of lectures as the primary engine of the medical curriculum and really don't have much training, experience or desire to teach in other ways. Finally, students may also take this view of the curriculum and can expect to receive lectures as the primary vehicle for knowledge transfer and the exclusive source of material for knowledge assessments.

The goal of this chapter is to present ways of organizing and presenting a large group presentation that goes beyond the traditional boundaries of the lecture format. Our shared interest is in increasing student learning; this can be accomplished by modifying the format to increase engagement and introduce "active learning" methods (see Chap. 2). This will result in better learning, more engaged students and hopefully, better evaluations of your teaching. In this chapter, I will cover methods for constructing and delivering a one-hour presentation. Other large group methods that require formal, outside preparation by the students, such as flipping the classroom and Team-Based Learning, will be covered in subsequent chapters. I will assume you have been given the assignment of presenting a lecture for the first time in a large course. The examples will be specific to medical school, but the lessons will apply to any teaching you will be called upon to make in any large group setting.

Creating an Environment that Supports Learning

Before considering the construction of the optimal large group presentation, it is useful to think about how students learn in this environment. Schneider (1983) described well-established ideas of cognitive function that explain how students learn in the lecture hall. First, students must be attentive and determine what to pay attention to. Thus, it is your job to make the lecture interesting and facilitate student focus. This includes attention to presentation style, varying the format and eliminating distracters. Next, students must organize this information into a pattern that is understandable to them. The lecturer must therefore pay particular attention to organization, context and prior knowledge of the students. In other words, the presentation must be designed to lead the students to the achievement of the session and course objectives. Finally, students must take the information that is stored in their short-term memory and add it to their existing long-term knowledge base through a process known as **rehearsal**. This implies that the lecturer should enable rehearsal to occur by reinforcing important points, summing up and introducing learning exercises that ensure that new information is applied in context. It also means that you must avoid introducing elements that overwhelm cognitive load (e.g., changing topics too quickly, introducing too much or irrelevant information, etc.). These topics are covered in more detail in Chaps. 1 and 2.

Developing a Large Group Presentation

Context

Before planning your large group presentation, it is a good idea to consider the role of each presentation in the course. Since many medical school courses are team taught, your presentation is likely to be interrelated to those of one or more instructors. Thus, preparation should begin with a thoughtful discussion between the lecturer and course director (also see Chap. 2). First, you should discuss the overall course objectives and assessment methods. Within that framework, what is your presentation supposed to accomplish? Second, you should determine the depth and scope of your area of responsibility. What do you expect the students to have learned (or to do) when the presentation is over? The answer to this question is best framed by creating presentation objectives (see below). Third, determine the relationship of the content assigned to you compared to that of the rest of the course. Is this topic related to other material in the course or curriculum? You should review the teaching materials presented by others on this topic to avoid gaps and redundancies of coverage. For example, if assigned a lecture on diabetes mellitus, you should consider how much carbohydrate metabolism should be included in your presentation. Fourth, you should become familiar with the instructional format of the course to ensure that your methods complement those used elsewhere in the course. Within these boundaries, you should strive to include active learning methods to enhance student learning and maximize retention. In this vein, an appropriate question to ask is whether a lecture is the most appropriate format to use to cover the objectives. Other learning methods, found in later chapters in this book, may well prove to be the optimal way to accomplish the course objectives. Assuming that this is not the case, planning for the lecture should continue as described below.

Table 4.1 Potential types of large group presentations and their purpose

1. Presentation of information about a subject. Example: a discussion of the etiology of heart failure.
2. Development of critical thinking skills. Example: how to interpret epidemiological data about heart failure and apply that information to the diagnosis and treatment of a hypothetical patient.
3. Demonstration of a procedure or clinical approach. Example: demonstration of the electrocardiogram in the diagnosis of heart disease.
4. Construction of an academic argument. Example: influencing student attitudes regarding ethical policies for the distribution of donor hearts among prospective transplant patients.

Purpose of the Presentation

Perhaps the most important question you can ask yourself when preparing a lecture for the first time is "What do I want my students to learn from this presentation?" Is it knowledge about a metabolic pathway? Is it how to perform a skill? It is how to critically interpret medical data? Is it to influence student attitudes about health policy? The answers to these question help frame the objectives that you will construct to prepare the framework of the presentation and will influence how you present the material in the classroom. Table 4.1 shows some of the types of large group presentations that are classically used by medical teachers.

Development of the Content

If you are lecturing as part of a larger course, your broad goals and objectives are probably already defined. The content for your individual session is likely left up to you. Therefore, it is initially useful to reflect on the topic and its many aspects without regard to the limitations imposed by the course. Depending on your preferences, the ideas can be in the form of lists of topics, concept maps, outcome lists, taxonomies, etc. An approach I find helpful is to create a list of the possible areas of instruction needed to cover a particular broad topic, and then organize them into a logical order. For example, let's say you have been assigned to teach the pharmacology of drugs used to treat heart failure:

Heart Failure Drugs

1. Normal cardiac function
2. Etiology of heart failure
   (a) Cellular
   (b) Organismal level
3. Strategies to combat heart failure

4. Drugs used to treat heart failure (repeat for each drug/class)
    (a) Chemistry
    (b) Pharmacokinetics
    (c) Pharmacodynamics
        (i) Molecular and cellular effects
        (ii) Cardiac and hemodynamic effects
        (iii) Effects on other organs
    (d) Toxicity
    (e) Therapeutics

When organized in this way, you will quickly discover several things about your presentation:

1. Your outline overlaps other areas of the course/curriculum. Students may have already been exposed to normal cardiac function and etiology of heart failure. As stated earlier, set your boundaries by discussing you presentation with the other course faculty. However, your outline is still helpful since it helps define the prerequisite knowledge needed to understand your lecture. The stage is set for seamlessly integrating your presentation into the rest of the course.
2. There is too much to cover! If you did it correctly, you have created an exhaustive outline of the topic. Aside from areas outside the topic areas as discussed in #1, your outline helps you understand and define the scope of knowledge you expect to cover in the lecture. If this topic is your particular area of expertise, you will be tempted to include a plethora of the latest research findings, new hypotheses about cardiac failure, drugs on the horizon, etc. However, if your learners are first-year medical students, your focus should be on covering the basics, saving the advanced material for another audience. One of the most common mistakes I see among new faculty is an overestimation of what students need to know from lecture. An advantage of developing a topic list is to help identify the essentials.
3. There are multiple ways to organize the material. The organization of topics need not be too refined at this stage. You should just make sure at this stage that you have captured all your ideas. Later, you will organize the material based on your objectives and the styles of the course.
4. The process has uncovered gaps in your <u>own</u> knowledge of the subject. One benefit of teaching is that it helps develop your own knowledge of various subjects. Your knowledge gaps will prompt you to read more on the topic and/or consult colleagues to bring yourself up to date. You should also familiarize yourself with the relevant chapters from the assigned textbooks for the course. This will help you decide what information you must emphasize in class vs. what is best left to the student to learn from the textbook.

At this stage you can then go back and compare your ideas with the specific objectives assigned for your course and lecture. Are the objectives appropriate and achievable in the time allotted? Do they need modification? You will likely conclude that the objectives need to be modified in some way. For example, if the objectives are not achievable in the time allotted, you will have to prioritize information for live presentation (i.e., what will be deferred for student reading or other out-of-class exercise, etc.).

Development of the Lecture Plan

A well-organized presentation improves learning and retention. What is the best way to organize a lecture? There is no best answer to this question; however, several factors should dictate the organization: the type of lecture (Table 4.1), the most logical sequence of information and the fostering of student attention, motivation and cognitive processing. Some common organizing principles are shown in Table 4.2.

Inductive approaches imply that a real-world example is first presented and then case specifics are used to generalize and develop the underlying theories. For example, a case could be presented in which a patient has developed the signs and symptoms of heart failure. This would allow a discussion of the mechanisms by which the patient developed this condition, and the principles of treatment. This could lead to a discussion of the specific drugs. **Deductive approaches** begin with a discussion of the underlying concepts (e.g., cellular physiology of the heart, hemodynamics, etc.) which lead to the discussion of specific cases. **Time sequencing** can be an effective approach (e.g., the development of heart failure treatment as a series of scientific breakthroughs) since the telling of stories promotes retention. Similarly, presenting a **pro vs. con** framework promotes retention because the academic argument presented promotes engagement and retention. A **familiar to unfamiliar** progression helps establish for the students the context into which the material fits.

Table 4.2 Ways to organize a large group presentation

1. Inductive approaches
Problem to solution
Clinical case to diagnosis and treatment
Phenomenon to theory
2. Deductive approaches
Concept to application
General discussion to specific cases
Chaining of ideas (e.g., if A and B are true, then C must also be true)
3. Time sequence (e.g., chronological stories)
4. Pro vs. Con leading to solution
5. Familiar to unfamiliar (progression of what students know to what they don’t know)

Adapted from McKeachie and Svinicki (2013)

Obviously, several of these principles may be used within the same lecture and all of them can convey information and enhance student learning. The plan will also be dictated by the type of session needed. If the purpose of the session is primarily the delivery of information or demonstration of a procedure, the objectives should be ordered in a simple outline format. If the purpose is the development of critical thinking skills or construction of an argument, then the organization and sequence must be less defined to allow adjustments during the teaching process. In this latter case, the number of objectives also must be scaled back since the development of skills and attitudes needs time for development during the class period. Most importantly, regardless of the plan used, the students must be made aware of the organizational structure of the lecture to avoid confusion and enhance their ability to process information.

Presenting a Large Group Session

Using one or more of the formats outlined in the previous section, you should present a session designed to promote a learning-enabled environment. This means you will enhance attention and use strategies to enhance cognitive function.

Planning the Beginning and the End

A great way to increase attention and instill student confidence is to have a well-planned beginning to your lecture. In your first lecture, it is a good idea to introduce yourself and your role (e.g., "I am a neuroscientist who researches the coordination of skeletal muscle movement by the brain, which is why I was chosen to discuss Parkinson's disease"). A brief outline of what will be covered is often the next step. It will aid learning if students understand your framework in advance. Use the learning objectives in the outline to clarify their importance. Depending on the type of lecture, the next step may be to address the gap between the student's current knowledge and that needed to understand the subject (e.g., "You all have an excellent understanding of carbohydrate metabolism. Today we will attempt to apply that knowledge to the understanding of the etiology of Diabetes Mellitus"). Alternatively, you may use this opportunity to introduce a case or open-ended problem, which will then form the basis for the content to come. The ending of the lecture should also be well planned. Here is it often best to summarize the most salient points of the lecture, which aids student rehearsal and provides a focus for later review. Allot time for final questions. Include time for students to approach you immediately after the lecture in case they are uncomfortable asking their question in front of the class.

Creating Engagement

Students respond to the enthusiasm of the instructor with increased attentiveness (Bligh, 2000). The quickest way to induce classroom boredom is a monotone presentation while standing directly behind the podium. This is particularly true in a large lecture hall where students may not easily see your facial expressions. Thus, it is important to get out from behind the podium and mingle with the audience. Make eye contact with specific students and vary your vocal expression. A technique that I use is to arrive early and scan the class photo (usually available from the course director or Office of Medical Education) to identify several students in the audience. During the lecture, you can call them by name and engage them specifically. Be careful to do this in a non-threatening manner! Relevant anecdotes can also enhance arousal and improve retention. Such overtures let the students see you are engaged and interested in rapport. Student attention and engagement are bound to rise dramatically.

A note of caution is needed when discussing enthusiasm. Although enthusiasm does promote learning in the classroom, studies have shown that excellent engagement alone can be perceived as excellent learning by the students, irrespective of the actual value of the content (Ware & Williams, 1975; Murray, 1997). In these studies, a fictional "Dr. Fox" gave lectures with either a high degree of enthusiasm (movement, vocal emphasis, humor, etc.) or low enthusiasm (unexpressive, monotone delivery) and varying degrees of meaningful content. As expected, the investigators found that student learning was greatest in high enthusiasm/high content lectures. However, student ratings revealed that they considered a high enthusiasm teacher to be effective regardless of the level of content. Ware and Williams (1975) called this the "Dr. Fox Effect." Thus, students appreciate the entertainment value of the lecture and the instructor may come to an erroneous conclusion as to their effectiveness based on student feedback. Always keep in mind that although enthusiasm is an effective tool to promote attention, challenging and meaningful content must also be introduced to produce student learning. Table 4.3 summarizes ideas to increase engagement.

Pacing and Density of Content

The speed at which material is introduced is a critical factor that influences learning. Often students are unfamiliar with material being introduced and must build their knowledge base during the lecture. Studies of lecture pacing revealed that students rarely complain if the lecturer has a delivery that is too slow (Bligh, 2000, p 223). On the other hand, if a lecture is paced too quickly, the ability of students to build concepts is overwhelmed and learning is impaired dramatically. The pace of delivery is directly related to the amount of information to be covered. Some instructors attempt to cover 80 or 90 detailed slides in a 50-min presentation. In this case, you

Table 4.3 Tips for engagement

Arrive early; stay late
Move around room, delivering various points from different locations
Make eye contact with students
Call students by name
Make expressive gestures and body movements
Vary the tone of your voice
Ask questions
Use a non-threatening tone with judicious use of humor
Vary presentation style

can expect very little long-term learning to occur. The speed necessary to deliver material of this density will increase cognitive load, reduce attention, depress cognition, inhibit effective note taking and decrease learning. Thus, you must limit the amount of material in your presentation and focus on major points to be remembered. If you have been assigned too much material and too little time it will be necessary to employ additional learning methods, such as assigned reading or homework problems to accomplish the learning objectives. The important thing to remember (and stress with the course director) is that simply speeding up the presentation is not a viable option.

Attention Span vs. Lecture Length

Some authors suggest that despite an enthusiastic presentation, student attention in the lecture hall can wane dramatically after only 10–15 min (summarized in Bligh, 2000; McKeachie & Svinicki, 2013). While other authors suggest that this decline in attention span varies widely (Wilson & Korn, 2007), even highly motivated learners can become distracted well before the lecture is over. Lecture length has another negative impact on learning: **interference**. Since there is a finite capacity to working memory, new material just learned can displace material learned just minutes earlier. This combination of reduced attention and interference can potentially create a gap in learning, particularly in the middle of the lecture. Fortunately there are measures you can take to prevent this. It has been shown that varying the format can restore attention. Further, providing opportunities for rehearsal of short-term memories into long-term learning can effectively combat interference. Therefore no more than 10–15 min should pass before summing up (which aids rehearsal) and introducing an active learning exercise to promote “hard coding” of student learning experiences. Some suggested exercises are included in the next section. See Chap. 1 for further discussion of factors that influence learning.

Getting Feedback

Even the best lecturers can lose their audience. I have witnessed enthusiastic lectures that were unfortunately delivered at a level well beyond the student's learning capacity. Thus it is imperative to obtain feedback from your learners during the presentation to determine that they are following your message. The easiest way to get this information is to ask at the end of each major point if there are any questions. This often elicits no response, especially in the large lecture hall. This may be general comprehension, or it may be that some students are too intimidated in the presence of their peers to admit their lack of understanding. One way to approach this challenge is to create buzz groups (see next section) which can be used to identify the "muddiest point." Another solution is via the use of an audience response system. This system can elicit anonymous answers to questions posed by you during lecture. This approach serves a dual purpose. First, you obtain real-time feedback as to whether students comprehend your lecture. Second, you are allowing rehearsal of the most important concepts during lecture, which enhances the likelihood of retention.

Handouts

Studies have shown that note-taking increases learning and retention of the material presented in large group formats. Thus, it is a good idea to prepare handouts that lend themselves to note taking and reinforcement of the lessons given in class. A familiar format is a general outline that can be filled in with specifics during the lecture. Another common format is to provide an exact copy of your presentation slides in paper or electronic form to the students. This allows students to annotate your presentation in the lecture hall. Both formats are easily posted into online learning management systems and allow students to use their computers to take detailed notes on your presentation. One should beware three things when preparing handouts. First, make sure that you have not provided too much information, such as long, detailed bullet points. This discourages note taking and encourages the instructor to read them in the lecture, reducing engagement. Second, make sure that slides that are easily seen when projected are also easily read when printed. Slides featuring detailed histology can become amorphous smudges, graph legends can disappear and complex biochemical reactions can be undecipherable when rendered as six black and white images per page. Thus, it is worth taking the time to look over how the handout of your presentation will look before entering the lecture hall. A similar issue can occur when presenting slides remotely over Zoom or another online platform. Finally, ensure that you have secured copyright permissions for figures and materials you will include in your handouts. Once in the student's hands, these documents fall into the public domain and you are responsible for their content.

Audiovisual Materials

Audiovisual materials introduced in a large group presentation should complement the presentation and promote active learning. The most common presentation method in large group settings is the "slide show," most commonly using Microsoft PowerPoint. Some tips for an effective slide show can be found in Table 4.4.

Other audiovisual materials can include videos, demonstrations, white or blackboard, models, etc. The key to the use of these materials is that they are relevant, and visible at a distance. If presenting remotely, ensure that these elements are easily visible on a computer screen. Added audiovisuals should be easily comprehendible in the lecture hall. I recall a colleague who developed a detailed animation of a physiological process for presentation in class, but upon presentation the students could not comprehend its complexity in the allotted time. Audiovisual materials should help explain things, not provide barriers to understanding.

Active Learning Methods in the Large Group Setting

As stated previously, a key to increasing learning in the large group setting is involving the students with active, rather than passive methods. When introducing active learning methods into the lecture hall, you may meet some resistance. Some students do not understand the need for active learning methods. A question you may sometimes get is "Why can't you just tell us what we need to remember for the exam?" In this case you should state that the purpose of the presentation is to apply knowledge to achieve greater learning IN THE CLASSROOM. Tell them that valid educational data show that sitting for an hour just listening is not the best way to learn. Thus other elements of active learning MUST be incorporated into the hour. Finally, you must ensure that your assessment questions on examinations require more than just rote memorization. If students are made aware of this, there will be great interest in active learning in the classroom. Students who initially disapproved of these techniques have regaled me years later with stories about how they still

Table 4.4 Effective slide presentations

Avoid dark backgrounds with white letters. This requires lower room lighting, which encourages dozing.
Don't put much information on a single slide. The number of bullet points should not exceed 4–5. The font size should be as large as possible, at least 18 pt.
Ensure that figures are legible when projected or presented online.
Use care when putting conflicting information formats on a single slide (e.g., a graph with bullet point explanation, see Chap. 1).
Allow 2–3 min per slides.
Allow time for other educational elements to be included in the presentation. A single lecture of 50 PowerPoint slides is a sure way to lose the student's attention.

remember lecture points solidified by active learning methods. In this section I will introduce some ideas for incorporating active learning into a large group session. The list is not exhaustive, but intended to help start your search for methods that best complement your presentation style.

Lecture Respites

The simplest way to promote student learning during a lecture is to provide a short respite from lecture. This can be done every 10–15 min to maintain student arousal. One way is to say "At this point I will stop for a **note check.** I want you to review your notes and then ask me questions if needed." This simple device allows students to re-engage, to begin to make sense of the lecture, clarify points they do not understand, and process the information into long-term memory. You can help the process along by suggesting areas to focus on in their brief review. The solitary review should last only about a minute, to discourage social chatting with neighbors.

Small Group Activities

The best way to overcome the limitations of a large group is to break up the class into smaller units that can engage in other activities. **Buzz groups** are a form of peer learning that can be introduced into any large group presentation. The instructor poses a problem, and then divides the class in groups of about four students each to quickly solve it. In my lectures I simply ask the students to turn to their neighbors and discuss the problem. After a short interval (1–3 min) the instructor calls on a reporter from selected groups to present their answer. The question can be subdivided so that different groups have different parts of the question, which can promote a class-wide discussion to synthesize the best solution. Further questions can be introduced during the discussion by the instructor to promote further discussion. I sometimes create impromptu buzz groups if I feel that the class is having difficulty understanding a concept. The buzz group format is quite adaptable and can occupy just a few minutes or an extended time as needed. A variant of the buzz group is the **"Think-Pair-Share"** or "**Pair Discussion**." Here students work on a problem or discussion question of limited complexity by themselves for 1–5 min (**think**), then form a working pair with their nearest neighbor (**pair**). The discussion time allotted is also short (about 3–5 min), and the instructor calls on a limited number of pairs to report and discuss their answer (**share**). Despite the limited discussion period, all students work on the problem with a peer and derive benefits from actively applying their new knowledge in this format. The pair discussion format can also be combined with the note check strategy described above in which students determine if they have missed anything, discuss the salient points and ensure that they both agree on what was important.

Reading or problem-solving activities can also be attempted in a large group setting. There are many variations to this format, but it usually the assignment of a specific reading, viewing a video vignette or problem-solving task. Students complete the tasks individually for a defined period of time, then break into pairs or small groups for discussion and resolution of problems. Then the groups report to the large group during a general large group discussion facilitated by the instructor. There are many possible variants to this scenario. This method is amenable to virtual presentation methods as well.

Classroom Survey Techniques

Classroom survey techniques are methods to poll the class about their progress and preferences on certain topics or answers to questions during the session (Angelo & Cross, 1993). This can be done by eliciting a simple show of hands, by holding up numbered cards or by use of sophisticated audience response systems as described in Chap. 1. This format can create a lively and interactive environment to promote learning in a large group. The most common approach to the method is to periodically ask the students a multiple choice question and to quickly tally the answers from the class. There are tangible benefits to both the instructor and the student. The instructor receives instant feedback as to the comprehension of the class and can adjust the content and pace of the lecture accordingly. Disparate answers can also be used to generate a class discussion. For the student, attentiveness is improved and knowledge gained during the lecture is directly applied to promote long-term retention. Use of an automated audience response system can greatly facilitate this process. In addition to instant feedback, the audience response system offers the advantage of anonymous responses, integration with presentation software, individual tracking and grading of responses and immediate graphical display of the results. When using any classroom survey technique, the instructor must be prepared to alter the course of the presentation based on the level of comprehension of the students. A final use of classroom survey techniques worth discussing is for assessment. Short quizzes can be introduced at the end of lectures to reinforce learning. Conversely, quizzes can be introduced at the beginning of each lecture to assess prior knowledge or to ensure completion of the reading assignment.

Reflective Techniques

A number of techniques exist (see Angelo & Cross, 1993) that call on the student to directly apply new knowledge in the class to increase comprehension and allow higher level of learning. For example, the **two (or one) minute paper** or **"half sheet response"** is an effective way for students to synthesize the knowledge gained during the large group session (McKeachie & Svinicki, 2013). Typically, the students are asked to take two minutes at the end of class to produce a short essay explaining the most salient point(s) of the lecture. Other topics that could be tasked include "Give an example of this concept' or "discuss treatment options for this disease," etc. This aids in retention and understanding of the material. The essay can be for self-evaluation or the instructor can collect them for grading. A variant is where the instructor stops the class and asks them to produce a one or two minute essay on an assigned topic that relates to the lecture material. A related technique is the **One-Sentence Summary**, where the instructor asks each student to prepare a declarative sentence that summarizes a key point. **Directed Paraphrasing** is another variant in which students are asked to paraphrase a specific part of a lesson in their own words. This can be done in written form or verbally after allowing a short reflective period. One final example is the **student-generated test question**, in which students are asked to develop a "one best answer" question about a specific point in the presentation. These questions can be used in several ways: they can be graded by the instructor, answered by neighboring students, compiled into a quiz given prior to the next teaching session, posted on the class bulletin board, etc. Several other examples of effective techniques are detailed by Angelo and Cross (1993) and in Chap. 5. In each case, the techniques serve to increase engagement and reinforce student learning in the classroom.

Games

Some faculty introduce active learning in students by catering to their competitive nature. In the game format, quiz questions are introduced and student teams compete to answer them. Scores may be kept and nominal prizes may even be awarded to the best teams. There are many variations to this format. Small competitions can be held during the last five minutes of the session, or entire sessions can be given over to review a course section via this approach. The biggest advantage of the game approach is that it creates a fun, energy-filled environment for learning. The primary disadvantages are the time it takes to conduct the sessions and the loss of focus that can occur in the game environment.

Getting Beyond the Boundaries of Lecturing

At the beginning of this chapter, I stated that although lectures are an educational mainstay, active learning is much more feasible in other educational formats. Recognizing this, educators are beginning to modify the large group setting to reduce or eliminate lectures and maximize the opportunity for active learning and peer teaching. Two related formats warrant introduction and are the subjects of chapters in this book: flipping the classroom (Chap. 5) and Team-Based Learning (Chap. 6). In both cases, students are responsible for completing assignments before

Table 4.5 Common mistakes to avoid in large group teaching

Lack of engagement: monotone presentation from behind the podium.
Information overload: too many slides, too fast paced, too many objectives.
Poorly thought-out beginning and ending.
Simply reading bullet points from the slides.
Inadequate knowledge of the context of your presentation: gaps, redundancies and conflicting information.
No time allotted for assimilation and reflection.
Not knowing your learners: teaching is too elementary or beyond their comprehension.
Entertaining but not instructive: Beware of the Dr. Fox effect!

coming to class to ensure a baseline knowledge acquisition. In the large group, students then complete assignments or assessments that apply this prior knowledge, leading to higher levels of learning and better retention.

Summary

Developing and delivering an effective lecture can be a daunting challenge. It is important to review the feedback gained from students and peers and to continue to improve the quality and the amount of learning that takes place in your sessions. Table 4.5 summarizes some of the common pitfalls that can befall even the most experienced lecturers. Further information on diagnosing lecture problems can be found in a humorous but informative paper by McLaughlin and Mandin (2001). Pay careful attention to evaluation data to determine strategies to improve your teaching (Jeffries et al., 2021).

Hopefully this chapter has provided both a framework for engaging students actively in the large group setting and a way of avoiding common mistakes. Additional resources are provided below to provide an in-depth treatment of this topic.

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Chapter 5
Flipped Classrooms

William B. Jeffries, Kathryn N. Huggett, and John L. Szarek

Abstract In this chapter, we discuss a movement among educators that goes beyond simply enhancing lectures. Here the lecture is replaced entirely with new types of learning, while preserving the efficiencies of the large group format. In this model, the aim is to maximize the availability of faculty expertise and feedback, take advantage of group learning, and ensure that learning is reinforced through application rather than memorization. This chapter details how to prepare, implement and troubleshoot a "flipped" classroom through a variety of customizable strategies

Introduction

As described in Chap. 2, one of the most significant challenges in medical education is incorporating active learning in an environment dominated by large group teaching. In Chap. 4, methods for incorporation of active learning *into* the lecture format were discussed. In this chapter, we will describe the flipped classroom, in which the typical lecture and homework elements of a course are reversed. This is an expanding movement among educators that goes beyond simply enhancing lectures. The lecture is replaced entirely with new types of learning, while preserving the efficiencies of the large group format. In this model, the aim is to maximize the availability of faculty expertise and feedback, take advantage of group learning, and ensure that learning is reinforced through application rather than memorization.

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What Is the "Flipped Classroom?"

In a conventional lecture format, the learner obtains knowledge by (1) passively observing a performance by an expert faculty member, (2) taking notes on the important points and (3) referring to an instructor-provided outline or PowerPoint presentation. This experience is later recounted in the student's own mind during study and during homework, i.e., assignments that must be completed for credit. The flipped classroom model turns this paradigm inside out. With the flipped classroom model, the knowledge transfer *is* the homework, completed before coming to class. This knowledge comes from assigned reading, podcasts or videos. Armed with this knowledge, students then come to class to work on knowledge application. The faculty member becomes a facilitator, leading students to higher levels of learning and retention. The desired result is higher levels of learning and engagement, optimization of faulty time, and the ability to expand learning objectives to domains outside of knowledge acquisition (e.g., professionalism, communication skills, critical thinking). Most importantly, students have ready access to expert help (you) and peer teaching as they attempt to apply their newly acquired knowledge to real world problems. The evidence that the flipped classroom and active learning enhances student performance is overwhelming (Freeman et al., 2014; Hew & Lo, 2018). Moreover, this method especially benefits students from social groups that are considered underrepresented in higher education (Barral et al., 2018).

Principles of the Flipped Classroom

The primary purpose of the flipped classroom is to remove simple knowledge acquisition from the classroom setting and to reserve classroom time for knowledge application and clarification. To achieve this aim, the following principles can effectively guide the design and execution of a successful flipped classroom experience:

- Students must have clear objectives for knowledge acquisition and access to materials that succinctly provide them with this information.
- The sources of assigned knowledge acquisition must be concise and focused to allow students to complete it before attending class.
- Students learn best in context; assigned class work should be focused on significant problems requiring application of their new knowledge and higher levels of learning.
- Peer teaching magnifies learning; assigned classwork is best designed for and conducted in groups.
- Assessment drives learning; assessment of class performance is desired and course assessments should mirror the higher-level learning that has occurred in class, not merely the knowledge acquired in pre-class work.

An important outcome of the flipped classroom is the ability to achieve higher levels of learning inside the classroom. This can be understood by considering the progression of learning through a formally identified framework of learning objectives. A group of educators chaired by Benjamin Bloom (Bloom et al., 1956) originally defined a taxonomy of six types of cognitive learning objectives that increase in complexity that can be conceptualized in the form of a pyramid. This progression from bottom to top includes the recall of facts, patterns, and concepts important for developing the cognitive domain of learning (i.e., intellectual abilities and skills). Individuals usually master one level before progressing to the next. A modified version (Krathwohl, 2002, Schultz, 2005) is shown below (Fig. 5.1).

Importantly, in the traditional lecture format, students participate with little preparation. Learning begins at the bottom of the pyramid. Mastery of the "Remembering" and "Understanding" levels is attempted during the lecture. Unfortunately, even this is difficult in lecture since students have not yet had time to assimilate the material and are subject to the loss of attention described in Chap. 2. Further, since students have varying abilities, there will be wide gaps in student understanding at the completion of the lecture. If the student has difficulty with lower levels of understanding, there is little opportunity to address that formally through in-class instructor intervention or peer teaching. Higher levels of learning await solitary homework assignments that may challenge student understanding and stimulate student understanding. Instructor feedback and peer teaching are not optimized in the traditional lecture format.

In flipped classroom approaches, students are expected to progress through the first two levels of Bloom's Taxonomy and begin work on mastering application and beyond. Ideal assignments are designed to stimulate recall and understanding by requiring students to *do* something with the knowledge they have acquired. Gaps in understanding are filled with peer teaching and instructor feedback. This allows students to catch up and achieve similar levels of learning at the conclusion of the session. It also allows a higher level of assessment to take place as test questions can cover student reasoning and not simple recall.

Since efficiency and increased depth of learning are important goals of the flipped classroom, it is important to consider the optimal ways to structure and execute the components of the flipped classroom. These include pre-classroom activities, the flipped session, and assessment.

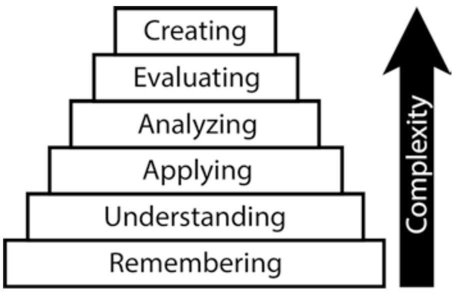

Fig. 5.1 Modified Bloom's taxonomy. (Adapted from Krathwohl, 2002 table 3, p. 215)

Pre-classroom Activities: Turning Your Lecture into Homework

The figure below depicts the flow from pre-classroom activities to outcomes. Details of each of the elements are defined in the following paragraphs (Fig. 5.2).

Careful consideration is required when replacing lectures with flipped sessions. First and foremost, students must have clear objectives for the session as they approach their preparatory assignments. These objectives should be constructed using verbs associated with the modified Bloom's taxonomy that **describe what the student will be able to do at the end of the session**. This way, students can prepare in a focused manner and not waste time guessing what will be covered. For example, if the topic is the treatment of diabetes complications, and the reading assignment includes the treatment of diabetes AND its complications, students will react strongly about the time spent over-preparing and they will lack enthusiasm in the flipped session. Thus, having clear objectives provides a map for student preparation and a map for the instructor to understand what students should be able to do by the end of the session. It is preferred to have distinct objectives for the preparatory assignment and the flipped classroom experience. In the case of the preparatory assignment, the instructor usually expects that the learner will accomplish objectives that relate to the remembering and understanding stages of Bloom's taxonomy. Objectives covering the higher stages will be addressed in the classroom.

The knowledge acquisition assignment must be focused and reasonable with respect to time needed for completion. This can be accomplished through reading assignments, specific handouts created for the topic, podcasts of previous lectures, new lectures created for the flipped session, or videos curated from other sources (e.g., YouTube). A combination of any of these assignments can be employed, providing the workload is reasonable and they are directly relevant to the session objectives. When assigning readings, identify succinct sources such as review articles or textbook chapters. Some instructors make handouts with specific excerpts that are most relevant to learning (ensure the copyright provisions are respected!). It is also helpful to construct short formative quizzes on fact recall or understanding that students can take online to ensure their readiness. As discussed below, these quizzes could be reserved for the beginning of the flipped session to ensure attendance and improve readiness.

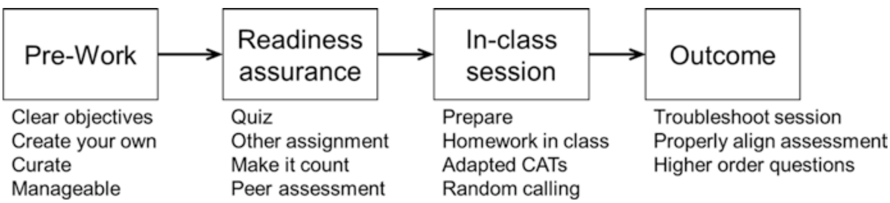

Fig. 5.2 Workflow in preparing a flipped classroom

Faculty commonly assign podcasts as a preparatory assignment. When choosing this route, there are two considerations to keep in mind. First, faculty members are tempted to use recordings of old lectures as the knowledge assignment, since they are usually assured of completeness of content and are confident that the student will get at least as much material covered as they did before the introduction of the flipped classroom. We strongly discourage this approach. Captured lectures are subject to many of the problems that were discussed in Chap. 2 (e.g., loss of attention). The sheer length of the sessions makes them ripe for loss of engagement. In addition, captured lectures include many irrelevant moments that are not conducive to a preparatory session: pauses and gaps as the instructor reiterates previously learned concepts and answers student questions, jokes, and (hopefully) active learning components intended for a live audience. A better approach is to create specific video podcasts for each session that are short (about 10 minutes) and succinct, covering the material in a narrated slideshow or virtual chalk-talk (Prober & Khan, 2013). This approach allows students to break down concepts into easily understood components, review the videos if needed and complete the work in their own time. Second, these authors also stress the incorporation of only "evergreen" material, i.e., material that is foundational and highly likely to be true (as opposed to controversial or still experimental data). Controversy and experimental data can serve a purpose in the educational experience but are better used as learning tools for the flipped session to climb the pyramid of Bloom's taxonomy.

Flipped Classroom Preparation

Setting Up the Room

The physical setting for the flipped classroom is often the same room where you have conducted your lectures. Ideally this would be in a room with a flat floor, with tables and movable chairs to allow students to configure themselves into learning groups. Often, the flipped session must take place in a tiered classroom that is better suited for viewing a lecture than participating in a group activity. This can inhibit, but not prevent, an effective flipped classroom exercise. Students should be encouraged to assume configurations that work best for them in a group learning situation. Group size can vary from two to six or seven, depending on the exercise, so keep the room layout in mind when configuring the session. Acoustics are important, and an active learning classroom will be loud during discussions but quiet when students are called upon to address the class from their places.

Regarding learning groups, a decision must be made whether to allow students to create their own groups or to pre-assign students to groups. Experience has shown that the former is often not be the best option. Left on their own, some students will choose to work on their own or with friends, diminishing the higher-order cognitive skills they can learn from their peers (Szarek et al., 2016; White et al., 2014). A preferred option, building on group principles of Team-Based Learning (Michaelsen et al., 2007), is to assign students randomly to small groups at the beginning of the course. As students spend more time in their group, they develop a feeling of accountability that enhances the achievements of all members of the group.

Although less optimal, active learning sessions can be accomplished remotely through distance learning methods. During the COVID-19 pandemic, many schools adapted their methods to suit an online synchronous environment using Zoom, Microsoft Teams, or other platform that allows students to be present synchronously with the option to form breakout groups, answer quiz questions, vote on group decisions, etc. All the methods presented here can be adapted to online learning.

Design of the Session

One of the best features of designing a flipped learning experience is that there are many types of activities that can be employed to hold student interest and contribute to learning. Prior to beginning the activity, one should ask several relevant questions:

- Assuming that students have met the knowledge objectives in the preparatory session, what will you expect the students to do with that information? This forms the basis for writing the session objectives.
- How will you assure readiness and participation? Students who do not complete the assigned work will not be effective participants in classroom work, so an effective session must deal with this question.
- What activities will be used and how will they be applied toward meeting the objectives? In the next section, a variety of possible activities are introduced that can be used to stimulate individual or group learning.
- How will learning be assessed? Assessment of learning plays an important part in the design of the session. Holding students accountable for advanced stages of their learning is essential to making the flipped classroom successful.

Readiness Assurance

Readiness assurance is a term borrowed from Team-Based Learning (Chap. 6). If students do not prepare for the session, it is doomed to fail since they have not considered, much less mastered, the lower level objectives. This can lead to failure in meeting the upper objectives and poor attendance. To prevent this, many adherents either require participation through mandatory attendance policies or have participation in some way count toward the student grade. The easiest way to accomplish this is to administer a quiz at the beginning of the session. The quiz should ideally be short, address the objectives of the preparatory session, and should contribute to the final course grade. This ensures that students take the assignment seriously and present themselves ready to learn. Other ways include completion of online assessments or assignments prior to participation in an online bulletin board, Wiki, etc. It is also possible to use peer assessment to ensure that students police whether students in their study group are dutifully preparing for the flipped classroom.

The Flipped Classroom Session

There are innumerable ways to design a flipped classroom session, and we will present two major categories here, "Homework in Class" and "Adapted Classroom Assessment Techniques."

Homework in Class and Related Techniques

Worksheet

This is the simplest (and least engaging) of flipped classroom sessions. Lecturers have often provided worksheets to students to practice application of discussed concepts (e.g., mathematics problems, chemical reactions, etc.). Sheets are returned to the instructor for grading as a homework assignment. In the flipped setting, the classroom becomes the venue for filling out a worksheet based on assigned activities (readings, podcasts, videos, etc.).

Suggestions for Application

1. Do not make this the entire session, as students get bored quickly.
2. Distribute the worksheet during class – if you hand it out in advance (or if students have access to it from previous students), students will avoid the session.
3. Allow students to complete it as a group. This allows students with a better grasp of the material to teach those who need help.
4. Combine the worksheet with adapted classroom assessment techniques (see below) to maximize the benefit.
5. Allow each group to submit one worksheet for credit, or give a short quiz at the end of the session containing similar problems to ensure that all students have achieved session objectives.

Dry Lab

A common practice among medical science educators is to provide students with the opportunity to design experiments and/or interpret provided laboratory data based on concepts presented in lecture.

Results can be returned to the instructor for grading. In the flipped classroom, knowledge objectives are assigned and satisfied outside of lecture (e.g., assigned readings, podcasts, videos) and the “dry lab” occupies the space formerly used for the lecture. Students or groups of students can be called upon to present the results near the end of the session.

Suggestions for Application

1. Distribute the dry lab data during class – if you hand it out in advance (or if students have access to it from previous students), students may avoid the session.
2. Have students work in small groups to complete assigned labs. Weaker students can be helped by peer teaching from stronger students. Faculty can “float” and answer difficult questions (but NOT lecture!).
3. Have students submit completed group work before presentations to ensure everyone participates.
4. Vary lab material from year to year to ensure students will not be tempted to use material and answers from previously enrolled students.
5. Assess achievement of objectives with a short set of relevant problems at the end of, or shortly after the session.

Case Report

A common practice among medical science educators is to provide students with a case report scenario, slowly revealing aspects of the case as they unfold chronologically. The case can be on paper or involve a standardized or simulated patient. This format is often used in small groups, based on didactic material from the curriculum. This can easily be flipped to a large group session. Many of the concepts discussed for “dry lab” apply here. If knowledge objectives are assigned and satisfied outside of lecture (e.g., assigned readings, podcasts, videos) the case report can occupy the space formerly used for the lecture.

Suggestions for Application

1. Provide some details of the case before class to encourage focused reading. We do not recommend giving out specific questions before class, except for one or two standard questions that go with EVERY case that have been developed so that students can orient themselves. If you hand out all material in advance (or if students have access to it from previous students), students will either avoid the session or deliver the answers in rote fashion.
2. Have students work in small groups to complete case questions. Cases can be done in episodes with large group discussion following small group deliberation, or cases can be worked out in small groups in their entirety. Weaker students can be helped by peer teaching from stronger students. Faculty can “float” and answer difficult questions (but NOT lecture!).
3. Students could develop a case note in SOAP or some other standard format as an in-class product. The SOAP note could then be used for a case presentation by selected students/groups.

4. Have students submit completed group work before presentations to ensure everyone participates.
5. Vary case material from year to year to ensure students won't use material and answers from previously enrolled students.
6. Assess achievement of objectives with a short set of relevant problems at the end or shortly after the session.

Review Session

Instructors or course directors sometimes include scheduled review sessions before exams to ensure students can bring their questions regarding the course material to faculty. In the flipped classroom, if students have achieved knowledge objectives without attending lecture, all or part of a scheduled lecture time can be devoted to answering students' questions.

Suggestions for Application

1. Avoid being drawn into giving a "mini-lecture." Students must be prepared to ask specific questions and the instructor must resist the desire to facilitate passive learning methods.
2. A review session is best combined with or replaced by classroom assessment techniques to ensure maximum participation and learning.

Adapted Classroom Assessment Techniques

Angelo and Cross (1993) compiled several effective ways to introduce active learning into an otherwise passive lecture (see examples in Chap. 4). Since the intent of these techniques was to engage students and promote higher order learning, it is relatively easy to envision how to adapt them to a flipped classroom. Some of these methods are presented below, but the reader is urged to consult the original literature to discover other classroom assessment techniques that could be of use in the flipped environment.

Background Knowledge Probe

The background knowledge probe is designed to determine student's prior knowledge, their recall and understanding of material key to success in a course or unit. The probe is usually in the form of a multiple choice or short answer test. In a flipped classroom, students can be assigned one or more prior readings, podcasts or videos to gain subject knowledge. The large group class meeting can then begin with an assessment that can be taken individually or in groups (or in the case of Team Based Learning, both).

Suggestions for Application

1. Use this as a tool to start a session.
2. In multiple choice format, an audience response system can be used by the instructor to quickly gauge student understanding of key concepts.
3. Short answer format can be effective for recall not based on word recognition. The probe can be graded quickly by neighboring students.
4. The exam can be used as a tool to encourage group learning and peer teaching. In Team-Based Learning, students complete initial assessments alone and then complete the same exam within a small group. This enables students to help each other clarify unclear points for each other and stimulates all students to participate in application of their knowledge.
5. Students take the exercise much more seriously if the assessment counts toward their grade.

The One-Minute Paper

The one-minute paper is used to assess prior knowledge, recall and understanding of key concepts. Traditionally, it can be used at the beginning or at any point during class when an important concept needs to be emphasized and imprinted into long-term memory. The paper is often in response to a question like "What is the most salient feature of the process we discussed today?" or "What concepts covered today are key to the treatment of X disease?" etc. The papers are graded and returned to students at the next session. For a flipped session, students can be tasked to either summarize the key concepts derived from class preparation (e.g., reading, podcast, video) or can summarize portions of a group discussion related to the application of a topic during the flipped classroom session.

Suggestions for Application

1. The essay can be used to start a session, or at any time during the active session.
2. The essay can be handed in for credit or graded by a neighboring student to stimulate discussion.
3. Students can be called on to read their short essays to stimulate discussion.
4. Students can develop an essay together, based on an assigned discussion or problem set that draws on their knowledge.
5. A variation involves groups of students creating a presentation during a learning session that summarizes key points. The presentation can be delivered near the end of the session or posted or podcast for further use by all students. The faculty challenge is to ensure expectations of accuracy and presentation quality.
6. Students take the exercise much more seriously if the assessment counts toward their grade.

The Muddiest Point

The muddiest point is a technique whereby students quickly note the greatest area(s) of difficulty ("the muddiest point") that they have with lecture material or assigned readings. In a lecture setting this is compiled at the end of class and the teacher returns in the following session to clarify the most frequent difficulties. In the flipped classroom, students can be given the routine assignment of specifying the muddiest point from assigned material and bringing those questions to the active session. If bringing a muddy point to class is required, it improves engagement and preparation.

Suggestions for Application

1. This technique is best used in the middle or at the end of the session ("muddy points" can sometimes develop into lengthy diversions!)
2. The question can be introduced into a small group formed among neighbors (or to pre-assigned groups) to stimulate discussion and peer teaching.
3. Difficult questions not solved by the group can be presented to the larger group for resolution. Resist the temptation to break into a spontaneous lecture in response to a muddy point – peer discussion is better.
4. Students can develop a group response that summarizes key points. The response can be presented near the end of the session or posted or podcast for further use by all students. The faculty challenge is to ensure expectations of accuracy and presentation quality.
5. Students take the exercise much more seriously if the assessment counts toward their grade.

The One-Sentence Summary

In the original lecture format, the instructor asks each student to prepare a declarative sentence that summarizes a key point. This works well when summarizing facts such as pathways or reasoning paradigms (e.g., "When assessing hyponatremia, one must first ascertain volume status…"). In the flipped classroom, the instructor asks the learners to develop one-sentence summaries for specific topics that they can look up or develop from recalled knowledge or from the active session. If bringing a one-sentence summary to class is required, it improves engagement and preparation.

Suggestions for Application

1. This technique can be used to summarize prepared or discussed material.
2. Summaries can be the result of a small group discussion formed among neighbors to stimulate discussion and peer teaching.
3. Students can develop a group sentence that summarizes a key point. The sentence can be presented near the end of the session or posted or podcast for further use by all students. The faculty challenge is to ensure expectations of accuracy and presentation quality.

4. Sentences from different students/groups on similar topics can be read aloud and students can vote on the best ones using an audience response system.
5. Students take the exercise much more seriously if the assessment counts toward their grade.

Directed Paraphrasing

This method requires students to paraphrase a specific part of a lesson in their own words. This makes the learner directly apply and present their newly acquired knowledge and reasoning skills. In the flipped setting, students can be asked to take a small amount of time to summarize a portion of an assigned lesson or repeat key points from the discussion. The latter aspect of this is already routinely used in clerkship presentations of patients on rounds.

Suggestions for Application

1. Paraphrasing can be used to summarize prepared or discussed material.
2. Students can be called on to summarize for an assembled peer group the key points of the assignment. DANGER: students could internally assign the task of preparing for the session on a rotating basis, thus eliminating the need for all students to prepare for the session.
3. The best use of this technique is to assign students to work on a specific problem or case, then have one of them summarize the findings for the large group.
4. Students can be assessed on their participation and presentation skills, as well as content knowledge. Peers can participate in the assessment process.

Application Cards

After learning a concept, students are given a card to write down possible real-world applications of this knowledge. Cards are assessed on a Likert scale with feedback. In a flipped classroom, students can understand basic science concepts and their relevance better when presented in the context of clinical medicine. Thus, assigned preparation material can be more readily understood if students are expected to relate it to a relevant disease process, or wellness concept. Students can be asked to produce a short, written description of the application of a particular basic science topic.

Suggestions for Application

1. This technique can be used for prepared or discussed material.
2. Students can be assigned the task of developing individual, non-overlapping cards based on key discussion points. The instructor can then call for unique applications from selected groups.
3. Cards from different students/groups on similar topics can be read aloud and students can vote on the best ones using an audience response system.
4. Students take the exercise much more seriously if the assessment counts toward their grade.

Student-Generated Test Questions

Students are asked to develop several exam questions with one best answer. This method develops comprehension and application skills. In a flipped classroom, learners can be assigned the task of preparing exam questions based on assigned material or developing them in class. Caution: since many students use commercially available question banks for their studies, plagiarism is a concern. Students generally prefer preparing for exams by using practice questions, so this method can be very popular.

Suggestions for Application

1. Students should be oriented towards the principles of valid examination formats and question styles.
2. Students could be assigned the task of individually generating three exam questions. Working in groups, students discuss the questions and attempt to modify and merge their group's question pool into a comprehensive 10-question quiz.
3. Generated (and accurate) questions can be posted on a student bulletin board or other suitable venue for their study.
4. Students could be further motivated by the promised use of a small number of their questions on the actual exam.

Pro and Con Grid

Learners are asked to chart the pros and cons of a specific issue or topic, which is useful in developing and assessing critical thinking skills. Students can be asked to develop a chart of the pros and cons regarding ethical or risk/benefit of certain treatments or public health approaches to societal problems, etc.

Suggestions for Application

1. Students can apply assigned knowledge objectives to real-world problems before coming to class. Students in class can work in groups to discuss specific cases and refine their grids.
2. Grids can be developed by individual groups, and presented for large group discussion, comparing the work of individual groups. A consensus grid can be developed for the entire class and posted online for later assessment.

Summary

Encouraging participation. In addition to ensuring that students are prepared for the session as described above, students need to work during the in-class session. One way to motivate students to do the work in the group is to call on a student to explain their responses. Several of the flipped classroom designs summarized above suggest calling on students for responses. This can be accomplished by calling on volunteers or by randomly eliciting responses. Usually the same students respond when volunteer responses are solicited. In this case, the rest of the class knows they will not be called on and may not prepare. Random calling obviates this problem by ensuring that all students have an equal chance of being called on, thus motivating students to work in their groups. The easiest way to accomplish this is for instructors to create a randomized list ahead of time to ensure that students are called on equally (Eddy et al., 2015; Szarek et al., 2016).

Assessment of student progress. Readiness assurance activities promote self-assessment and accountability, and in-class application activities also constitute formative assessment in the flipped classroom session. The true determination of the effectiveness of the flipped classroom experience is the lasting educational outcome. This will come in the course assessments, subsequent performance in later courses and clerkships, and application of acquired knowledge and skills in clinical practice. It is important to remember to align the learning and formative assessment activities in class with the course objectives and summative course assessments. What you choose to measure on assessments sends a powerful message to students, and they will detect if a mismatch in rigor is present between classroom activities and questions on course examinations. Thus, you should ensure that summative course assessments include higher order questions and not just knowledge recall questions. This will reinforce learning and provide an immediate reward for students who seek to maximize the effectiveness of active learning.

Troubleshooting the active learning setting. Active learning exercises are subject to unexpected turns that may derail even the best planning. It is important to remain flexible and be willing and able to change class activities as needed. These disruptions can come in many forms. The physical environment may be disrupted (fire alarm, technology failure, etc.). Develop class norms or guidelines that are agreed upon in advance to handle contingencies in case of such disruptions. A social contract can also be developed with learners to handle classroom behavior. Students who do not prepare are often the biggest problem. It is best to let this be handled by peers in the group (either through explicit rules or peer assessment), or use “for credit” in-class assessments to address lack of preparation and participation. A final difficulty may be colleagues who agree to facilitate but appear to give mini-lectures as they circulate around the room. Be prepared to redirect these peers before they undermine the intended activity. Gently remind them that the students should be engaging in peer learning.

Barriers to implementation. The primary barrier is your own imagination. Creative planning can overcome most barriers, but time is needed upfront to prepare course content and to plan challenging in-class activities. Regardless of whether you create your own material or curate content, plan on more time to prepare for your first flipped classroom session. In one study the authors found that 127% more time was needed to prepare a flipped classroom, but in subsequent iterations less time is needed since materials can be reused (McLaughlin et al., 2014). Do not attempt to “wing it” as some of the aforementioned difficulties can prevent effective implementation. Attempt to secure an optimal room size and layout for the flipped classroom, in which students can effectively collaborate. If only a tiered classroom is available, it is effective to group students with those directly behind them. As mentioned previously, the assignment materials should be distributed judiciously to prevent some students from undermining flipped classroom learning activities. In our experience, if students have all the learning materials in advance, some will strategically assign completion of the work in advance of sessions. These students may perform well on the formative assessments, but the collaborative, discovery-based learning process will be stunted when everyone knows the answers in advance.

It is clear that the flipped classroom provides an excellent opportunity to energize the classroom by engaging students and faculty in an effective way to stimulate learning. We anticipate that as the use of this modality grows, that many more innovations will be introduced to create an even more dynamic way of teaching.

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Further Reading

For a detailed "how to" website of flipping the classroom, review the Center for Teaching and Learning guide at Vanderbilt University. http://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/ Accessed 21 Jan 2021.

For examples of other active learning methodologies see: Fornari, A. & Poznanski, A. (2017). *How-to Guide for Active Learning*. IAMSE. http://www.iamse.org/manuals/

Chapter 6
Team-Based Learning

Dean Parmelee

Abstract Team-Based Learning (TBL) is a large group, peer teaching method that can also be described as an expert-led, interactive and analytical teaching strategy. TBL keeps the class together (large group) with one or more expert(s) while the learners apply the content to specific problems (analytical) in small groups (interactive) at intervals during the learning session. The learners are expected to prepare prior to the session. Content is used throughout the session rather than simply introduced. This approach allows learners to apply the content through problem-solving and receive feedback both from peers and the instruction or content expert.

Team-Based Learning (TBL) is an instructional strategy that uses the power of small group learning within the large classroom setting. It works well with class sizes as small as a dozen to as large as over two hundred, depending on space design and acoustics. For the learner, it requires considerable accountability to come on time, come prepared, and engage collaboratively with a small group of peers to solve problems and make decisions. For the instructor, it requires subject matter expertise, adherence to the structure and process of the strategy, and the conviction that the best use of one's time in the classroom is to uncover content, not cover it. Done correctly, it transforms the learning culture. TBL enables learners to become more self-directed, but also fosters their ability to work with others. For the instructor, TBL augments the vitality of the teaching experience by applying expertise at the point of learning.

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Why Do TBL?

Most faculty have learned to teach from their own experiences as a learner – lots of lectures and didactic sessions to cover content for a test. What would motivate any of us to do this differently, since we all turned out just fine? Although there is evidence that TBL leads to improved academic outcomes, a more compelling reason emerges through either observing or participating in a TBL session. The learners are fully engaged with the material and each other, analyzing information, speculating, making decisions that they can defend. No one is napping, engaging in social media or other activities on their computer. The instructor listens to the conversations around the room and when teams display their choices to a question, s/he asks the teams to explain their reasoning. The emerging focus of the session becomes the "why" and "how" of a problem, which is important for the transfer of knowledge and reasoning skills to solve novel problems in health care practice.

In addition to better academic outcomes and inspiring classroom engagement with the learners, another important reason for using TBL is that instructors often discover they prefer this modality to passive large group teaching methods. TBL focuses on application of knowledge and building of skills to think critically, creatively, and work collaboratively. For example, if you teach about acid-base balance through presentation, are you ever sure that the learners both understand it and can apply this knowledge to the solution of a clinical problem? No, of course not – they will only truly grasp the principles through solving progressively challenging problems – with you there to coach, probe, and affirm them when they can do so successfully.

In practice, TBL teaches learners how to solve any problem while being part of a team, similar to real practice where health professionals from different disciplines work together to manage medical problems. In TBL, team spirit and collaboration between team members develop early. With the increasing focus on patient safety in health care settings, TBL provides learners with many opportunities to learn how to better communicate and collaborate in the team setting.

How Did TBL Develop?

In the early 1990s, a business school professor, Dr. Larry Michaelsen, became frustrated with lecturing to increasingly large classes. He could never tell whether his learners were paying attention or if they could apply what they were hearing. Furthermore, he wanted his learners to leave his classes and be able to use what they learned when they went into business for themselves. He wanted to give them examples of "real life" problems they would face and ensure they knew how to make the best decisions. He thus designed a novel instructional strategy that used the power of small groups (teams) to solve authentic problems through consensus-building discussions and to defend them in the whole class setting. Learners learned quickly to come to class fully prepared as individuals – there was a "test" at the beginning, followed by the same test taken as a team. An individual learner's grade in the course depended upon his/her individual effort AND how the team performed. To promote learner accountability to the group, a peer evaluation component was introduced to the grading.

Dr. Michaelsen's strategy (Michaelsen & Sweet, 2007) became very popular with his learners, other faculty started to use it, and learners started asking for its use in more classes. Since its introduction, there have been many peer-reviewed publications in the higher education literature on the effectiveness of TBL. In 2001, Dr. Boyd Richards at the Baylor College of Medicine received a grant from the U.S. Department of Education to help health professions institutions explore and use TBL. This grant inspired many U.S. medical, dental, nursing, and allied health schools to learn more and implement TBL. This has resulted in many publications by health professions educators on effectiveness, strategies for implementation, and clarification and refinement of the method (Burgess et al., 2018; Koh et al., 2020; Dearnley et al., 2018: Koles et al., 2010; Haidet et al., 2012; James et al., 2019; Thomas & Bowen, 2011; Parmelee et al., 2012; Levine et al., 2004). The grant established the *Team-Based Learning Collaborative (TLBC)*, an international organization of educators from secondary through post-graduate programs in higher education. Through its dynamic website, annual meetings, regional workshops, practitioner database, and listserv, a learning community has evolved along with scholarship of teaching and learning on the strategy. (http://www.team-basedlearning.org)

What Are the Components of TBL?

To implement TBL, five essential components must be considered.

- Advanced Preparation – Learners need to know what they must learn before coming to class and at what level of mastery. Preparation may include readings, attending lectures, completing dissection, patient examination or laboratory assignments. To encourage their lifelong learning skills, clarify that your Advanced Preparation assignment is the <u>minimum</u> for preparation, and that they can identify their own and additional learning objectives for the unit of study. Over time, learners will do this, not so much for any grade enhancement, but to contribute more to their team discussions!
- Readiness Assurance – first, an individually-administered multiple choice question (MCQ) test is administered based on material derived from the Advanced Preparation (Individual Readiness Assurance Test – iRAT) followed by a Team Readiness Assurance Test (tRAT), using an Immediate Feedback Assessment Technique (IF-AT, see below). Discussion of difficult questions is directed by the instructor to assure clarification of key facts and concepts in preparation for the Group Application. As throughout TBL, the instructor does not provide a lecture,

only Socratic-style dialogue with individuals and teams on their decisions, and getting teams to teach other teams. An Appeals process should be available to address points of ambiguity, but should not slow the class down.
- Group Application – this is a question or a set of questions the answers for which cannot be found in the books or on the internet but only through in-depth discussion within teams. There are data to analyze, interpret or synthesize with other information. A specific choice must be made by each team, either in a MCQ format or another format that makes it easy for display for full class discussion. The problems posed in the Group Application are just like the ones to be solved in real life as a practitioner. By design, this is the most important part of a TBL module – the one where learners should feel that they are learning how to apply what they have learned about the subject.
- Instructor Summary – the instructor seizes the opportunity to reflect on what has been learned and accomplished in the module, clarifies any remaining misunderstandings, and asks learners what else they feel they need to learn or do to become "expert."
- Peer Feedback and Evaluation – this is done about halfway through a course for practice, then at the end for a grade. There are a variety of formats, but all ask learners to provide honest and forthright feedback to teammates about what each has contributed to one another's learning, and how they might contribute more in the future.

What Do Learners Experience with TBL?

As indicated above, learners become very engaged with learning both outside and inside the classroom. As one can imagine, it can be unpopular to tell learners that the next time they come to class they will have a test on new content that they must learn on their own. Thus, learners should be carefully introduced to the structure of TBL. How does this happen? The instructor can demonstrate how TBL works by doing a practice module:

- Give learners 15 min to read an article/paper
- Administer a 5-question test (MCQ format) about the material
- Administer a team test in which small groups of 5–7 learners take the same test together
- Use the Immediate Feedback Assessment Technique (IF-AT, http://www.epstein-education.com/home/about/) to achieve consensus decisions on the questions
- Ask learners "What has just happened?" with their learning
- Give learners a question that requires them to work in the same teams and apply what they learned so far
- Conclude with dialogue on this brief experience and outline how the next one will be conducted

What Does the Instructor Need to Do to Get Started with TBL?

First, one should consider the appropriate educational design for TBL. Whether one is developing a single TBL module to "field test" or designing an entire course that will include TBL as an instructional strategy, the place to start is with good "Backward Design" (Wiggins & McTighe, 1998). At its simplest, this means doing these three things:

- Define what you want your learners to be able to do with what they learn by the end of a unit of study. Bloom et al. (1956) defined progressively more challenging expectations of learning that begin with knowledge, progress to understanding, application, analysis, synthesis and evaluation. In TBL, do not settle for what you want them to know or understand. Make the leap to higher levels of learning, such as application, analysis, and synthesis. Being clear about this empowers you to write your goals and objectives with a language that is outcome-based and measurable. Consider this example from Human Anatomy and ask which learning objective is better for your learners' future careers?
  - List and describe the muscles, tendons, fascia and skeletal features of the brachial plexus.
  - Given a case description of a patient with a shoulder injury, be able to analyze the problem by localizing the injury level and its extent, characterize its impact on limb/body function, and design -with justification- a multimodality approach to manage patient's injury
- Determine how to assess whether your learners have accomplished your goals and objectives at the end of the unit. Identify the evidence that will assure you and them that they understand and can apply what they have learned.
- Design the teaching and learning activities that will provide the learners with the greatest opportunities to accomplish the unit's goals and objectives. This should include in-class and out-of-class activities. Keeping the brachial plexus example in mind, consider a combination of activities such as: a lecture (live or online) using images (moving and static) of the anatomical structures and relationships; guided dissection of the area or programmed study of a prosection; in-class or online case problems that give practice in how to diagnose an injury to the region; a TBL module where the Group Application is case-focused and builds on knowing the detailed anatomy from the dissection.

The Second step is to design and write the Group Application for one TBL module. To do this well, adhere to the 5 S's (Parmelee et al., 2020):

- Significant Problem – Choose a problem, situation, or case that is both authentic and representative of the kind of problem the learners will encounter in their professional careers. In medical education there is no shortage of good case material, and when presented well, the learners know that you are selecting a meaningful problem.

- Specific Choice – Structure the question or questions so that they must make a specific choice. Remember, decision-making is close to the heart of TBL, and nothing generates as much passion within a group (or angst in an individual) than having to decide among similar options. Sometimes, all of the options you pose are good, but given the particular context of the problem and how one interprets the data, one can endorse a BEST option. WARNING -- this is the greatest challenge for the instructor—anticipating how learners will process a set of data and formulating plausible choice options.
- Same Problem – By having all teams working on the same problem at the same time, you avoid one of the greatest pitfalls of large class/small group activities. Most learners will have had the experience of working with a small group of learners in or out of a class, each group working on a different but related topic, and being required to present the findings to the whole class. This is a colossal waste of time: learners who are not presenting their findings are not paying attention; once a group has presented, they feel done and tune out; the individual learner may learn something about their group's assignment, but very little about the others. In TBL, everyone stays engaged because they want to defend their team's choice and, in so doing, they learn when questioned by other teams.
- Simultaneous Reporting – In TBL, all teams display their choices at the same time. Why? This does two things: every team invests in their choice since it has to be seen by all, no escape; every team gets feedback on their choice in comparison to all the other teams – they know where they stand. The instructor strategizes on the spot how to generate the most debate on the choices displayed, which should be the golden teaching opportunity of the module.
- Self-directed learning – there is much opportunity for learners to develop their self-directed learning skills. When they prepare for a session, they learn that the assigned reading is the minimum required to do well on the iRAT; most learners do not stop with the minimum and explore other sources to gain greater mastery of the content. For the Group Application, learners can be encouraged to use the web to deepen their within team discussion to justify their choice for a question. Creating these kinds of questions, ones that force them to expand their knowledge base to answer a important question, is essential for developing life-long learning. For more on self-directed learning, see Chap. 3.

The Third step is to prepare the Readiness Assurance Test. This should use the MCQ format, and the quality and difficulty level of the questions should be equivalent to the course's final exam. Learners appreciate well-constructed Readiness Assurance Tests because they provide feedback on how well they are learning the content and they should predict how they will perform on any summative exams.

Step Four is to select the best resources for the learners to learn the content. Besides textbooks, articles, and lecture material, one can include problem sets, fieldwork, patient interviews, reflective essays, anything that you feel facilitates preparation for the Group Application and the Readiness Assurance. If in the course of the whole class discussion, a team makes an important point or observation that has evolved from their going deeper into the content with other sources, be sure to highlight this for the class. Learners often go beyond the minimum and establish additional learning objectives for concepts or topics they feel will be important.

What Are the Greatest Obstacles to Success with TBL?

There are several things that can go wrong with implementing TBL into a course or curriculum – here are some of them:

- Course planning: If the TBL module or modules do not link meaningfully with the rest of the content, then the learners will not feel that the time they spend in TBL is worth it. TBLs have to be tightly integrated with the content and not perceived as appendages.
- Module design: It takes considerable time and effort to construct a good TBL module. Creating one is much more difficult than putting together a few lectures. It also has a better chance of success if it is peer reviewed by colleagues and learners. Allow plenty of time for this, but remember that once you have a good one, you can use it again.
- Little details: Make sure your materials for a module are well prepared, proofread, and organized. There will not be time in a live session to make corrections to materials or fix a major clerical or administrative error, e.g., the IF-AT form is not coded correctly for the question set.
- Facilitation: Take some time to attend a faculty development workshop on TBL and learn how to facilitate a module. There are lots of little tricks you can add to enhance the classroom experience for your learners and yourself. For example, use a device or smart phone app to select learners at random when you ask questions rather than ask for a volunteer; require learners to stand when they speak and address to the whole class; "listen in" to as many team discussions as you can during the periods when they are making decisions, and use what you learn about how they are thinking to probe further in the class discussion phase; and never exceed 2½ h in any one session because the learners will drift off from fatigue. You can always split up a module, e.g., do the Readiness Assurance in one time period and the Group Application in another. Always allow a few minutes at the end BEFORE they start packing their bags to summarize what you feel they have learned and ask for feedback on the day.
- Facilities: There are ideal classrooms for TBL, but usually you won't have them. The quality of your materials and your facilitation skills either make or break a module. However, it does help if you have space in which your team numbers are visible from throughout the room and the learners can cluster easily. Rooms with large round tables are the least conducive to TBL. The learners will have a hard time clustering and they'll move to spaces between the tables. If you are invited by your administration to help plan the next education building, contact some of the consultants on the TBLC website for input.

Summary

TBL is a well thought-out and proven instructional strategy that is being used increasingly in medical education around the globe. It has several components that address the professional competencies of the health care professional: self-directed learning, teamwork, interpersonal communication, peer instruction and feedback. There is significant evidence for the academic outcomes of TBL (i.e., summative exam performance). Learners prefer TBL over other types of small group learning, and much prefer it to hours of passive lectures. Because it has a defined structure that works, novice instructors are advised to follow the process carefully to have the greatest chance of success. There are many good resources in the literature and TBL websites for one to learn more about how to implement TBL and connect with practitioners from several disciplines within medicine.

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Chapter 7
Teaching with Laboratories

Kirsten M. Brown

Abstract Laboratory-based teaching has been a foundation for medical education for decades. Although the time dedicated for laboratory teaching has declined for several reasons, the literature clearly outlines the many benefits that laboratory exercises can have on a student's professional development and growth. When done well, teaching with laboratories offers opportunities for students to explore concepts in more detail and apply what they have already learned. A fundamental aspect of laboratory teaching is the integration of principles of active learning and instructional design. By considering these factors, you will seamlessly incorporate structure, assessments, opportunities for feedback, and constant communication as you plan your exercise. With careful thought and attention to details you are well on your way to becoming a proficient laboratory instructor.

Introduction

This chapter presents basic information on how to implement laboratory teaching exercises. You may be reading this content as an expert, who is looking to find more information for how to better adapt your laboratory sessions in ever-changing curricula. On the other hand, you may be reading this content as a novice, who is looking for more formal guidance on implementing sessions. Regardless of your background, this chapter will guide you through laboratory teaching, including how to design a session, how to evaluate a session, and how to avoid pitfalls. After reading the chapter, you may also find yourself thinking less about a specific setting or space, and more about the concept of a laboratory. No matter how you approach the

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chapter, hopefully you will find the information here thought-provoking and valuable to use at your own institution.

Benefits of Laboratory Teaching

There are many benefits to teaching in a laboratory setting. First and foremost, laboratory teaching allows deeper exploration of concepts that have already been covered. For this reason, laboratory teaching is also an ideal setting to incorporate principles of adult learning.

Research has shown across multiple disciplines that laboratory teaching sessions are well received by students and result in greater understanding of content (Modell et al., 2004; Pizzimenti et al., 2016; Rae et al., 2016). Students have rated laboratory sessions positively because of the additional opportunities for exploring complex concepts (Horrigan, 2018). Moreover, sessions are most effective for knowledge transfer and retention when grounded or tied to clinical scenarios or cases (Jurjus et al., 2016). Laboratory teaching has also been shown to positively influence the development of psychosocial skills like teamwork (Huitt et al., 2015) and positive attitudes toward interprofessional roles (Alfaro et al., 2019; Hamilton et al., 2008). Laboratory exercises help students develop teaching skills (Bian et al., 2018) and reinforce ethical principles (Stephens et al., 2019). When modelled to mirror clinical handoffs, laboratory teaching can also provide a necessary link for incorporating clinical skills early in medical education (Lazarus et al., 2016). Overall, laboratory teaching can have a profound positive impact on the student's development into a healthcare professional.

Examples of Laboratory Teaching

A common theme you will notice throughout this section is the pressure to add more content in a curriculum without including any additional instructional time. For many of the standard laboratory experiences – gross anatomy, histology/pathology, and physiology – this pressure has resulted in a significant reduction in laboratory hours (Dee, 2009; McBride & Drake, 2018). With concurrent expansion of technologies for teaching, there has also been a shift from traditional laboratory experiences to more small-group and self-study exercises. Given these drastic changes, our definition of "laboratory" has also changed, to include multidiscipline activities and virtual options. Accordingly, the standard practical examination may have been phased out for specific disciplines. Should you find yourself wanting to include more of a traditional laboratory experience, you need to weigh all these factors and work with your colleagues to prioritize the laboratory, the assessments, and timing within the curriculum.

Gross Anatomy

One of the cornerstones of premedical education is the gross anatomy laboratory. Gross anatomy laboratory sessions can vary widely in time allocation and structure, but most include some aspects of student dissection, faculty-created prosection, and osteology and imaging. Instructors include graduate teaching assistants, anatomy faculty, and clinical faculty (e.g., surgeons). Students are traditionally assessed using a practical examination, although there are a variety of assessment opportunities. After dissection is completed for a given region, faculty select bodies to pin structures to identify or ask something about the structure's function. Given evolving curricular structures and time constraints, the traditional anatomy practical exam and laboratory setting continues to evolve to meet learners wherever they are. Recent examples include incorporating ultrasound (Jurjus et al., 2014), 3D models (Cui et al., 2017), and virtual reality (Birbara et al., 2020).

At many institutions, a proactive approach is applied to adapt the undergraduate medical laboratory sessions to curricular changes and resource limitations. If this is a need at your institution, you may use dissection as a primary teaching modality for first- and second-year students, and supplement sessions with prosections and ultrasound sessions. Instead of full-length practical examinations, team-based quizzes can be used periodically, and practical-based questions can be included on all written summative assessments. For those students who are interested in surgical specialties, you can also expand clerkship offerings to include more focused dissection opportunities. In this way, the anatomy laboratory sessions and the discipline can span all 4 years of undergraduate medical education.

Histology/Pathology

Like gross anatomy, histology and pathology have also undergone significant changes in their laboratory format over the past several years. Decades ago, both disciplines were taught with laboratory sessions organized around light microscopes and slides; however, with advances in digitization of slides, histology and pathology transitioned to virtual microscopy (Dee, 2009). Regardless of the format (virtual or light microscopy), histology and pathology laboratory sessions involve examining slides with an accompanying laboratory manual. Faculty could include cell biologists, system-or specific pathologists (e.g., dermatopathology), and residents. Disease process, epidemiology, and clinical presentation are emphasized where appropriate. Assessments in the laboratory setting include practical examinations, with questions targeting structure identification and/or function. More recently, some institutions have adopted virtual pathology (Eraña-Rojas et al., 2017) and histology laboratories (Jurjus et al., 2013). Others have combined their pathology laboratory materials with other disciplines to create integrated laboratory sessions

(Azer et al., 2013). Therefore, faculty have continued to adapt these disciplines and their assessments to better coincide with overall trends in medical education.

Another option to consider is administering histology laboratories as self-study modules for students to review on their own time. If you choose this option, synchronous live laboratory periods can be used for faculty to provide additional review in image identification and structure relationships. In this model, there are no practical examinations, but be sure to include practical-based questions on written exams. Similar models use virtual slides for pathology self-study modules with in-person case-based sessions on diseases and disorders.

Physiology

Although not as prominent as gross anatomy laboratory sessions, laboratories involving physiology also exist in medical education. These sessions are usually structured so students can work through physiological processes as they relate to complex clinical problems and concepts. Examples of physiology laboratories include sessions on heart rhythms, respiratory volumes, and acid-base balance. During laboratories, students work through protocols that involve either experimentation by generating *in vivo* data or using existing data to test various hypotheses. For sessions where drug interactions and effects are critical, pharmacology can be introduced as well. As Horrigan (2018) demonstrated, one of the major benefits of these laboratory sessions is that it allows students to visualize physiology and better translate basic science content to clinical scenarios. Accordingly, pathophysiologic data can be added to further emphasize clinical integration of concepts and aid in generating a diagnosis (Fris et al., 2010).

Educators continue to modify the above format to provide a greater emphasis on active learning (Modell et al., 2004) and peer teaching (Bian et al., 2018). At my institution, physiology laboratory sessions roughly follow the above format. For a session on respiratory volumes, students generate their own volume-time curves and flow-volume loops using a spirometer and computer program. They can also compare their own data to ideal computer controls. Finally, using computer data, students then compare control respiratory volumes to those in conditions like asthma and chronic obstructive pulmonary disease (COPD). Besides experimenting with the equipment, this exercise offers students practical application of foundational physiology concepts in pulmonology.

Online Laboratory Considerations

The rapid development of new technologies, curricular constraints, and educational research has resulted in many institutions adopting online learning strategies. Laboratory exercises have not been immune from these changes, with educators opting for either fully or partially online components for laboratories. As with any educational intervention, there are advantages and disadvantages when considering online laboratory sessions.

From a performance perspective, student performance on written or practical examinations is equivocal when comparing online to face-to-face (F2F) course formats (Acosta et al., 2018; White et al., 2019). Students regularly rate the self-directed format and continued ability to review material at one own's pace as a benefit to the online format (Attardi et al., 2016; Eraña-Rojas et al., 2017). Similarly, data from Wilson et al. (2019) reinforced the idea that repeated exposure to content, particularly with computer-based platforms, is critical for student learning. However, students have also reported difficulty in communicating with instructors, a lack of kinesthetic learning opportunities, challenges with technology, and a failure for a true replacement for an interactive, face-to-face session in the online environment (Attardi et al., 2018).

Ultimately, it is up to the instructor to determine whether online laboratories are a realistic option for teaching content within their curriculum. External factors, such as faculty and financial support, are also likely to impact these decisions. Therefore, faculty should carefully consider the above when opting for an online laboratory session.

Assessment of Laboratory Teaching Techniques

Above all, assessment options must be tied to the instructional design and learning objectives of the laboratory session. Table 7.1 presents examples of assessments for relevant Bloom's cognitive processing dimensions and learning objectives (Engelhart et al., 1956). It should be noted the examples provided are not exhaustive or exclusive; there is likely some overlap between the assessments you could select for neighboring cognitive dimensions.

Without considering instructional design, it is easy for components of a hidden curriculum to overshadow the goals of the laboratory session. For example, in a dissection-based anatomy laboratory session, is the goal for your learners to

Table 7.1 Learning objectives, assessment options in a laboratory setting

Cognitive dimension	Learning objective verb	Assessment example
Knowledge	Define, list, repeat	Multiple choice tests, fill-in-the-blank worksheets
Comprehension	Describe, discuss, identify	Labelling exercises, multiple choice tests
Application	Apply, demonstrate	Skill demonstration
Analysis	Analyze, criticize	Open ended prompts, Oral examinations
Synthesis	Construct, create	Student-developed projects
Evaluation	Appraise, assess	Simulations

demonstrate good dissection techniques or to identify structures? If you ask anatomy faculty, they may say both! However, the way the sessions are organized and learning objectives are selected would suggest that is not necessarily the case. If good dissection technique is your objective, then you would want to consider designing an assessment that would target the skill. This could include assessing the overall quality of a dissection and any techniques necessary to complete the skill. If structure identification is your goal, then a multiple-choice quiz would be appropriate. It should be noted that the learning objectives and assessments need to be targeted to the level of the learner. You may have different assessments for different student populations.

Regardless of what type of assessment you choose, both formative and summative options should be provided to help learners navigate the topics. Formative assessments should be low-stakes, nonthreatening, and worthwhile. The nature of the formative assessment should also match that of the summative assessment. Therefore, you want to consider a formative assessment that is as similar in format and structure to the summative assessment as possible. You should also provide feedback to your learners for both formative and summative assessments. Feedback allows learners to identify any gaps in their knowledge or skill sets. For written assessments, that may include rationales to questions. For higher cognitive domain assessments, you may need to provide specific comments related to the assessment. In the scenario above, a debrief with the learner on the dissection quality and their technique would be appropriate for feedback for skill development. In the labelling example, detailed rationales for written questions would be appropriate feedback.

How to Set Up a Lab Exercise

By far the most amount of your time spent laboratory teaching will be spent designing and setting up your laboratory exercise. Successful laboratory sessions require thought, time, and coordination among all participants. This section will cover laboratory session design, setting expectations, and inclusive teaching in the design process. Although these topics are separated, they should be done in unison during the laboratory session development.

Laboratory Session Design

I employ a structured design process for my laboratory sessions known as the PLHET process because it includes the steps of Prep, Link, Hook, Engagement, and Transfer (Jurjus et al., 2013). This method incorporates principles of both adult learning and instructional design. An example of how we used the PLHET approach to structure clinically-oriented anatomy laboratory sessions for our third year

Obstetrics and Gynecology (OB/Gyn) clerkship students is included in Table 7.2 (Jurjus et al., 2016).

Once you have defined your learning objectives, outline how you want your laboratory session to run. A critical component of the model is the inclusion of preparatory work to be completed before your learners attend the session. If you include preparatory work, this needs to be communicated to the students prior to the session. In our example, we clarified the session format at the clerkship orientation and sent multiple reminder emails. At the onset of the session, you will review the learning objectives and general flow and timing of the session. To initiate the learning process, you "link" to what they already know or have covered. In the example above, this was done by referencing the preparatory work and their prior experiences in seeing patients. A practicing clinician led this discussion by getting students to discuss how in clinical situations, normal anatomical structures may not be readily visible. By anchoring or giving a "hook" for your session, you provide your learners with a foundation for how your content relates to their professional goals. In other words, how is what you are teaching them essential for clinical care? In the example above, the "hook" discussed the consequences of not correctly identifying anatomy in perineal lacerations for patient outcomes. Session engagement is where the bulk of the teaching and learning happens by leveraging prior knowledge and experiences to create new knowledge. In the example above, students rotated through several prosection stations focused on the gross anatomy for different clinical scenarios: laceration repair, intrauterine device (IUD) placement, hysterectomy, and cesarean section incisions. After learners have engaged with the material, you offer a "transfer" to reinforce what they learned. This can be done by repeating the

Table 7.2 Using the PLHET Model to plan a surgical reproductive anatomy laboratory session

Component of model	Definition	Example of design	Time allocated
Prep	How the learners prepare for the session	Three videos on relevant female reproductive anatomy	45 min
Link	How the learners can relate prior experiences to content	Outline of learning objectives and overview of timing Faculty-led discussion on why understanding anatomy is better than memorizing the steps of a procedure	10 min
Hook	How the learners perceive the relevance of content to work	Faculty-led discussion on the consequences of improperly identifying or repairing a perineal laceration	10 min
Engagement	How learners apply the material, integrating it with prior knowledge and creating new knowledge	Flipped-classroom style discussion of anatomy through clinical prosection stations	70 min
Transfer	How learners reinforce the retention of new learning by applying it to a different scenario	Student-led summary to classmates of clinical scenario incorporating anatomical knowledge to improve surgical technique	30 min

engagement in a different context, such as a slightly different clinical case, or in the example above by having the students lead discussions to review the take-home points from reach of the stations.

As you are developing the session design, you also need to consider the laboratory space, resources, and the total number of participants. 185-person dissection laboratory sessions are run very different than 30-person prosection laboratory sessions. You need vastly different resources for both. In a larger laboratory exercise, you need more cadavers, dissection tools, PPE, and faculty to assist. For smaller prosection exercises, you need a few prosections, several probes, PPE, and fewer faculty. For any laboratory session, you should be aware of any informational technology (IT) needs that you may need. You may need to include the ability to play videos demonstrating examples such as surgical repairs. If you do need to use video capabilities, be sure to do a test run on that equipment to ensure the sound and video work with your space. With continued changes and curricular innovations, you may find yourself needing to update your laboratory needs over time. Over the past few years, we have updated our laboratory to include brighter lighting, better ventilation, designated spaces for specific programs, and newer audiovisual equipment.

These instructional design tenets hold true for virtual laboratories too. Technology should not drive your laboratory design; your laboratory design should dictate the technology. For example, if you've decided to run a virtual laboratory with breakout rooms, what video-conferencing system would work to meet your needs? If you've decided to use a web-based slide repository for a histology laboratory, are there concerns with bandwidth needed to access the images? How the laboratory space functions is a reflection of your overall session design and you should plan accordingly, regardless of format.

Setting Expectations

In addition to the overall design above, it is critical to set expectations in the design process. By using clear communication, you can help reduce anxiety for both learners and faculty. Learners and faculty should each know the goal of the session, the content being covered, how the session will run, what the schedule looks like, and any assessments that you plan to include. When dealing with multiple laboratory instructors, I suggest creating a faculty guide to follow during the session. For more experienced teaching faculty, this will help to narrow their extensive expertise to the most critical aspects of the session. For less experienced teaching faculty, this will help them review relevant content prior to the session. I also recommend doing a walk-through of the laboratory session space and resources with all faculty prior to the session. For lab sessions that we have done several times, a quick 30-minute faculty discussion before the session starts is adequate. For newer labs, I typically schedule a longer discussion and walk-through a few days before the session is supposed to occur. This walkthrough allows us to discover limitations in technology or laboratory space and to facilitate faculty feedback to create needed changes in the session. Keep in mind that this is also critical in the virtual environment. If you have designed your online laboratory session to have breakout rooms and faculty cannot access the rooms, you have a major problem. The earlier you identify these issues, the easier it is to fix it to make the session run as smooth as possible.

Inclusive Teaching in the Laboratory Setting

While you are developing the session and setting expectations you should also consider how to make your laboratory session more inclusive. Inclusive teaching is not a single event, but rather a mindset. You should regularly ask yourself, "what can I do as an instructor to make sure all learners are engaged equally?" Inclusive teaching extends to both the environment (climate) and the activities (pedagogy).

From an environmental perspective, make sure physical space is ADA accessible and students can easily access everything in the laboratory. As the leader of the laboratory session, you are responsible for setting the tone and norms for the session. This includes establishing a positive rapport with fellow faculty and learners. Things you may want to consider are how you want faculty addressed (e.g., formal titles) and how learners preferred to be addressed (e.g., use of pronouns). You want to cultivate positive interactions and respectfulness among all participants.

From a pedagogical perspective, consider how the students are engaging with the material and how you are engaging them. Prior to any session, confirm that educational materials are inclusive and accessible. Examples include text descriptions for images, selecting font color and sizes that learners can easily read, and captioning for videos. For our anatomy teaching materials, we aim for a diversity of body sizes, race, and skin tones in any images, prosections, or cadavers. Regarding teaching techniques, use a variety of teaching techniques to engage all learners. Open-ended prompts and discussion engage some learners, but others may feel uncomfortable answering verbally; therefore, you may want to consider anonymous polling options as well.

Another aspect to consider if you are using small groups in the laboratory is how to assign groups. Do all your groups have diversity of experiences, background, expertise, or are some groups more homogenous? Ideally, you would want each group to have individuals with a range of experiences and backgrounds. For that reason, it is helpful to consider this factor before you get to your laboratory session.

Conducting the Lab

With all the effort to develop and plan, you might be surprised how fast the laboratory session goes! As the leader of the laboratory, your responsibility is to make sure the session runs smoothly. This includes ensuring that all participants keep to the outlined schedule, cover the learning objectives, and promote a positive learning environment.

At the beginning of the session, provide learners with your roadmap for how the session will run. Provide a breakdown for each task that needs to be accomplished before the end of the session. Do not forget to mention any assessments that need to be completed during or after the session. If you followed the PLHET process, then your students should be aware of this; however, it never hurts to reemphasize this important content. If you are asking your learners to do something technical or skill-related in the session, you should demonstrate proper techniques for them. Some learners may opt to try it themselves first, but others may want some assistance. Offer the demonstration to everyone as a standard. If there is anything that needs to be completed before they leave the session, such as clean-up procedures, emphasize it at the beginning.

When teaching with other faculty, I suggest performing spot checks whenever possible to ensure they have what they need. Questions will continue to arise even after your planning. Faculty may need clarification on the session flow, the content, or resources (e.g., tools). For a two-hour session, I check in with my faculty every 20–30 min just to make sure that everything is still flowing smoothly. Finally, be sure to have fun! Laboratory teaching is interactive and a wonderful way to engage your students.

After the Lab

Now that your laboratory session has concluded, you should evaluate how it went. If your session is part of an official course, you will likely get formal student evaluations at a later point in time; however, the most useful feedback is the immediate feedback that you can solicit from participants once the session concludes. You do not need to make your evaluation overly formal. Rather, I recommend asking all participants the same three questions:

- What worked well?
- What didn't work well?
- What could be improved?

This type of feedback allows you to modify and correct issues immediately, as opposed to waiting several weeks for official evaluations. Additionally, learners and faculty may have very different suggestions for improvement. Both sets of data are valuable, and you have the discretion to act on suggestions as needed. This feedback may also cause you to assess your resources and space requirements if you have future sessions planned. From the OB/Gyn anatomy laboratory example, we heard from students that while the session was valuable and informative, the timing of the session would have been better earlier rather than midway through the clerkship. Faculty suggested increasing the amount of time dedicated to the final review and discussion. Both of those suggestions were incorporated into the laboratory sessions the following academic year.

Pitfalls

With all the hard effort you put into planning and running your laboratory session, how can anything go wrong? Unfortunately, things can and do go wrong, even after the best planning. In my experience, these pitfalls fall into three major categories: timing, content, and structure. Any of the above pitfalls can result in your participants not learning what is intended. With proper planning many of these can be avoided.

Timing pitfalls involve inadequate time to accomplish the tasks you planned or not following the proposed schedule. Some of this is resolved through trial and error. Even the most proficient laboratory instructors are sometimes poor estimators of how long tasks will take. Based on the learners' experiences during the sessions, you may discover that you had too little time allocated to complete at task. Your participants are taking longer to move through the content that you had planned, which means they will not meet all the learning objectives. Alternatively, you may discover that you had much time allocated for a task and participants are moving faster than you anticipated. Therefore, you have wasted time that you could have used better for other purposes or to meet another learning objective.

Content pitfalls involve not following the learning objectives for the session. Invariably this happens when you have experts, well-intentioned as they may be, cover content that is not tied to the learning objectives. Perhaps the content is too detailed or inappropriate for the learner's level. While these topics may be conceptually related, they should not overshadow the overarching content and goals of the session.

Structure pitfalls involve a lack of clear structure and flow to the session. This may rear its head when you assume learners should know what to do without any guidance presented. You may not have provided clear instructions for how the session will run. Alternatively, your structure may be inadequate because you did not appropriately plan the necessary resources.

Summary

Laboratories within medical education span a wide range of settings and experiences. The most important aspect of incorporating laboratories within a curriculum is the instructional design process. Although time-consuming, a detailed design will help you plan an organized session and prepare for potential pitfalls to ensure the session runs smoothly. With the appropriate planning and organization, you can create well-received educational experiences for your learners.

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Chapter 8
Case-Based Learning

Stephen Loftus

Abstract Case-Based Learning (CBL) is becoming more and more popular in the education of many health professions. It is seen as having many advantages: it is a means of integrating basic science knowledge with clinical knowledge, it fosters inquiry-based learning, it is both student-centered and patient-centered, its authenticity develops clinical reasoning skills and so can make it excellent preparation for clinical practice. Like all educational approaches it needs careful and sensitive design, and sensitive and careful implementation. Both students and teachers need to understand what is required of them and must fully engage with their roles, and the spirit of the approach, if it is to work well. CBL needs careful integration within a curriculum and can even be the centerpiece of an educational program. CBL needs to be constructively aligned with the overall goals and learning outcomes of a curriculum.

Introduction

CBL has been defined as, "a learning and teaching approach that aims to prepare students for clinical practice, through the use of authentic clinical cases. These cases link theory to practice, through the application of knowledge to the cases, and encourage the use of inquiry-based learning methods" (Thistlethwaite et al., 2012, p. e434). In this chapter we explore the implications of this approach, such as how best to understand what CBL is and how it works, and then how to design and implement it so that it can be successful. Firstly, it may be prudent to differentiate CBL from Problem-Based Learning (PBL, see Chap. 9) with which it is often confused. CBL and PBL have much in common but there are significant differences. Both deal with clinical cases and attempt to integrate basic sciences with clinical

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knowledge and prepare students for real world practice. Both normally use a small group learning approach with plenty of discussion and interaction. However, there are different emphases. PBL can be understood as a specialized form of CBL. In its original form, PBL emphasized self-directed learning with the students deciding what their learning goals were to be. In contrast, CBL offers a lot more structure and guidance to students. There is still inquiry-based education but there are more explicit instructions and expectations about the learning that students are expected to undertake. What can cause confusion is that many educational programs that claim to be PBL have evolved over time so that they have become more like CBL but still retain the label of PBL. PBL is dealt with separately in Chap. 9 and will not be discussed much further here. The key point is that there is much in common between the two approaches while there are subtle, but important, differences. Designing and implementing a CBL program is demanding, and can be a lot of work, and so a key question is what is the rationale for CBL?

Rationale for CBL

There are several reasons for adopting CBL. It fulfills nearly all the SPICES criteria for judging if an educational intervention is suitable for modern medical education (Harden et al., 1984). It is Student-centered, Problem-based, Integrated, Community based and Systematic, although it is not usually an Elective. It is an active inquiry-based form of education that attempts to get away from the passive learning so typical of lectures. Students take a much more proactive role in their own learning. They are encouraged to answer questions that are meaningful to them such as how to diagnose and manage the kinds of patients they will see in clinical practice. These are the types of questions that medical students are naturally highly motivated to answer. Inquiry-based learning provides time, both in class and at other times, to explore these questions and the knowledge needed to answer them in a small group setting.

Inquiry-based learning is usually described as having four levels (Banchi & Bell, 2008). There is level 1 or Confirmation Inquiry, in which students work to confirm information they have already been given. There is level 2 or Structured Inquiry, in which the teacher provides the initial question and an outline of the procedure to answer the question. Students evaluate and analyze the information they find to formulate an explanation that will answer the question. Next there is level 3 or Guided Inquiry. Here, the teacher provides only the question and the students must begin by first working out how to find the information they need. Finally, there is level 4, Open (or True) Inquiry. Here, students begin by formulating their own research questions and then work out how to answer them. CBL in healthcare is usually seen as being predominantly at level 2 and sometimes at level 3. The details of how this is implemented in practice are provided below.

The proponents of inquiry-based learning (Banchi & Bell, 2008) claim that it encourages students to be much more critically engaged in their own learning, to actively seek out links between the different bodies of knowledge that they learn and how all this applies to the real world of professional practice. This is because students must not only obtain evidence that might answer the question but go on to explain how, and why, the evidence might answer the question. In the healthcare setting, inquiry-based learning is seen as a robust way of encouraging clinical reasoning in a safe environment and where the connections between different kinds of knowledge can be fully explored. The different kinds of knowledge vary from biomedical science, such as the anatomy and pathophysiology of the heart, to social issues such as the management of a patient who, having been diagnosed with a heart problem, can no longer return to their own home and manage their own healthcare. Apart from inquiry-based education there are many educational theories that can be used to conceptualize CBL and help us understand it in more depth. Before moving on to take a brief look at some of the theories that can be used to understand CBL, we shall take a brief look at the place of CBL in the history of medical education.

CBL in the History of Medical Education

Medical education appears to have been a chaotic mix of theoretical learning with some clinical practice (sometimes very little) until the early twentieth century. It could occur in a university or through apprenticeship with a practicing physician. In North America, the Flexner Report (1910) brought attention to the chaos with the result that there was a move to standardize medical education with a firm grounding in the biomedical sciences. It was also felt that such education should occur in centers where there was active research in biomedical sciences so that students would get up-to-date information. This would be followed by a period where students would learn to apply science in supervised clinical practice. Tertiary hospitals were seen as the obvious places for such education as they could support the research and had sufficient numbers of specialists who could provide the right kind of clinical experience. In North America this resulted in the so-called ‘two plus two’ model where 2 years of biomedical science (where lectures and practical lab classes dominated) were followed by 2 years of clinical education (mostly with clinicians in a large hospital setting). Other parts of the world adopted variations on this. This was the dominant, and conventional, model of medical education for most of the twentieth century and many schools still use this approach. However, the model has weaknesses that prompted changes, such as CBL. The weaknesses of the conventional model are many.

One major weakness of the conventional curriculum is that, as biomedical science has advanced, there has been more and more detail that can be learned in a medical program. The curriculum in many institutions quickly became overstuffed, with students required to cram masses of detail in a short time in order to pass exams, especially the kind of exam where factual recall predominated. There are reports going back to the middle of the nineteenth century complaining that the medical curriculum was too full (GMC, 1993). This simply got worse as time passed and more scientific data accumulated. In addition, there was little attempt to integrate different bodies of knowledge. The anatomy of the heart, for example, might be learned separately from the physiology of the heart with no attempt to show how the two were related.

A second major problem was the transition from learning basic sciences to the clinical setting. It has long been a commonplace observation that medical students, who might know a great deal of detailed science, can struggle to apply this knowledge to real-world patients. In science, one usually learns about the normal and then the pathological. The pathology is seen as a cause that results in an effect, the clinical features of a disease. The problem with patients is that they present with the clinical features of a disease and the clinician must work out the cause. So, where a scientist engages in what can be seen as 'forward' thinking, from cause to effect, a clinician has to engage in 'backward' thinking, from effect to cause. These problems eventually led to the realization that the structure of medical education and its pedagogical practices would benefit from reform. The adoption of various forms of CBL has probably been the biggest response to this perceived need for reform (PBL is still probably the best-known version of CBL). With such an important and fundamental change, to curriculum and pedagogical practice, there is a need to theorize CBL in order to better understand its place in the education of health professionals.

Theorizing CBL

The dominant theory of exploring CBL is currently cognitive psychology. Cognitive psychology arose in the 1960s and uses the information processing of the computer as a metaphor to understand mental processes such as the clinical reasoning that is encouraged in CBL. ten Cate and Durning (2018) provide a summary of how ideas on clinical reasoning have developed in this theory. There has been a progression from prototypes, instances, semantic networks, schemas on to illness scripts. Illness scripts are seen as a form of complex mental data structure that have "medically meaningful interconnected nodes that can be strengthened and adapted based on clinical experience" (p. 38). The nodes are seen as having 'slots' for different variables. A fuller definition has been provided by Custers (2015) as being:

> (1) high-level, precompiled, conceptual knowledge structures, which are (2) stored in long-term memory, which (3) represent general (stereotyped) event sequences, in which (4) the individual events are interconnected by temporal and often also causal or hierarchical relationships, that (5) can be activated as integral wholes in appropriate contexts, that (6) contain variables and slots that can be filled with information present in the actual situation, retrieved from memory, or inferred from the context, and that (7) develop as a consequence of routinely performed activities or viewing such activities being performed; in other words, through direct or vicarious experience (p. 457).

From this perspective, illness scripts are seen as the knowledge structures that clinicians need to call on in their clinical reasoning. CBL can be seen as an excellent way of helping students to develop and organize the relevant knowledge they need into a series of illness scripts. The concept has also lent itself to the development of the script concordance test. This has become a popular means of assessing medical students, and junior doctors, to see if they have both the requisite knowledge and clinical reasoning skills to solve a case, especially under conditions of uncertainty (Lubarsky et al., 2013). There will be more on assessment below. Despite its popularity, the concept of illness scripts is open to critique. The underlying metaphor of comparing human cognition to computer information processing can be seen as superficial and misleading. There are many other ways of conceptualizing what happens in CBL, such as Narrative Medicine (see Ajjawi et al., 2009 for a more detailed comparison of cognitivism and narrative medicine). Having a strong theoretical framework for understanding CBL is important as it gives depth to the detailed design work needed for CBL.

CBL Design

CBL needs to be carefully designed and integrated into the curriculum. This can be demanding and time-consuming work. Those who want to introduce a curriculum where CBL plays a central role should plan to have a long lead time in order to fully engage with the process. A year or more is not unusual. CBL can be tried out on a small scale for those who wish to see how it works but it is, more and more, being seen as a curriculum centerpiece and integrated with other curriculum approaches such as organ system courses. CBL can also be integrated with other learning activities, such as lectures, labs and clinics. If the curriculum is to be redesigned then this should be rigorous and comprehensive. CBL needs to be constructively aligned with the aims and objectives of the program, together with the learning outcomes, and how they are assessed (Biggs, 1996).

The curriculum design should also consider detailed logistics such as timing and location of CBL sessions. There needs to be a sufficient number of rooms suitable for small group study so that a whole cohort of students can be divided up to study a case at the same time. Each room should be arranged to permit everyone to be seated around one table together to allow good discussion. A whiteboard (or blackboard) large enough for keeping summary notes needs to be available as well as access to online information sources. There are no hard and fast rules about how all this must be decided and organized. The CBL approach is flexible, and not rigidly prescriptive, but these detailed design decisions will need to be made (and documented) and the designers must be clear about why they made their decisions. CBL can be conducted exclusively online if necessary and it can also be adapted to a Blended Learning approach. Some of the design issues to be decided include the number and frequency of cases, and the length and timing of CBL sessions, together with the study time students will need to be given so that they can come well prepared to each CBL session.

van Zijl et al. (2018) recommend only ten cases per year but recognize that many institutions will probably want double that number, if not more. Each case is usually dealt with in a single session but can be spread out over two or more. A review by Thistlethwaite et al. (2012) found one institutional setting in which a case stretched out over a year. Sometimes it can make sense to do two related cases in one session, where the second case is a major variation on the first. For example, the first case might deal with pathology in a young person with no other problems and the second might deal with the same pathology in a much older person with comorbidities. The frequency of cases needs to be carefully decided. Van Zijl et al. (2018) recommend at least 2 weeks between cases, arguing that this is the length of time that their students need to do the preparatory work, along with all their other commitments. They also have three student peer teachers per group, selected to lead the case, and these people need time to learn and organize the additional information that they will provide during the session. The length of CBL sessions is also variable but 2–3 h is common. Cases should be designed and documented by teams of teachers.

CBL Design Teams

A team that designs CBL cases should be made up of experts from different disciplines to ensure that the different bodies of knowledge needed are represented and can be fully integrated. There should be clinicians and basic medical scientists who can all provide appropriate input to the case. There can also be input from ethicists, social workers and other relevant health professionals, depending on the demands and complexity of the case and its intended learning outcomes. CBL lends itself to Interprofessional Education (IPE) defined as a setting where students from two or more professions learn about, from and with each other to enable effective collaboration and improve health outcomes (IPEC, 2016). In the case of IPE, there will need to be substantive input from the other health professions involved so that it is clear what the students from different professions will gain from the experience. This will include what they can learn about the other health professions present and their potential input to the team management of a case. Another important consideration in the design and implementation of any form of professional education is that of diversity, equity and inclusion.

CBL and Diversity

We live in a diverse and multicultural society which is more and more heterogeneous. There is a growing realization that this heterogeneity can have profound effects on clinical reasoning (Wasserman & Loftus, 2019). This heterogeneity needs to be reflected in medical education and CBL is no exception. Krishnan et al. (2019) have explored this issue in CBL and shown that “race, culture, ethnicity, gender, and sexual orientation" are significant determinants of health and effect the care that patients receive. One of their critiques is that conventional training in cultural competence does not go far enough and can leave much stereotyping in place. As a result of their analysis they devised a "Race and Culture Guide for Editors of Teaching Cases" (p. 553–554). This is a checklist that can assist CBL authors in ensuring that cases do not inadvertently discriminate against minorities and, at the same time, help these minorities receive appropriate representation in the cases that students work through. One example they suggest is to have a trans woman who suffers from meningitis rather than HIV/AIDS (p. 553). The latter could reinforce stereotyping. It is clear that diversity, equity and inclusion should be explicitly addressed in the curriculum wherever it is appropriate to do so.

CBL Design and Curriculum

The design team will have to decide on the overall learning goals of the case and ensure these are aligned with the rest of the curriculum. The team decides what content will be present, the depth and breadth of content and the level of difficulty of the case. Cases should be real (or realistic) clinical cases. ten Cate and van Loon (2018) state that every case should have five characteristics. They should be: relevant, realistic, engaging, challenging, and instructional. Beginning students should start with typical cases while more advanced students can be challenged with some atypical cases. Other criteria for selecting and designing cases are that students need to be prepared to cope with the kind of cases they will see on their first clerkships. Therefore, common, but important, conditions should be included. Uncommon problems that are serious and should not be missed should also be included.

The case writing teams themselves need to be overseen by a larger curriculum team. Ridley et al. (2018) provide a detailed account of how they planned and managed a new curriculum in which CBL played a central role. They recognized the need to have people taking responsibility as "Year Leads" as well as other module leaders and case leaders. In addition, when the program is implemented many other people will be needed to take on the role of facilitators to guide each and every small group. There will almost certainly be a need for professional development of teachers, at every level, so that everyone has a clear understanding of what CBL is and how it works. Students too will need to be briefed on their role in CBL.

Student Roles

The students will need to be taught about how CBL works and what is expected of them so that they gain the maximum educational benefit. They will, for example, need to be clear that CBL is not a competition and a race to get to the right answer as fast as possible. CBL is an educational approach where the journey is very much more important than the destination. The point, for students, is to explore the knowledge they find, to test its relevance to the case, and see the links between different kinds of knowledge so that they can gain a holistic and in-depth appreciation of each case. They need to take the opportunity, with the rest of the group, to try out, and understand, the clinical reasoning that helps them work through to a successful conclusion. They should also accept that trying to find out the "correct" answer from previous students defeats the purpose of CBL, and is in nobody's interest, and they should resist attempts from students who succeed them to find out case solutions for the same reasons.

Students will also need to know how to play their role in each CBL meeting. Normally, they will behave like clinicians assessing a patient. They should be encouraged, especially in the early years, to follow recognized protocols for clinical information gathering and to understand how and why the protocols exist. Someone will need to take the role of providing information from a patient. This can be one or more students who have been previously delegated to the role of student leader for that case or it could be a faculty facilitator. These decisions are part of the details that curriculum planners will need to make. Deciding how to organize participants in sessions is not rigidly fixed and is an example of the flexibility of CBL as it can be easily adapted for local circumstances. For example, many institutions will delegate each student to take a turn at leading sessions once they are familiar with the approach. The faculty member will then adopt more of a "backseat" approach and simply ensure that the student leader covers the goals of the case in sufficient depth, and at a sufficient pace, without too many deviations. However, there are variations. Some institutions (e.g., van Zijl et al., 2018) prefer to have three student "peer teachers" per session with clearly defined roles for the peer teachers. For example, one peer teacher will give a short mini-lecture of about 10 minutes towards the end of the session. Group size can also vary. van Zijl et al. (ibid) have groups as large as 10–13 although it is generally agreed that small group learning works best with approximately 6–8 students and one faculty facilitator.

Faculty Facilitators

There should be one faculty facilitator per group. In their professional development, preparing them for the role, faculty facilitators will need to understand that their job is not to provide formal didactic teaching. As the old adage goes, they will be a "guide on the side" and not a "sage on the stage." Their role is to facilitate the active learning that gives CBL its strength. The student leader(s) should be taking the lead to guide the group through the case. The faculty facilitator is there to ensure that the students do not hurry or get diverted, and to make sure that the various issues are discussed in appropriate depth. If the student leader gets into any difficulty with leading the discussion, then the faculty facilitator can provide some help to get the group get back on track. Ideally, faculty facilitators should be clinicians who will be able to use their own clinical experience and knowledge to ensure the group makes the most of the case. They do not need to be very experienced clinicians and indeed, some institutions make some use of final year medical students. This has the added benefit of giving the final year students some exposure to a teaching role in a safe environment.

Highly specialized clinicians may not always be the best facilitators for cases in their field. There is often a strong temptation for such specialists to start didactic teaching in these circumstances and they often assume the students should have a far more detailed knowledge than is required. It is a common observation that family medicine physicians often make the best facilitators as they seem to have a better understanding of what knowledge base can be assumed for students. However, the reality is that many institutions simply cannot recruit enough physicians to take on the role of facilitators. In this case, biomedical scientists and clinicians from other health professions may have to be recruited. This is why the documentation provided to faculty facilitators should contain sufficient detail so that non-clinical facilitators can ensure that the learning goals of the CBL session can be met.

CBL teams need to provide the appropriate study guides for each case and these should follow a standard format so that there is consistency throughout cases. Facilitators will need to know what information the students and student leaders will be given and the level of detail provided to each. The student leaders, of course, will need far more detail and information than the standard study guide supplied to the rest of the students. All the various study guides, and any other handouts, for the different roles should be planned, written and be ready for distribution well in advance of the CBL sessions. ten Cate and van Loon (2018) provide three levels of study guide for each case, increasing in detail and complexity, with the first and simplest study guide for the students, a more detailed version for student leaders and an even more detailed version for faculty facilitators. The study guides also provide some standardized structure to the running of each CBL session.

CBL Sessions

The progression of a CBL session generally follows a path that closely parallels the way a clinician assesses a patient and can be easily divided into various stages. Prior to the session, the students will be given some preparatory work. They will be provided with a study guide that will contain the following. There will be a short introduction, a set of objectives for the session and a case vignette (see Fig. 8.1) of approximately 150–200 words that sets the scene for the work to be done. There will also be a clear indication of which sources should be studied beforehand so that the students can come well prepared. Some excellent and detailed examples are provided in the appendix to ten Cate et al. (2018). There will also be some key questions that the students are expected to be able to answer by the time they come to the session.

In this case, the key questions in the study guide that are common to nearly all cases can be the following:

"You are a general practitioner (GP). Mr. Evans visits your office together with his 17-year-old daughter Emily. You know Emily as an insecure girl. Mr. Evans tells you that Emily has had a swelling in her neck for 6 weeks. Emily had a cold at the start of this period, so Mr. Evans was not worried at all. However, the swelling still exists and has become even more visible. Therefore, Mr. Evans insisted that his daughter visits your office. Four months ago, Emily consulted you because of a persistent cold. A chest X-ray was obtained because her father insisted: no abnormalities were seen. Against your own typical practice, you prescribed antibiotics. Now, Emily also suffers from itching. "Could she be allergic to those antibiotics doctor? All those medications, I do not like it," Mr. Evans says. During the whole consultation, Mr. Evans talks with you while Emily stares absently out of the window".

Fig. 8.1 Sample case vignette from ten Cate et al. (2018) p. 136

- What is the chief complaint?
- What are the possible causes, and which are most likely?
- What questions in the medical history can help establish the differential diagnosis?

These questions serve as prompts for the in-class discussion that begins stage 1 of the session. When providing answers, the group should be encouraged to justify their answers and make their reasoning explicit. The group can make use of a white-board to write a simple table that summarizes their findings (see Fig. 2 table from ten Cate et al. 2018, p. 137). This particular vignette is a good example of what a vignette can do, as it offers many further openings for further discussion with the group. In this example, there are questions relating to the ethics, and power balances, of relationships between doctors, patients and significant others. How and when should a doctor make a decision that goes "against their own typical practice" and do things like prescribe antibiotics for a viral infection? Can these kinds of decision ever be justified and how might they be justified? The parent insisted on a chest X ray. Should doctors accede to this type of request? A parent is answering questions on behalf of a child aged 17. What are the implications of this?

Through this kind of open discussion, the group can discover that even answering the first question (what is the chief complaint?) can be complex. The overall goal is to help students engage, both with the various bodies of knowledge needed to understand the case, and the clinical reasoning required to come to a justifiable conclusion. This is why the proponents of CBL emphasize that carefully articulating the differential diagnosis can be more educational than coming up with a definitive diagnosis. Throughout the CBL session there is a persistent focus on the differential diagnosis and the reasoning behind the decisions to include, exclude and prioritize the possible diagnoses on the list.

Once these initial questions have been dealt with, the students can move on to the second stage. The leader provides a summary of the findings from the history. The group is then prompted to revise the differential diagnosis based on the new information. The overriding question at this point is: What information in the history helps clarify the possible causes? Once this is established the group can turn to the next question which follows the clinical assessment of a real patient: what physical examinations can help refine the possible causes? Again, the students should explain what information would be obtained from examinations such as inspection, palpation, auscultation, and vital signs.

Facilitators can encourage deeper thinking by asking for justifications. The kinds of questions they ask can be used at any of the stages, such as: "Why do you want to know that? How will that information help you?" They can ask questions that extend the thinking involved, "What if this information is different?" "What if this patient was 40 years older? How might that affect the situation?" "What if this patient was a refugee from country X?" The leader can then provide a summary of the physical findings and this prompts the discussion of the third stage where the differential diagnosis is further refined. This naturally leads into discussion about the kinds of special tests that could be indicated and the extra information that might be provided by the tests and how this helps the clinical reasoning process. A further refinement might be to limit the tests to those available to a family practitioner, as was the case in the original vignette.

This will then lead in to the fourth stage where the test results are provided. Once again, the significance and meaning of the test results need to be thoroughly discussed in appropriate detail. As an example, if radiographs are part of these results then the group can be prompted to systematically describe in detail what they see and relate any abnormalities to normal structure. The differential diagnosis can then be further refined. By this point, the group should have been given enough information to make, and justify, a definitive diagnosis. The group is then ready for the fifth and final stage, which is the management of the case. The stages of CBL are summarized in Fig. 8.2.

In the fifth and final stage, the students can discuss what they know of treatment options and closure will come when they are given a summary of the management in the real case. ten Cate and van Loon (2018) then have one of the peer teachers give a short mini-lecture on some aspect of the case and one of the students is delegated to provide a case summary. They also provide a template that students can use to help them put such a summary together.

> I saw a … year old man/woman with complaints of … Patient has … as relevant prehistory. Relevant medication is…. The major problem during history taking is … During the physical examination, I saw … Additional test showed … (special findings or negative findings). In conclusion, I saw a … year old man/woman with probably … (working diagnosis) for which I want to start … (additional testing or policy). In the differential diagnosis I still consider… (ten Cate et al., 2018, p. 146).

Depending on the design of the CBL session, the group might continue with a parallel scenario in which a similar complaint is considered but with very different findings. All this needs to be clear in the official study guides given to student leaders and faculty facilitators. It might help the leaders if the study guides clearly indicate the approximate time each stage should take so that sufficient time is devoted to each stage. Because the cases are clinically relevant they can be highly motivating for students. One option used by some institutions, is to have the whole cohort

CBL Stages

Stage 1: Aims/objectives, prereading and vignette.
Questions:

- What is the chief complaint?
- What are the possible causes, and which are most likely?
- What questions in the medical history can help establish the differential diagnosis?

Stage 2: History findings.
Questions:

- How does this information change the differential diagnosis?
- What physical examinations can help revise the differential diagnosis?

Stage 3: Physical Exam findings.
Questions:

- How does this information change the differential diagnosis?
- What special tests can help revise the differential diagnosis?

Stage 4: Special Test results.
Questions:

- How does this information change the differential diagnosis?
- What is the definitive diagnosis?
- What treatment/management is indicated?

Stage 5: Conclusion, management and follow up

Fig. 8.2 The Stages of CBL

of students gather together immediately after a CBL session for a short debrief with one or more of the case writers. This allows the design team to get immediate feedback on how the session went and can help them fine-tune the case for future use. There is also an opportunity for the case writers to reveal exactly what they intended the students to learn. This can help with any issues that need clarification and reinforces the objectives of the case. Another significant motivator for students is how the learning from CBL will be assessed.

CBL Assessment

As stated earlier, for CBL to be truly successful there needs to be constructive alignment throughout the curriculum (Biggs, 1996). If the learning goals of the curriculum include the clinical reasoning and application of knowledge that occur in CBL then the summative assessments need to ensure that students can demonstrate these.

In other words, the assessment of CBL needs to parallel CBL itself. If the assessment does not test what the students learn in CBL then the students are unlikely to take CBL seriously. It is widely accepted that many, if not most, medical students are strategic in what they choose to focus on in their learning. Therefore, assessments need to be designed that make it abundantly clear to students that the knowledge and skills acquired in CBL will be needed in the assessment activity. Schuwirth et al. (2019) summarize and compare several approaches that can be used to assess clinical reasoning. While their emphasis is on clinical reasoning in particular, what they say applies in full to CBL. They point out the various strengths and weaknesses of several techniques. The approaches include well-known assessments such as the Script Concordance Test (Charlin et al., 2000), Extended Matching questions (Case & Swanson, 1993) and the Comprehensive Integrative Puzzle test (Ber, 2003). ten Cate (2018) uses the latter three in a combination which is a rigorous assessment of knowledge and clinical reasoning.

The assessment follows a case format. A short vignette is provided of a patient presentation attending a primary care provider. The sequential stages of the patient assessment can then be used to test students from the initial differential diagnosis through history questions, history findings, etc., to management options and prognosis. For example, a question about physical examination could be "What are the three most relevant physical examination procedures to be performed next?" A question about the results of the physical examination could be "What physical findings would you expect if hypothesis 2 is true?" ten Cate recommends that the number of correct items in a list should be no more than a third and preferably much less. Variations on cases can greatly add to the flexibility of the approach. For example, a new question could ask students to consider a very different set of lab results in the case and ask for a new decision on likely hypotheses. It may not be necessary to test every single stage of a case. A subset of stages should provide sufficient insight into the students' abilities to demonstrate their knowledge and clinical reasoning.

This approach lends itself to computerized testing which has the advantages of preventing students from going back and changing earlier answers as they gain more information about the case. The use of case variations allows flexibility in asking questions. For example, one question might ask the students to make a decision based on a particular set of lab results. The next question could present a realistic variation and ask students to make a decision based on a very different set of results. While there is a need to ensure that assessment of student learning aligns with what is learned in CBL, there is also the issue of the effectiveness of CBL as an educational intervention. It appears to be extraordinarily difficult to compare CBL with other educational measures that might demonstrate its effectiveness as an educational approach (Thistlethwaite et al., 2012). The difficulty is similar to the long-lasting debate about the effectiveness of PBL (e.g., Colliver, 2000). An underlying "confounding variable" seems to be that medical students are selected for their intelligence and willingness to work hard. This has the effect that, no matter how good or bad an educational intervention might be, medical students will do whatever it takes to succeed. Rather than try to compare different educational interventions it might be more realistic to ask how any particular intervention works and how it relates to professional practice.

Summary

What is clear is that both students and teachers enjoy CBL. It is clearly an approach that prepares students for clinical practice, with its emphasis on the realism of the cases that they know they are going to encounter in the real world. There is an explicit linking and integration of biomedical knowledge to professional practice through structured learning activities that have authenticity. The emphasis placed on clinical reasoning is a major advantage of the approach. CBL is both student-centered and patient-centered and exploits the setting of small group learning to its fullest. Like all educational interventions, CBL needs careful planning and implementation to succeed and the planning involved can be considerable. Those new to the approach will need training so that they know their roles and how to "play" the CBL game. It can also be integrated with other pedagogies and curriculum formats. If done well, CBL can be both effective and enjoyable.

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Chapter 9
Problem-Based Learning

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Abstract Problem-based learning (PBL), an instructional methodology developed by Howard Barrows at McMaster University 50 years ago, has changed the landscape of medical education. Learners once relegated to long hours in lecture halls now find themselves researching learning issues during periods of self-study or discussing patient cases with fellow students in small group settings. Teacher-centered, passive learning has been supplanted in many medical schools by student-centered, active learning. PBL has expanded beyond medical education, into other health science-related settings, and into other disciplines such as engineering and business. This chapter is designed to achieve two objectives: the first, to help readers decide if PBL is a methodology to be used in their courses or curriculum, and second, once decided, to help prepare themselves for using PBL in reality, as it is very different from more passive learning activities.

Introduction

Problem-based learning is now 50 years old. It has changed the way medical educators teach by changing how we ask medical students to learn. Instead of sitting in lecture halls, passively absorbing the lecture notes of the lecturer and memorizing by rote huge amounts of information, we now ask students to wrestle with complicated medical presentations to help them build complex networks of knowledge that are integrated across disciplines. While the latter is in some ways more difficult for learners than the former, learners retain knowledge in ways that are easier to recall and use in clinical settings, which ultimately, is where their performance matters. Facilitating the tutor groups used in PBL is different than lecturing, taking the

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faculty member off center stage and relegating them to a more supportive but no less crucial role. This chapter will provide you with the rationale behind PBL, and then the tools to start a PBL course/curriculum at your institution.

Definition of PBL

Problem-based learning (PBL) is a widely used instructional method in medical education. It helps students integrate clinical and basic science knowledge as they address a patient's problem, facilitated by a faculty tutor in a small group setting. Barrows and Tamblyn (1980, p. 18) defined PBL as "the learning that results from the process of working toward the understanding or resolution of a problem," and they defined a problem as "an unsettled, puzzling, unsolved issue that needs to be resolved. It is a situation that is unacceptable and needs to be corrected." Unlike subject-based medical curricula in which students obtain medical knowledge organ-by-organ or discipline-by-discipline, students in a PBL curriculum learn these medical concepts and skills using patient problems in a more integrative manner. This unique method allows students to learn interdisciplinary knowledge more efficiently and effectively, and with better recall of an expanse of knowledge even as they cover more and more patient problems (Barrows & Tamblyn, 1980). Students participating in the PBL process become motivated as they encounter patients' problems, learn about the patients progressively, generate differential diagnoses, and identify their knowledge gaps across multiple disciplines collectively with peers. The use of this active learning method involving a patient problem is in line with the intent of the Liaison Committee on Medical Education (LCME), which accredits medical degrees in the U.S. (Cianciolo & Regehr, 2019).

Educational Philosophy of PBL

The objectives, methods, processes, and evaluations of student learning in a medical school curriculum are aligned with the two major tasks that a physician performs throughout a medical career: (1) Evaluating and managing patients with medical problems effectively, efficiently, and humanely, and (2) Continuously defining and satisfying educational needs to keep skills and information contemporary in his or her chosen field. (Barrows & Tamblyn, 1980). PBL effectively addresses two major tasks – clinical reasoning and self-directed learning – first, by helping students acquire a consolidated body of clinical and basic science knowledge associated with a patient problem and, second, by enhancing their ability to use and refine problem-solving skills. (Barrows & Tamblyn, 1980; Cianciolo & Regehr, 2019). PBL is an excellent choice for schools and teachers who are passionate about educating students to perform health professional duties not only during an undergraduate education period but also throughout lifelong medical careers.

Howard Barrows: The Development and Spread of PBL

The history of PBL can be traced back to the early 1960s when Howard Barrows, then at the University of South Carolina, was in charge of a neurological clinical clerkship (Barrows & Tamblyn, 1980). Barrows realized that students were not competent when applying basic science knowledge to patient encounters, even though those same students had successfully passed a comprehensive neurology course (Barrows & Tamblyn, 1980). Barrows visited McMaster University, Canada, on sabbatical in 1968, and joined the faculty in 1971 (Servant-Miklos, 2019). At that time, he and his colleagues worked to transform the paradigm of medical education from a teacher-centered and subject-based practice to a student-centered and problem-based practice. Three core faculty members at McMaster contributed to the initial innovation of PBL; Howard Barrows, the use of patient problems and simulated patients, Jim Anderson, small group learning, and John Evans, the structuring of the education within the faculty (Hillen et al., 2010).

Development of PBL

Based on extensive educational research and teaching experiences, Howard Barrows and his colleagues at McMaster University developed a PBL curriculum to engage medical students in a rigorous and structured learning process using patient problems. The first full PBL pilot program was developed based on a neurology clerkship and began as a neuroscience unit of the curriculum (Barrows & Mitchell, 1975; Barrows & Tamblyn, 1980). The program consisted of educational goals specific to the learning unit, learning resources (i.e., a manual, study materials in multiple media formats, and a list of external learning resources), small group learning with a faculty tutor, the educational prescription for individual learning planning, evaluations with patient actors, and a series of interview evaluations with a psychologist over the course of the program (Barrows & Mitchell, 1975). Studies that examined the efficacy of the PBL program confirmed its success (see Barrows & Mitchell, 1975).

The Spread of PBL in Medical Schools and into Other Fields

The new paradigm of PBL was initially implemented at several new medical schools, including Michigan State University, Maastricht University, and Newcastle University (Hillen et al., 2010). SIU SOM started its PBL curriculum after Barrows joined the faculty in the early 1980s. There are now more than 60 medical schools which have adopted the PBL approach around the world (Neville, 2008). This proliferation of PBL demonstrated a paradigm shift in medical education around the globe (Baker, 2000).

PBL is useful for any discipline that uses knowledge to evaluate and provide patient care and pursues continuous learning and improvement (Barrows & Tamblyn, 1980). It is now common to find PBL in non-medical schools and various other academic disciplines. The adoption of PBL in nursing education has spread to many countries, including the U.S., Australia, the U.K., South Africa, China, Japan, and Thailand (Baker, 2000). Other health science fields have also implemented PBL, for example, dentistry, occupational therapy, physical therapy, public health, and veterinary medicine, in addition to non-health science disciplines, such as social work, architecture, and forestry (Baker, 2000). In their meta-analysis study of the use and variations of PBL, Walker and Leary (2009) reported the use of PBL in non-medical disciplines including allied health, teacher education, social science, business, science, and engineering.

Variations of PBL

The primary objectives of PBL in the context of medical education are to train students to acquire a strong body of clinical and basic science knowledge, develop skills to apply the knowledge in their practices of patient care, and pursue lifelong learning to address future patient problems (Barrows, 1985). Although the principles of the PBL approach have not changed, variations exist in the format or modality of how PBL has been used. In general, a successful PBL curriculum requires a well-structured system of educational efforts and resources, which include, but are not limited to, facilitated teaching, PBL learning units, patient problem simulations, and PBL-specific evaluations (Barrows & Tamblyn, 1980).

PBL Led by Faculty

When McMaster University initiated a PBL curriculum, the small tutor group was comprised of five undergraduate medical students and one faculty member (Barrows & Mitchell, 1975). The faculty member's role as a tutor is to facilitate the overall process of the small group learning as the students encounter a patient problem, make multiple hypotheses, review tests and exam data, and identify learning issues for further self-directed learning. A faculty tutor, in this case, performs the tutor's task using metacognition (i.e., making conjectures about what students are thinking) to facilitate the process of students' critical reasoning and knowledge acquisition at the individual and group levels. Barrows (1998) highlighted the use of the faculty tutor's metacognition skills "to initially guide the students in their thinking and to stimulate them to adopt similar metacognitive skills on their own; to be reflective, carefully reasoning thinkers and not impulsive ones" (p. 4).

PBL Led by Near-Peers

Effective facilitation of a PBL tutor group is also attainable through the involvement of medical student tutors, supported by the research findings of students' satisfaction on learning and their academic performance (Cianciolo et al., 2016). In a national survey of 99 U.S. medical schools on the students-as-teachers initiative, 24 schools (24.2%) reported the involvement of medical students as facilitators in the PBL curriculum (Soriano et al., 2010). For example, SIU SOM utilizes fourth-year medical students as small group tutors in the second-year PBL curriculum. Their role as PBL tutors is identical to that of faculty tutors, as described above. In a PBL group setting, faculty tutors may have an advantage in facilitating clinical or basic science topics as subject matter experts; however, near-peers as student tutors tend to excel in the areas of both cognitive and social congruence (Cianciolo et al., 2016), meaning that the student tutors share a similar knowledge structure and communicate better with students within a tutoring group. Cianciolo et al. (2016) reported that these student tutors interacted with students to a greater extent, advised the student group on board certification and end-of-unit exam strategies, and provided tips on clerkship rotations, which were not observed typically in faculty facilitation situations.

Virtual PBL

The traditional modality of a PBL tutor group started in a face-to-face, small group setting. Both students and tutors can freely and easily interact with each other and easily grasp non-verbal cues in the same space. Such an environment promotes group thinking and learning processes in a natural way. However, this traditional PBL setting is not free from limitations; for instance, an individual is excluded from group learning if that person is not present at the site due to illness or unavoidable travel. The adoption of a virtual PBL method is useful for educators and learners who want to learn and collaborate from different locations (Donkers et al., 2010). For example, during the COVID-19 pandemic, SIU SOM converted in-person tutor groups into remote tutor groups using an online conferencing tool to provide a physically safe, small group learning environment. Students actively engaged in the virtual group learning process, and tutors were able to facilitate the tutorial process using both audiovisual and text-based (chat) communication methods. Studies on virtual PBL group's engagement in critical thinking (Kamin et al., 2003) and e-PBL (Hashim et al., 2017) support the success of the virtual PBL process. Additionally, a virtual PBL curriculum can provide a wide variety of PBL curricular elements using current instructional and communication technology, (e.g., microscopic images of tissue samples, digital simulations of physiological processes, recorded lectures), an interactive virtual patient system, virtual reality, and serious games for an authentic and contextualized learning experience (Donkers et al., 2010).

Outcomes of PBL

Examining whether a PBL curriculum has achieved its desired educational outcomes has been a long-standing task for all stakeholders in medical education, including administrators, medical educators (tutors), students, and educational researchers. Not all medical schools adopt the same principles and structure of PBL as developed by Barrows and his colleagues; therefore, it is difficult to investigate the learning outcomes of PBL from a single perspective (Neville, 2008). A few critical outcomes of PBL's efficacy include knowledge acquisition, clinical reasoning skills, clinical skills, and self-directed learning skills (Barrows, 1985; Barrows & Tamblyn, 1980). PBL outcome dimensions identified in several review studies corroborate the effectiveness of these PBL outcome dimensions (e.g., Neville, 2008; Schmidt, 2010). This section explores different areas of medical students' competencies improved by a PBL curriculum.

Better Knowledge Acquisition

The acquisition of an essential body of medical knowledge is one of the most frequently examined dimensions of PBL outcomes. PBL allows medical students to learn new knowledge "in the context of patients' problems; the symptoms, signs, laboratory data, course of illness, etc.," thus helping them retrieve the knowledge in clinical settings (Barrows, 1985, p. 5). Medical students acquire new knowledge and recall information better by (1) activating prior knowledge as they discuss patient problems and make hypotheses, (2) elaborating on new knowledge as they share the knowledge with the group, and (3) connecting new knowledge to a patient problem in a more meaningful and memorable way (Dolmans, & Schmidt, 1996). In a recent meta-analysis study on the effectiveness of PBL in Chinese pediatric medical education (N = 1003), the authors found that the knowledge acquisition levels (examination scores) were higher than that of lecture-based learning (Ma & Lu, 2019). Hoffman et al.'s (2006) study on a PBL curriculum's positive effects on medical students' STEP I and II scores supports the effectiveness of PBL on knowledge acquisition. However, there are other studies in the literature that contradict these findings.

Enhanced Clinical Reasoning Skills

In a PBL curriculum, students evaluate patients' problems using newly acquired information and make clinical decisions to provide appropriate care for them in a simulated environment (Barrows, 1985). Students in a PBL curriculum perform well integrating knowledge from multiple disciplines (e.g., anatomy, biochemistry, population science, behavioral science) associated with a patient problem in the clinical context (Dolmans & Schmidt, 1996). Dolmans and Schmidt (1996) reviewed the empirical evidence of medical students' competencies in a PBL curriculum, highlighting the following aspects: the application of basic science knowledge into the evaluation of patient problems, gradual enhancement of diagnostic hypotheses over time, consistency with pathophysiological interpretation, and better diagnostic performances.

Advanced Clinical Competence

Physicians manage patients' problems effectively and efficiently using clinical skills; therefore, students studying in a PBL curriculum are expected to develop and advance their clinical (technical) skills, which includes patient interviews, physical examinations, and interpersonal and communication skills (Barrows & Tamblyn, 1980). Farnsworth (1997) reported positive effects of repeated case simulations on the development of the quality and efficiency of veterinary students' physical examinations. Hoffman et al. (2006) studied the effects of a PBL curriculum on medical students' academic performance and residents' clinical performance. They found that as perceived by residency directors, PBL prepared their graduates to perform better during their first year residency in various areas of clinical performance vs. graduates from a traditional curriculum. Areas of comparative strength were physical diagnosis and history taking, performance under pressure, quality of presentations, medical students' teaching abilities, communication with team member and openness to criticism. (Hoffman et al. 2006).

Lifelong Self-Regulated Learning Habits

For all medical students and physicians, acquiring and developing self-directed learning skills is essential to keep their clinical knowledge and skills contemporary and effective (Barrows, 1985). PBL helps students develop self-regulated learning habits, and boosts their intrinsic motivation towards the subject matter by effectively identifying knowledge and skill gaps, organizing new knowledge, and applying the knowledge to future problems. There are four areas of self-study skills as an outcome of PBL, including the self-evaluation of clinical competence areas based on the self-reflection of patient encounters, self-study planning ability (goal setting and achievement strategies), learning resource acquisition and utilization, and the ability to evaluate learning resources (Barrows & Tamblyn, 1980). Blumberg and Michael (1992) reported improved self-directed learning behaviors of medical students in a PBL curriculum using multiple data sources, such as library circulation and students' self-reports, compared to a traditional, lecture-based curriculum. Juul-Dam et al. (2001) also found that learners, such as pediatric residents, under a PBL curriculum conducted significantly more self-study than in a lecture-based curriculum.

Prepping for Tutoring in PBL

Successful facilitation in PBL requires group leaders to take on a very different role compared to traditional didactic sessions. The facilitator must relinquish the idea that their primary role is to provide expertise. Instead, the tutor should use acquired expertise to assist students in assimilating their own usable knowledge base. The focus is on teaching critical thinking skills so that students become lifelong learners. Nor does the facilitator simply pose a problem, sit back and watch the students master everything on their own. Facilitation requires engagement with the process through adoption of a coaching mindset. Coaches promote learning through allowing students to practice, monitoring development of critical thinking skills, holding students accountable for their own learning, assisting them in identifying gaps in knowledge and providing specific feedback for improvements. Thus, preparation for tutoring requires less organization of materials, and more understanding of the intended direction the problem. Tutors need to understand the goals of PBL, which include

- acquiring a usable knowledge base
- developing rigorous reasoning processes
- fostering habitual learning
- cultivating teamwork

For many novice tutors (and students), this is an entirely new approach to instruction. Tutors need an opportunity to observe the process in action, to practice running a group, and to learn how to give effective feedback. Tutors sometimes fear that they lack the required expertise to run a group. To provide a general scaffold for how to guide a particular case, tutor guides, developed by curricular leaders, can be very helpful. Equipped with a guide for what the intended learning issues are, the tutor should be prepared to engage students in an in-depth discussion.

Room Setup

The physical setting for small group work is structured to facilitate access to case information, and enhance discussion and collaboration among group members. Learners can be seated in comfortable chairs around a conference table, allowing for ease of conversation and discussion. Computer software that allows for embedding case information in in a searchable database is ideal for approximating the clinical patient encounter; access to the internet allows for quick searches or sharing of diagrams/images that might be helpful in discussion. A monitor large enough to allow viewing from around the table promotes a group process during the inquiry phase. Whiteboards placed around the periphery of the room allow for visualization of discussion topics and collection of information.

Use of Cases and the Development of Cases

Favorable PBL outcomes are directly related to the quality of the cases developed for use in the tutorial setting. Good cases promote students' deep understanding of material, rather than memorization of facts (Azer et al., 2012). They serve to push the student down into the underlying sciences of clinical symptomatology, rather than superficially trying to "get the diagnosis." A variety of structures can be used but all PBL cases have a few common features. Cases that are based upon authentic scenarios (i.e., "real patient cases") provide realistic problems leading to excellent richness and depth of discussion. Cases need to engage students, allow generation of a broad list of initial differential diagnoses and permit integration across disciplines. Cases should be designed with a specific set of curriculum objectives in mind, and be tailored to be challenging, yet suitable for the students' level of training. Cases should generate in-depth discussions, develop logically, be up-to-date, and relevant.

One way to approach case development is through a team of case writers. In the pre-clinical years, having a basic scientist work together with a clinical faculty member allows all disciplines to be addressed with the necessary breadth and depth. A good place to start in case writing is with identified educational objectives derived from the specific curricular element with which the case is associated. Establishing a template can be useful so that cases are consistent in design throughout the curriculum. An important element in case writing is establishing an opening statement that engages the students in the PBL process. An example of an opening statement might be: "Mr. Johnson is a 45 year old man who presents to his primary care physician complaining of shortness of breath." From the opening statement, the students should be able to form initial hypotheses, but more importantly, the statement should prompt the process of inquiry. It should be authentic, reflecting real practice or real issues in the community. The structure should be flexible enough to promote thorough thought processes. As the case unfolds, information that is revealed should allow for deductive reasoning to narrow the list of possibilities and guide students to relevant deeper learning opportunities. Logical flow should incorporate the intended educational objectives, weaving together basic sciences, clinical medicine, professionalism, psychosocial issues, ethics, etc. Cases should be designed with test values and images that promote further discovery. An accompanying manual for facilitators (see for example El-Aziz El Naggar et al., 2013) for each case can help tutors guide students and focus in on the intended curricular objectives. Feedback and periodic review can assess the success of the case and allow necessary updates.

Faculty Development for Tutoring

Facilitation challenges educators to adopt a perspective on teaching and learning that may be very different from their own learning experiences. Traditional lecture-based teaching requires communication of content in a logical and organized manner. Effective lecturers make difficult content understandable. For tutors, the prime focus is guiding students towards developing their own skills as self-learners. PBL requires educators to develop skills that enable them to use expertise to coach individual learning and manage group dynamics. Theoretical and practical training is required to enable faculty to take on this different role, including exposure to adult learning theory and the differences between teacher-centered and learner-centered educational approaches. Facilitators need to understand the goals and objectives of the small group process, and their role in accomplishing the goals. They need training in the use of PBL cases to accomplish those objectives. Training sessions where faculty take on the student role are beneficial for new facilitators to realize the value of the process, which promotes enthusiasm for, and confidence in, the PBL process. Other mechanisms to provide training include watching an experienced facilitator and practicing with observation by an experienced facilitator. More advanced role-playing uses difficult situations that can be encountered in real practice, such as combatting surface level coverage of learning issues, poor group dynamics, lack of interactions, or lack of equity in participation. Training should include opportunities to "debrief," receive feedback, share thoughts and ask questions.

Student Intro to/Development of Skills for Being in a Tutor Group

New students may have limited experience with PBL. Initial training in the philosophy and process can assist with their transition into this method of instruction. They need to know that PBL is a tool designed to help them acquire knowledge, critical thinking and teamwork skills needed for their future careers as physicians. Students must embrace the idea that they are responsible for their own learning. Learning in a group setting allows for teamwork and development of problem solving skills. Students' training should focus on what it takes to become an effective group member. Solving problems together allows for better engagement, deeper thinking and more thorough understanding of material. Students need to see the facilitator as a coach, not as a primary source for information. They must understand that for group learning to work, they must do their homework outside of group, come prepared to explain and discuss, and to ask questions. It is their responsibility to drive understanding; each group member must contribute. They must also understand that "solving the case" by getting the diagnosis is only a starting point for a deeper dive into the material. Students must also see that many ideas can be explored; there are no "wrong" ideas and everyone should be able to express themselves without reservation. It is an opportunity to lead and to learn from each other. The best groups are those where the students make it their own, they lead, and the facilitator fades into the background. Finally, some training in the mechanics of the process are helpful. Students need some initial guidance on the process. After the initial presentation, and perhaps some questions, they should pose preliminary hypotheses, followed by more questions. They may need some guidance on what to do when the group seems stuck. Frequent summaries and reassessment of the problem can help here. Some instruction on how to determine when something is a learning issue, what resources are appropriate, and how to develop a concept map can all be helpful. A single introductory session, where students are given the opportunity to try it out and then ask questions should be sufficient to get them started.

PBL Process

PBL groups are optimal with 6–8 learners and one facilitator. The first meeting should establish ground rules, and begin to develop group identity by introducing members, setting goals and expectations. Practical considerations at the first meeting include how to share group tasks and how to handle information gathered during group work (e.g., creation of a spreadsheet with headings of (1) Hypotheses; (2) Data; (3) Learning Issues that can be shared), and the frequency and nature of group feedback. The group engages an individual problem in 2–3 sessions, separated at intervals to allow ample time for self-directed learning. Objectives for the initial, "case-opening" session include acquisition of information associated with the clinical presentation, generation of hypotheses, preliminary analysis of collected data, initial synthesis of the problem and development of learning issues to drive self-directed learning. Learners proceed by asking questions to reveal the picture regarding the current problem, as well as a complete history. Learners should be able to justify their questions, relate information gathered to the emerging clinical picture, and identify those topics that require further study (learning issues). After probing for relevant history, physical exams and test results can be explored. Learners should be able to justify physical exam findings/test results and relate them to the emerging clinical picture. Ideally, the group works together until they reach a point where they need to stop and explore learning issues before they can continue in a meaningful way.

The second meeting begins with a reassessment of the problem. When the problem is a clinical case scenario, a case presentation from one of the learners, with collaboration and questions from other group members, facilitates reorientation. Learners apply new knowledge garnered from self-directed learning to critique and refine prior thinking and then re-evaluate the problem. A discussion of learning issues and their application to the clinical scenarios drives learning deeper into the problem. If there is a third session, then this session should include identification of additional learning issues. If there are only two sessions devoted to the problem, the second session may still be used to identify gaps in knowledge, with the caveat that there will not be additional class time devoted to resolving these issues. The last session should conclude with a summary of the case, and integration of learning issues into the clinical scenario, which can be accomplished with a conceptual diagram, or concept map that depicts relationships among facts in the case.

Fig. 9.1 Sample of facilitating statements in tutor group

1. What do you think this means?
2. Why do you say that?
3. How does "X" connect to "Y"?
4. How does this connect back to the clinical scenario?
5. Are we missing anything here?
6. Are you sure?
7. I don't understand, who can help me?

The facilitator's responsibility is to coach the learners, to provide a safe, productive environment that maximizes learning, to motivate students to cover applicable topics at appropriate breadth and depth, and to promote equitable contributions from all learners. The facilitator must guide both the group and the individuals in it. At the group level, the facilitator empowers equitable member participation, deals with challenging learners, and asks questions that encourage discussion of learning issues to appropriate depth. Practically, the facilitator ensures that the group develops curriculum-based learning issues, fosters open-ended hypothesis generation, and promotes case progress through encouraging synthesis and summary at appropriate times. The facilitator encourages group independence. At first, the facilitator may need to model appropriate approaches, and encourage learners to dig deeper and question each other, driving discussion amongst group members rather than question and answer sessions with the facilitator. As the group matures and becomes independent, the facilitator can fade into the background.

Facilitators ask open-ended questions at appropriate junctures. Questions should be designed to urge learners to explore the problem more deeply and more exhaustively. Several types of probes can be used to effectively promote group work. Learners tend to make surface level statements; to determine the depth of understanding, use simple questions that ask students to extend their thought process by explaining their statement more fully (See Fig. 9.1).

Additionally, ask for a justification of a statement to expose the student's depth of knowledge. Questions that provide for clarification of broad statements, or illustrations of specific examples, are also useful to help identify knowledge gaps or learning issues. If an individual or the group appears anchored in their thought processes, ask what other possibilities might be considered to open additional topics for discussion. Finally, when the group appears stuck in a particular line of discussion, use questions to redirect the group towards another aspect of the topic.

PBL Evaluations

Learners should evaluate themselves, other group members and the facilitator. Evaluations for learners should be consistent with small group learning objectives and provide a mechanism to identify strengths and weaknesses (See Fig. 9.2).

Targeted narrative feedback promotes future learning. When providing feedback, it is important to target the task, rather than targeting the learner's identity. Use specific, actionable feedback, as opposed to vague ideas of how to improve, or simple congratulations for good work. Feedback that focuses on the process and gives specific plans on how to improve is more valuable than emphasizing only results. Finally, use frequent and timely feedback to enable a chance for measurable improvement. In the small group setting, it is easy to identify both positives and deficiencies as they occur, as opposed to leaving the learners on their own with feedback only given at the end of the PBL work.

PBL GOAL #1. Develop a rigorous reasoning process (Critical thinking → Clinical Reasoning)
A. How does the student contribute to the development of the case?

Contributes few differentials or cannot justify	Contributes some differentials, justifies some	Contributes many differentials and justifies very well
Cannot use patient data to refine hypotheses	Can use some patient data to refine hypotheses, justification may be lacking	Uses patient data to refine hypotheses and can justify very well
Asks no or few questions regarding history, physical exams; struggles with lab tests	Asks appropriate questions and identifies necessary lab tests, but does not always justify or use to develop hypotheses	Asks relevant history and physical exam questions, identifies appropriate labs and uses these data to develop sound hypotheses
Unprepared for to summarize patient data, or presentation lacks organization and clarity	Prepared and organized to provide patient summary, but presentation may require assistance from others	Strong ability to articulate a case presentation in a concise and thorough manner

What can the student **specifically do** to make improvements in his/her contributions to case development?
____

PBL GOAL #2. Develop a useable knowledge base
Can the student express their understanding of relevant concepts?

Has difficulty expressing understanding of underlying basic science principles	Can express understanding of basic science principles adequately	Has strong ability to express basic science principles and makes connections to clinical medicine

What can the student **specifically do** to make improvements in his/her knowledge base (i.e., comments)?
____

PBL GOAL #3. Become a habitual learner
How well does the student prepare, what is their self-directed learning process?

Preparation for group is frequently inadequate	Preparation for group is adequate	Excellent preparation to participate and frequently lead the group
Has trouble identify gaps in knowledge (learning issues)	Identifies gaps	Excellent grasp of knowledge gaps and noticeably works to remedy these
Relies only on board study materials	Sometimes uses primary resources in addition to board study materials	Integrates board study materials with primary texts or literature

What can the student **specifically do** to make improvements in his/her approach to self-directed learning (i.e., comments)? ____

PBL GOAL #4. Become an effective team player -- Professionalism

Fig. 9.2 PBL Tutor group evaluation (Individual student)

How well does the student work as a part of the team?

Frequently or occasionally late	On time and generally prepared to begin	Always on time and frequently ready to lead the group
Unprepared	Generally prepared and contributes to sufficient depth	Always prepared and frequently ready to lead
Does not lead discussions, reluctant to contribute when prompted	Sometimes leads, adequate depth	Leads voluntarily, excellent depth and integrates others into the discussion
Does not listen or is distracted frequently	Listens and contributes to discussion	Listens, integrates ideas and incorporates others ideas into the discussion
Frequently has a negative attitude, or is often quiet	Generally positive attitude and productive group member	Always positive, productive member, frequently leads the group and assists others in learning
Does not or reluctantly contributes to group tasks, or infrequently contributes	Volunteers for group tasks and participates adequately	Directs group frequently and incorporates the work of others
Provides little or no constructive feedback	Provides adequate feedback, makes improvements based upon previous feedback.	Provides insightful feedback and incorporates the ideas of others, evidence of improvements based on previous feedback

What can the student **specifically do** to improve his/her contributions to group work?_______________

5. Comment on the function of the *group* as a whole.

Fig. 9.2 (continued)

Barriers/Common Problems with Tips/Tricks to Help

Effective PBL requires effective collaboration among group members and a good rapport between the group and the facilitator. Problems can be associated with group members, the facilitator, or various aspects of group dynamics. Facilitator problems commonly stem from some kind of discomfort with the PBL process. It is sometimes difficult for educators to discard the idea that as the expert in the room they must actively impart knowledge to the group. These facilitators subvert the PBL process by assuming a role that is too active. At the first sign of learners' struggling with the material, they step in and start explaining or lecturing to the group. Facilitators must become comfortable with the struggle and refocus their energy on guiding students toward a better understanding. Some understand that they are not supposed to lecture, but still struggle with letting the group explore the problem at their own pace. Second to lecturing, constant inquisition can also subvert the PBL process. These facilitators use the Socratic method to constantly barrage learners with questions. The small group setting turns into a question and answer session, where learners are not able to converse with one another. They instead engage in a dialog with the facilitator. PBL is messy and inefficient. Facilitators must learn to sit back and let the learners lead. Effective coaching requires the patience to allow the learner to show what they know, and to struggle with the material, by identifying their own gaps and working through their mistakes. The struggle with the material is actually one of the key ingredients to learning and retaining the information in all active learning settings.

Facilitators can encounter problems while managing the small group, which may be generally classified as difficulties associated with individual group members, or overall group function. The most common problems are coverage of learning issues at appropriate depth (rather than skimming the surface), general lack of group interaction and unequal levels of participation. Problems with group dynamics are best handled by avoiding their development. Setting concrete expectations at the first group meeting, and engaging the group in frank and frequent feedback keeps the group on track. Leave time at the end of each session to provide feedback on group function.

Problems associated with individuals can occur at several levels, and most commonly occur when the group encounters a student who (1) does not buy in to the PBL process, (2) dominates the group to the exclusion of the participation of others, or (3) is quiet and struggles to participate. Facilitators must intervene early, at the first sign of a problem, or the dynamics of the entire group can be destroyed. As a facilitator, the best way to overcome each of these problems is to first get a better understanding of the individual. Listen to their perspective and work with the individual to find ways to enhance the group learning experience. For the non-believer, find out why they are resistant to PBL. Ask them to be more open to the process. Dominant students can be difficult and require a certain awareness on behalf of the facilitator (and hopefully eventually the student). The facilitator should model appropriate behavior. Politely interrupt the dominant student. Encourage that student to engage their colleagues in discussion. Encourage others to step in; make space for others to share information. If the situation cannot be handled within the group, a private meeting with the dominant student is necessary.

Learners can be quiet for several reasons. Some people are uncomfortable speaking in group settings. Others are very good listeners and feel most comfortable absorbing information. Some have not engaged in self-directed learning and are not prepared to share information. As a facilitator, it is important to understand why a student is quiet. Set expectations at the initial group meeting to encourage everyone to participate. For those who are less gregarious, helping create space to share can be helpful. Encourage the quieter students to engage early in each session. Have them provide an initial case presentation at the second session. Find opportunities to call on them and bring them into the conversation. For those who are unprepared, find out what their barriers are to preparation and participation. To help less outgoing students feel safe, establish a group dynamic that allows for honest and open discussion about difficulties and misconceptions, and that promotes asking for help from other group members.

Summary

Problem-based learning is a decided change from traditional teaching methodologies, and the change requires not only substantive alterations in the curriculum, but a culture change for faculty. While some may miss being the "sage on the stage" what they will gain is a close relationship with a smaller group of students and an ability to guide a group and watch the lightbulbs go on as students work through their knowledge deficits to a deeper understanding of the material. This is intensely rewarding to faculty who make the leap, as well as to students who can trust enough in the process to engage in it. An active learning, student-centered learning methodology that allows students to understand the material deeply as well as build cross-connections to disciplines and clinical scenarios is ultimately a much more satisfying way to learn.

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Chapter 10
Asynchronous Teaching

James D. Pickering and Kelly M. Quesnelle

Abstract Asynchronous teaching is more than just delivering content to learners online. A well-designed asynchronous teaching experience considers the level of the learner, the delivery of both organizational logistics and content, and the facilitation of intentional social interactions for learners. Whether you are new to asynchronous teaching or you currently use it, this chapter will review the fundamentals necessary to create an outstanding asynchronous teaching experience for both learners and instructors. The ultimate goal of this chapter is to provide you with the tools to increase dialogue among your learners, improve their satisfaction with your asynchronous teaching, and improve the knowledge-based outcomes of your learners.

Introduction

There are many different pedagogical approaches available to support the acquisition of knowledge and, coupled with the increased accessibility of internet-enabled mobile devices, the opportunities for learners to access high-quality learning resources has grown exponentially over the last decade. While many learners will be based at a learning institution, many will access their learning remotely. Asynchronous teaching has filled a niche that has expanded the availability and reach of education in order to cater to remote learners.

In this chapter, we will introduce you to the most important considerations for designing successful asynchronous teaching materials. After a brief introduction to asynchronous teaching, we will discuss different models of delivering

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asynchronous teaching exercises depending on the expertise level of your target learners. You will then learn the basic principles of designing specific resources for your asynchronous teaching. Next, we will discuss the most important element of asynchronous teaching: you. Maintaining your instructor presence is how you will convey your asynchronous teaching model to your learners, deliver content, and maintain a social element to the course in order to improve both learner satisfaction and your own satisfaction during asynchronous teaching and learning. Finally, we will discuss in more detail how to cultivate those social interactions and build community during asynchronous teaching.

What Is Asynchronous Teaching?

Asynchronous teaching is a mode of education that allows learners to engage with their curriculum at any time and any place. Recently, the term asynchronous teaching has become synonymous with asynchronous "online" teaching, and although in many cases the delivery of materials in asynchronous teaching will be heavily facilitated by an online delivery approach, it is not exclusively an online pedagogy. Historically, asynchronous teaching has formed part of a pedagogy that relies on learners being able to access teaching and learning materials at any time and place.

Although the development and popularity of asynchronous teaching has emerged with the increased utilization of internet-enabled devices, the fundamental delivery principles have been around for decades. These approaches were initially realized in distance learning courses where, for example, many learners would obtain textbooks and reading material through a mail delivery service. More recently, and concomitant with the increasing capabilities of technology, learners have been able to login to virtual classrooms and engage in learning material at a time and place of their choosing. The increasing popularity of Massive Open Online Courses (MOOCs) has allowed learners from around the globe to engage with high quality learning materials at a time and place of their own choosing (Downes, 2011; Leckhart & Chesire, 2012; Liyanagunawardena et al., 2013). This general approach to education has widespread implications for all individuals interested in learning regardless of their current education or career stage. You can read more about online and distance learning in Chap. 17.

Delivering Asynchronous Teaching

Although asynchronous teaching is principally focused on providing learners with flexibility in their ability to access learning resources, it is critical that educators provide clear direction and purpose. It is essential to establish the journey upon which the learner will need to embark, why they are working through the set tasks, and links to the broader outcomes of the course or program. Once you have established specific learning objectives, several items become imperative to clarify for learners regarding what is expected of them: (1) the sequence that resources should be engaged with to achieve the learning objectives; (2) how feedback and evaluation of progress will be provided; and (3) how the learning objectives will be assessed at the end.

Educators can rely on traditional course design approaches to structure the course, but you will likely need to enhance some delivery approaches to make up for the lack of social community. The social community of a course normally allows learners to answer questions and fill in gaps that your teaching approach has covered, so it is important to emulate this community during asynchronous teaching. To begin, a detailed and clear timetable that links the specific learning resources to the learning objectives, and the order in which these resources should be completed, will be essential. Sequencing of resources in a way that allows the learner to understand key concepts and fundamental aspects of the course on schedule is critical considering the temporal constraints on learner discussions and assessments later in the course.

The delivery of asynchronous teaching can fall into two broad categories, based largely on the level of the learner: Model A and Model B. These are depicted in Fig. 10.1.

Model A details an approach to asynchronous instruction within a specific module or course that requires the learners to engage with prescribed content prior to discussion sessions. In a traditional synchronized classroom setting this would be an active learning lecture followed by a tutorial or seminar where content can be discussed in a face-to-face setting. You can initially deliver the content through a variety of media including screencasts, podcasts, videos, captured lecture recordings, or interview-style talking heads with content experts that are posted on the course's learning management system.

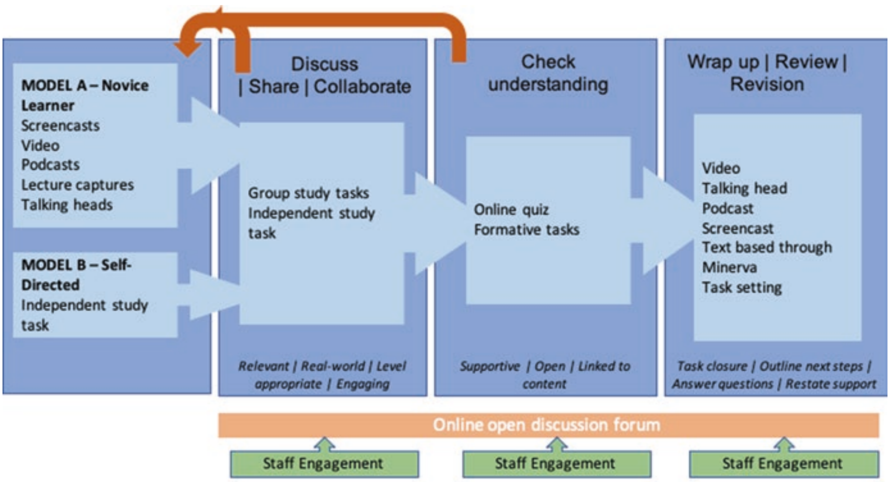

Fig. 10.1 Models of asynchronous learning

Once the learners have engaged with this material, they should then be able to test their understanding through retrieval practice and consolidation activities such as short answer questions and other opportunities to summarize their knowledge. These assessments can be scored automatically in real-time with instant feedback provided to support understanding. If there is written work that needs to be assessed, then clear guidelines on the format of the work and when it will be returned to the learner will be essential to allow them to plan and integrate this feedback into the learning journey. Learners will need to be aware of their understanding before deciding whether to go back and refresh or move forward and engage with new material.

As learners engage with content, it would be ideal if there were multiple opportunities for them to express their understanding within discussion forums that allow them to share their ideas and expand their knowledge base with the support of their peers and the instructor. This can be done in an online space where prompts for research questions or discussion points are posted and learners are allowed to contribute to the shared knowledge. Importantly, in Model A, discussion opportunities are appropriate both before and after formative assessment.

Model B is similar in approach but does not have a specific set of resources available to the learner in advance. Instead, learners are required to research specific topics based on a number of prompts or research questions. The information gleaned during independent study should then be shared with their peers through online discussion forums. Once again, it is crucial that you provide support to learners on when and how they will receive feedback. Model B is aimed primarily at expert learners. Although they may be a novice with regard to the particular subject, they will already have a certain baseline knowledge that gives them the necessary skill set and information to research content independently. This contrasts with Model A, which is aimed at novice learners who need to have access to primary learning resources to develop that knowledge base, along with plentiful opportunities for feedback and discussion. It is likely that an instructor may wish to use both models as the learners progress through the course and have acquired the necessary baseline learning and move from Model A to Model B. In addition to supporting the learners with their academic study, the variation in delivery will support interest and motivation with the content.

In delivery of both Model A and Model B, it is important that instructor expectations are clear. As discussed later, your role in creating a sense of social belonging and instructor presence is essential. You must clearly indicate when the learners will receive feedback, or when there is an open window for them to join an online live session. In this regard, instructors should consider developing weekly wrap-up materials, such as videos or announcements, which specifically draw on content discussed and summarize the work to date. Moreover, a projection about what is to come and what the learners will need to do is essential for maintaining their motivation and ensuring that the learning journey is clear.

Designing Resources for Asynchronous Teaching

Although there are numerous ways in which content can be delivered, the most popular are screencasts, videos, and podcasts for specific content delivery. You can use online discussion boards (e.g., Padlet) for sharing of ideas and discussion, or run an online video-based discussion session using software like Zoom or Microsoft Teams. Remember that with asynchronous teaching, depending on the delivery model used, the individual learner may be accessing learning materials in isolation from any real-time corrective feedback. Therefore, it is essential that regardless of the platform, you must design and develop all learning materials using evidence-based learning pedagogies to ensure optimized learning. Moreover, if you deliver a session live, you should ensure the session is recorded (with permission of the participants) so that learners who cannot participate in real time can view the material later and observe the discussion.

The most commonly cited approach to designing media for online delivery is the Cognitive Theory of Multimedia Learning established by Richard Mayer (Mayer, 2009). These principles have been refined over time but are fundamentally based on Cognitive Load Theory (see Chap. 2). They aim to use the mental architecture of the brain to support the development of schema which are stored in the long-term memory for later retrieval. An understanding of this core educational theory will be essential for faculty and instructional designers involved in creating resources for asynchronous delivery. The six main principles of this theory can be briefly summarized here, with other sources providing a much more substantial review (Davis & Norman, 2016).

1. **Coherence** – Exclude extraneous words, pictures and sounds
   - *Only include images, text and narration that is linked to the learning objectives (i.e., don't use unrelated images, logos or supplemental materials).*
   - *Do not use music in the background to add ambience.*
   - *Use simple visuals that are specifically related to the content.*
2. **Signaling** – Provide cues to highlight the organization of the essential material
   - *Draw attention to important and relevant information by using the cursor or highlight arrows and other visual cues.*
3. **Redundancy** – Minimize redundancy of graphics, narration, and written text
   - *When narrating a presentation, use either graphics or text, but not both.*
   - *Reduce the amount / use of text during a narrated presentation.*
4. **Spatial Contiguity** – Consider the proximity of words and pictures
   - *Position text in close proximity to the graphics/pictures it references.*
   - *Provide the text to be read in advance of an animation or graphic being presented.*

5. **Temporal Contiguity** – Consider the timing of words and pictures
   - *Present words and pictures simultaneously rather than successively.*
   - *Time the narration so that it plays along with the animation or drawing.*
6. **Modality** – Be intentional with what is presented visually
   - *During a narrated presentation with images and graphics, only use on-screen text for the most important points (i.e., listing key steps, providing direction for next steps).*

You can easily apply these principles with resources that are based around visuals such as videos and screencasts (Pickering, 2016), and even PowerPoint slides (Issa et al., 2013), but the themes can also be adapted to simple audio recordings or podcasts. These types of media are able to convey important information in a format that is limited in the level of extraneous information. When possible, you should consider a balance of visual and non-visual approaches, as non-visual approaches can also bring numerous benefits to learning and wellbeing. Universal design (Meyer & Rose, 1998) is a philosophy that electronic learning should be usable by people with different functional capabilities, which may mean using multiple means of expression, representation, and engagement to appeal to the broadest group of learners.

Maintaining Instructor Presence During Asynchronous Teaching

Regardless of which modalities are used for asynchronous teaching, one key characteristic of all successful asynchronous electronic learning is instructor presence. Instructor presence is exactly what it suggests: some type of virtual presence of the instructor so that learners feel supported in their learning. Asynchronous learners have large amounts of material to learn with limited guidance on *how* to learn it, as well as additional pressures to balance other commitments with their studies. The lack of any social interaction with instructors or other learners can also compound this and make asynchronous learners feel isolated. Maintaining instructor presence is critical to virtual learning because it improves learner perceptions of virtual learning as well as the learning outcomes themselves. Studies have shown that instructor presence improves recall, increases perceived learning and satisfaction, and leads to lower self-reported mental effort for difficult topics (Wang & Antonenko, 2017).

There are many ways that you, the instructor, can be present to learners during asynchronous teaching. Generally, these are divided into three unique components of instructor presence: instructional design and organization, facilitating discourse, and direct instruction (Anderson et al., 2001 and Shea et al., 2005). These components account for the organizational, social, and intellectual contributions that all

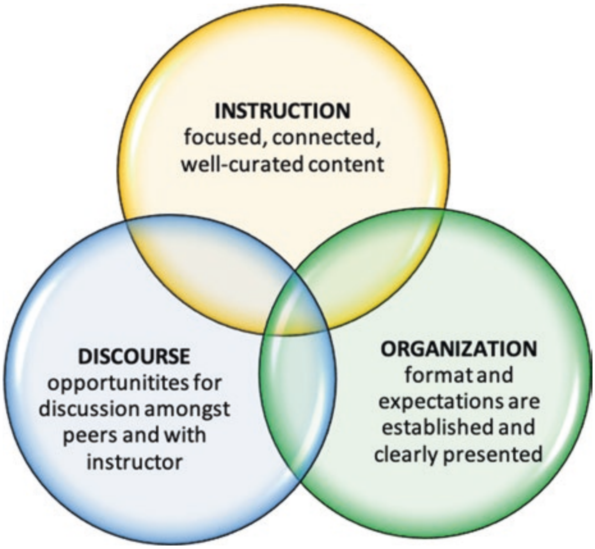

Fig. 10.2 A model depicting the required elements of instructor presence during asynchronous teaching

teachers make in their classrooms. Figure 10.2 depicts the required elements of instructor presence during asynchronous teaching.

The first component of instructor presence is instructional design, and this role of the instructor aligns well with the role of a medical teacher as a manager and leader (Harden & Lilley, 2018). In this role, you need to set the curriculum, design the teaching methods, establish time parameters, and utilize the e-learning platform effectively (Shea et al., 2005). These tasks often run behind the scenes during synchronous, in-person learning. The difference is that during in-person learning, you are readily available to answer any logistical questions that learners may have. To maintain this instructor presence during asynchronous online instruction, you should consider making a brief orientation video to include with each lesson. That video should contain information about how the lesson fits into the curriculum, what is included in each lesson (reading, videos, quizzes, etc.), how long the lesson should take the average learner, and how the learner will know that learning was accomplished by providing a description of the assessment or feedback that will be provided. By providing these types of details to the learners up front, you can avoid confusion and frustration during the lesson. This keeps the focus from the logistical details and redirects it appropriately to the content of the lesson.

The next component of instructor presence, facilitating discourse, can be particularly difficult with asynchronous online learning. Facilitating discourse and mentoring are critical roles of any medical teacher (Harden & Lilley, 2018). Thus, within the social community of the course, the instructor bears the burden of responsibility for facilitating communication. Even if you are running an exclusively asynchronous course, it is your responsibility to provide opportunities for learner engagement, discourse, and feedback. Many learning management software programs provide platforms for asynchronous class discussion through some type of "chat" function. If this cannot be achieved through the course software, social media platforms can serve the same purpose by allowing you to create a group page or a chat with a certain hashtag, but privacy concerns need to be addressed in these circumstances (Hennessy et al., 2016; Pickering & Bickerdike, 2016; Quesnelle & Montemayor, 2020). Lastly, you can always provide online teleconferencing "office hours" where learners can drop in at a specified time to converse with their classmates and the instructor(s). These casual interactions help foster a positive learning environment, allowing learners to develop a sense of psychological safety where they are free to ask questions and receive formative feedback in a low-stakes environment.

The final component of instructor presence is the actual direct instruction. This is where you establish yourself as the information provider and coach (Harden & Lilley, 2018). Many of the same fundamental principles that apply to synchronous instruction also apply to asynchronous instruction. Effective instructors will present focused content, apply the content to other topics for broader understanding, and clarify common misconceptions. Asynchronous teaching gives you the unique opportunity to provide materials from a range of resources, including electronic audio and visual resources. The most effective asynchronous instruction is tailored to the rest of the course or the curriculum in order to guide learners in making connections and provide a personal experience for them. When you package the asynchronous teaching content with a basic outline of the organization, and also provide opportunities for discussion, learners will have the best possible asynchronous teaching experience.

Community Building During Asynchronous Teaching

One universal aspect of asynchronous teaching, regardless of method, is isolation of learners (Delahunty et al., 2014). Fostering a sense of community and belonging can be critical to any course that includes asynchronous content. Many studies have shown that increasing a sense of community improves learning outcomes, and others have shown an increased sense of satisfaction when a feeling of community is present (for scoping review see: Pirashanthie & Sandars, 2018).

So, what is meant by "community", and how can one be created during asynchronous teaching? A community is a venue for interaction and participation in order to enhance learning. Communities afford individuals a chance to engage in dialogue or discussion, either synchronously or asynchronously, with other people who bring perspectives that are different. Alfred Rovai (2001) defines classroom community by four major components:

> Classroom community can also be constitutively defined in terms of four components: spirit, trust, interaction, and learning. Spirit denotes recognition of membership in a community and the feelings of friendship and cohesion that develop among learners. Trust is the

> feeling that the community can be trusted and feedback will be forthcoming and positive (McMillan, 1996)…Spirit and trust are directly related to interaction, which is the feeling that mutual benefit comes from discussions. Each learner's understandings are influenced by interactions with others (Brooks & Brooks, 1993, Glaser, 1990). Thus, interaction among learners is an important element of the learning process. Learning, the final component of community, reflects the purpose of classroom community and epitomizes learner attitudes concerning the quality of learning and the degree to which one's educational needs are being satisfied. (p. 287).

Striking the proper balance between nurturing psychological safety (trust) and critical discourse (interaction) will be your greatest challenge when developing communities within asynchronous instruction. Interactions among learners can involve different levels of participation, and they can be task-oriented or relationship-oriented. By correctly directing both the orientation of the interaction and the expected level of participation, you can foster a sense of community and maximize interactions while maintaining trust.

In designing community-building interactions and experiences for your asynchronous learners, you must consider the role of asynchronous teaching in the larger course and medical program as well as the model of asynchronous teaching chosen. For example, consider two courses that both incorporate asynchronous teaching. The first course includes 5% asynchronous teaching and the second course includes 80% asynchronous teaching. Creating opportunities for dialogue and critical discourse during the asynchronous component of the second course is much more important than in the first course. In the second course, which is majority asynchronous, the learners will not be engaging in community building as much during other parts of the course, so it is essential to build this into the asynchronous teaching experience. In the first course, however, where asynchronous teaching is only one small component of the course, more superficial monologue-type interactions could be sufficient. Presumably, learners in the first course will find superlative ways of fostering a sense of community outside of asynchronous teaching. The other consideration you will need to make is whether interactions will be related to the learning (task-oriented) or related to building group dynamics (relationship-oriented). Figure 10.3 summarizes the considerations for each.

You have a responsibility to design community facilitation with the appropriate function in mind (Rovai, 2002). Again, you must consider the role of the asynchronous teaching in the larger course and medical program as you plan these activities to foster social belonging and support learning. Relationship-oriented interactions are critical to maintaining the spirit of, and trust within, the classroom community, but these types of interactions may not be necessary during asynchronous teaching if these needs are met within other components of the course or curriculum. Task-oriented interactions, on the other hand, must occur during asynchronous teaching. For many topics within medical curricula, the asynchronous teaching experience serves as the sole means of content delivery for a specific topic. The content covered in many asynchronous teaching experiences will not be covered elsewhere in the curriculum. Therefore, it is essential to provide opportunities for task-oriented social community in order to foster dialogue among learners and promote deeper

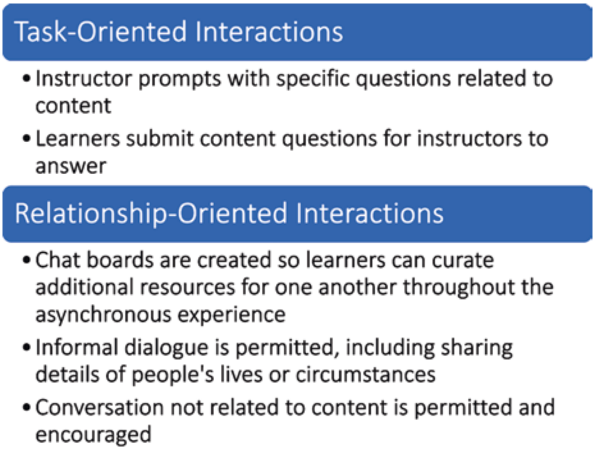

Fig. 10.3 Examples of task-oriented and relationship-oriented interactions

learning. As discussed earlier, course websites, "chat" functions, and even social media can all be used to facilitate task-oriented interactions. Task-oriented interactions occur when you, the instructor, provide prompts to learners in order to check for understanding and close knowledge gaps.

You should also consider whether you are delivering your content using Model A or Model B, as described above, to determine whether your focus will be on incorporating task-oriented or relationship-oriented interactions. When delivering content using Model A, it is much easier to incorporate specific task-oriented interactions like posting questions related to the content you provided for learners to answer and discuss with their peers. When delivering content using Model B, where specific "tasks" are not universal to all learners because learning is more self-directed, you will want to design more relationship-oriented community-building activities. In addition to a few task-oriented interactions, when delivering content using Model B, you will want to include a place for learners to post and comment on resources. You should also consider video forums using platforms like Zoom, Microsoft Teams, or Blackboard Collaborate, for peers to discuss learning processes and have opportunities for less structured interactions so learners can bring up issues they feel are important. This may involve similar technology as that used previously to deliver content, but the utility of the technology is to be learner owned to provide opportunities for informal sense checking and peer-peer instruction. In either Model A or Model B, you could also consider incorporating formative peer-feedback as a way to develop both relationship-oriented and task-oriented group dynamics.

Finally, learner behavior during group interactions may take several different forms. As you design interactive experiences, you should consider these types of participation and provide opportunities for different types of learner engagement so that all learners feel comfortable but are also challenged to grow. Learner participation can be classified three ways (Delahunty et al., 2014):

1. **Lurking** – Passive interaction
   - *Some learners may never actively interact with other learners, but they do watch other learners interact with each other.*
2. **Monologue** – Active, but not engaging
   - *Learners may make statements that do not engage with other learners. These are called monologues.*
   - *Helpful for a one-way dissemination of knowledge.*
3. **Dialogue** – Active and engaging
   - *Learners make comments that are responding to comments shared by other learners.*
   - *Demonstrates critical discourse and is the ultimate goal for classroom community interaction.*

Medical instructors want lifelong learners who are capable of encouraging their peers, but who are also capable of disagreeing with them when appropriate. However, from a pragmatic standpoint, rich dialogue may not always be possible during asynchronous instruction. This will depend on how much online discourse is occurring, and whether that discourse is complemented with in-person discussion elsewhere in the curriculum. The most important aspect to community building, no matter what the design, is that learners are permitted to engage at a level within their own comfort zone. Learner interactions should never be forced, otherwise you risk decreased learner satisfaction with the learning and subsequent poor knowledge-based outcomes.

Summary

Asynchronous teaching is becoming more prevalent throughout medical education. However, translating content that was once delivered synchronously and in-person to an asynchronous experience for learners is not a simple endeavor. You should ask yourself the following questions as you begin to design your asynchronous teaching:

- How much experience do the learners have, and what type of model will I use to guarantee appropriate content delivery, discussion, assessment, and review?
- What specific electronic modalities will I use to deliver the content?
- How will I maintain instructor presence during organizational matters, content delivery, and learner discourse?
- How will I use task-oriented and relationship-oriented interactions to promote learner engagement with the course and achieve the desired level of learner rapport?
- What prompts can I use to promote learner dialogue with one another during online interactions?

By being intentional as you plan your asynchronous teaching, and applying the concepts discussed in this chapter, you will be able to design asynchronous teaching that satisfies learners and instructors and provides learners with a sense of social belonging, all with the ultimate goal of improving learner outcomes.

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Chapter 11
Teaching Clinical Skills

Janet M. Riddle and Alison F. Doubleday

Abstract Being a clinician teacher is stimulating and fulfilling. Most clinician teachers enjoy teaching and value contributing to the development of young professionals. Clinicians also find that teaching keeps their knowledge and skills up to date. In this chapter, we explore each of the key phases of clinical teaching: planning for teaching, teaching during the clinical encounter, and reflecting on the clinical experience. We focus on specific and effective strategies for enhancing learning in the clinical setting through inquiry and feedback.

Introduction

Being a clinician teacher is stimulating and fulfilling. Most clinician teachers simply enjoy teaching and value contributing to the development of young professionals. Clinicians also find that teaching keeps their knowledge and skills up to date. Clinical teachers are asked to fulfill a variety of roles. These include:

- Serving as a role model – exemplifying competent professional care of patients
- Participating in a multidisciplinary patient care team
- Teaching and reinforcing clinical skills
- Observing and providing feedback on learner performance
- Assisting learners in integrating basic sciences with clinical presentations
- Mentoring learners and facilitating their career development

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Your satisfaction with teaching will increase by learning teaching skills, including how to prepare for teaching and how to reflect on clinical experiences.

Teaching in clinical settings is characterized by diversity. You may be asked to teach learners at different levels of training – from first-year medical learners to post-graduate learners. You may also teach pharmacy learners, nursing learners or a multidisciplinary team of learners. We will use the word “learner” throughout this chapter to refer to any of the learners you teach. Clinical teaching occurs in a variety of settings – in outpatient clinics, hospital wards, the emergency department, in the operating room, and during home visits. Any setting in which you care for patients is an opportunity for you to teach clinical skills. Although your teaching will be influenced by the kinds of patients you typically see and by the level of learners you teach, the skills presented in this chapter can be used in any setting and with any of these learners.

In the following sections, we will explore each of the key phases of teaching in clinical settings: planning for teaching, teaching during the clinical encounter, and reflecting on the clinical experience (Irby, 1992).

Planning for Teaching

As you plan for clinical teaching, you need to understand the goals and objectives for the clinical experience in which you are teaching. What are learners expected to know or to be able to do as a result of your teaching? This will help you to know how the course or clerkship in which you are teaching relates to other courses and clinical experiences in the curriculum. Clinical experiences early in medical training allow learners to correlate the basic sciences they are learning in the classroom with clinical problems. Later in training, learners need patient care experiences to refine communication and clinical skills and to develop their fund of knowledge. You will want to plan learning activities that assist learners in integrating content among courses, build on previous clinical experiences, and enhance the learner’s clinical capabilities.

When planning for clinical teaching, you need to consider the level of training of the learner you will be working with and that learner’s interests and learning needs. Learners early in their training are learning basic skills in interviewing and examining patients. They need opportunities both to observe you demonstrating these skills as well as opportunities to practice them with patients. More novice learners are also socializing to the role of being a physician. You will want to explicitly role-model professional behaviors. Learners welcome mentoring that focuses on their development as novice clinicians. More advanced learners are eager to refine their physical diagnosis skills. They are also developing clinical reasoning skills and capabilities in negotiating management plans with patients. More advanced learners are often exploring career options and are eager for your advice. Within these generalizations, there are individual differences. You should plan to discuss goals and learning needs with learners when you start working with them. You should also revisit learners’ learning needs throughout the time that you supervise them.

Orienting Learners to Facilitate Clinical Teaching

Orienting the learner to your clinical setting is an important step in planning for clinical teaching (Alguire et al., 2008). An orientation eases the learner's transition to working with you and your patients. During the orientation, be sure to explain your routines in patient care. Introduce the learner to anyone else you work with, for instance nursing staff, office staff or pharmacists. Consider what the learner might learn from each of these people. Medical assistants can teach learners to measure blood pressure or blood sugar. Pharmacists can teach learners about medication counseling. Learners value diverse experiences in clinical settings and appreciate the importance of learning to work on a healthcare team.

During the orientation, describe to the learner how you provide clinical supervision and teaching. This is a key step in establishing a positive learning climate. Learners value clinical teachers who are enthusiastic about teaching, inspire confidence in learners' knowledge and skills, provide feedback, and encourage learners to accept responsibility for patient care (Fromme et al., 2010). You can demonstrate your enthusiasm by asking learners about themselves and their learning needs. Learners appreciate your efforts to provide them with clinical experiences that are relevant to their learning needs and their stage of development. Describe how clinical encounters will occur. Should the learner expect to "shadow" you for some encounters? How will you observe the learner's clinical skills? What information do you want included in case presentations? What kinds of notes do you expect the learner to write? Will you give assignments to the learner? When and how will the learner's final assessment take place? When and how will the learner receive feedback from you?

Don't forget to find out what the learner expects to learn by working with you. Some clinical teachers use "learning contracts" to negotiate goals and expectations with the learner (Alguire et al., 2008). These contracts can include self-assessments of clinical skills, a statement of the learner's goals for the experience, and planned strategies for meeting those goals. While exploring the learner's expectations, you can confirm that the learner understands the goals and objectives for the experience, and that you understand the other courses and clinical experiences that the learner has had. Discussing the learner's career interests is also helpful. Table 11.1 summarizes keys for an effective learner orientation.

Table 11.1 Keys for an effective learner orientation

•	Review the learning goals and expectations for the clinical experience.
•	Orient the learner to your clinical site, patient care routines, and staff.
•	Discuss your learner's expectations for the experience.
•	Explain your expectations of the learner.
•	Describe how you provide clinical supervision and teaching, including how feedback and assessment will occur.

Alguire et al. (2008)

Selecting Patients

You need to plan for each of the learner's clinical encounters. Although teachable moments occur in encounters with every patient, you want to have a clear purpose for each encounter that the learner has. What will the learner learn by working with this patient? Patients who have typical presentations of common diseases or prototypical clinical findings are good choices for learners. These kinds of cases can be effective for more novice learners or learners who are experiencing your specialty for the first time. Some clinical teachers select a general problem or theme for each session with a learner. Learners can observe a spectrum of patients with a similar diagnosis. By focusing on a clinical problem, learners can compare and contrast different diagnoses with similar presentations. This assists learners in developing concepts of the key features of diagnoses. You should assign patients to your learners who represent diversity in every aspect of the community that you serve.

Plan to cover enough material with each patient encounter to stimulate the learner's clinical thinking, but without overwhelming the learner. Have one or two important teaching points for each encounter. The teaching points that you have selected should help the learner meet the learning objectives for the clinical experience. Make sure that you have selected patients of manageable complexity for the learner. At the beginning of each session, review the list of patients you are scheduled to see. Together you can select patients and discuss the teaching points that you have in mind.

Select patients who are willing to work with learners. Many patients appreciate the extra attention that learners give them. Patients understand the importance of teaching learners. They know that they are contributing to the development of the next generation of physicians. Be sure to brief each patient about the "teaching encounter." Introduce the learner, explain how the encounter will occur, solicit the patient's consent, and inform the patient that you will return after the learner has finished the encounter. Respect your patient's decision to not to work with your learner. Many clinical teachers find that modeling the kind of relationship that they would like learners to have with patients is beneficial. A useful rule of thumb is to treat your learners as you would like them to treat your patients.

Teaching During the Clinical Encounter

As a clinical teacher you will be best served by having a variety of teaching methods to use in different situations and with different learners. Effective clinical teachers engage learners through multiple strategies (Hatem et al. 2011; Fromme et al., 2010; Sutkin et al., 2008):

- Asking questions, listening carefully, and responding effectively
- Involving learners in meaningful ways – through demonstration, observation, and feedback
- Role-modeling and reflection

What is most important is that you allow learners to practice skills and work with problems that will help them gain clinical competence. Let the learners practice what you want them to be able to do!

Using Questions and Feedback to Enhance Clinical Reasoning

Questions play a key role in any clinical teaching. Questions stimulate and engage learners, help you to determine your learner's knowledge level and learning needs, and help you monitor how your learners are progressing. The questions you ask can promote higher-order thinking and encourage reflection. The questions you have asked, and the learner's responses, are also the basis for giving feedback.

When discussing clinical cases, your questions can have three purposes – to obtain clinical information, to explore the learner's reasoning processes, or to explore the learner's learning needs (Connell et al., 1999). A common problem with case discussions is that questions are limited to obtaining information. These lower-order questions ask for more information about the patient or about what the learner knows. You can also ask learners to repeat or recall what they have learned. Lower-order questions may help the clinician to care for the patient, but these questions do not help learners develop clinical judgment or problem-solving skills. In contrast, you can ask questions that explore the learner's understanding of the patient's clinical problem – by asking the learner to formulate the problem or to think through the problem (Bowen, 2006). You can also probe the uncertainties or difficulties that the learner is having to elicit the learner's learning needs. Exploring clinical thinking and learning needs require higher-order questions – questions that ask learners to summarize, analyze, compare and contrast, and justify. Higher-order questions also tend to be open-ended, thus have a range of possible responses. Table 11.2 offers keys to asking effective questions.

Table 11.2 Keys to asking effective questions

•	Ask one question at a time.
–	If you ask more than one question, you increase the complexity of the learning task.
•	Wait a few seconds before and after the learner answers.
–	Give learners time to organize their thoughts.
• Stay neutral until after the learner has explained the answer.	
–	Avoid the "rapid reward" that terminates thinking.
•	Use higher-order, open-ended questions.
•	Create a safe environment that permits learners to answer incorrectly or to guess.

The One Minute Preceptor Model for Case-Based Teaching

The "One Minute Preceptor" (OMP) model, or "microskills" model is useful for teaching during clinical encounters (Neher et al., 1992). The steps of the OMP model are:

- Make a commitment
- Explore or explain reasoning
- Teach to the gaps
- Reinforce what was done well
- Correct mistakes

After presenting a patient case to you, the learner may pause or ask a question. This is your cue to ask the learner to make a commitment to what she is thinking at this point. Your question allows the learner to process information collected during the encounter. You are asking the learner to formulate the clinical problem and to demonstrate their knowledge related to that clinical problem. Depending upon the specifics of the clinical case, your question might be "What do you think is going on with this patient?", "What is the most likely diagnosis?", "What tests would be most useful?", or "What treatment plan would you propose?" You may be tempted to ask for more information about the patient but wait.

Once the learner has committed to a specific diagnosis (or diagnostic strategy or treatment plan), your next question is to ask the learner to explain her answer. You might ask, "What information in the history and physical led you to that diagnosis?", "What do you expect to find from the tests that you propose?", "Why did you select that medication for treating the patient, given the options available?" These questions ask learners to analyze information and to justify their decisions. Two questions that are helpful to probe the learner's thinking are to ask "What if the patient had …? How would that change your thinking?" and "How are … and … similar or different?" (Bowen, 2006). Questions that explore the learner's reasoning provide opportunities for the learner to reveal additional information obtained from the patient but omitted from the original case presentation. If you still have not heard important information, now is the time to ask.

After hearing the learner's responses to the first two steps, you know where the learner's gaps in knowledge or misconceptions are. The third step in the OMP model is to teach to the gaps. In general, you should teach one or two important points – but not everything that you know about the patient or the diagnosis. Your teaching should match the learning needs of the learner and should develop the learner's knowledge and skills. The first three steps in the OMP model may be used for a brief teaching encounter or may be repeated during a more in-depth case discussion. Your learner may raise questions, which you can assign to the learner for self-directed learning.

Each clinical encounter is an opportunity to give feedback to the learner. The final two steps in the OMP model prompt you to do so. Begin by reinforcing what the learner did well. You should describe clearly the specific desirable behaviors you observed. Then correct any mistakes you observed or make suggestions for improvement. Again, you will need to be clear and specific. We will discuss feedback in more detail later in this chapter. The important point here is that you can give feedback based upon the learner's knowledge and skills that you have probed through the questions that you have asked.

Teaching the Learner to "Prime the Preceptor"

The SNAPPS model for case-based teaching is an alternative to the OMP model. In this model, the learner guides the clinical teaching encounter. In SNAPPS, the learner primes the clinical teacher with what they need to know or learn from the preceptor (Wolpaw et al., 2003). The learner uses the following steps in clinical case presentations:

- Summarize briefly the patient's history and physical
- Narrow the differential diagnosis to two or three most relevant possibilities
- Analyze the differential diagnosis by comparing and contrasting the diagnoses
- Probe the clinical teacher by asking questions about areas of confusion, uncertainty, or knowledge deficits
- Plan management of the patient's medical issues
- Select a focused, patient-related question for self-directed learning

Learners need to be taught this approach to case presentations. SNAPPS is a learner-centered model that focuses on both exploring the learner's clinical reasoning and learning needs.

Teaching in the Patient's Presence

Teaching in the patient's presence involves a learning triad – the patient, the learner, and you, the clinical teacher. Your task is to care for the patient's clinical problem along with meeting the learner's needs. As discussed earlier in this chapter, it is important to prepare patients for their role in clinical teaching. Obtain the patient's consent, ensure their understanding of the discussion, and allow them to ask questions and give feedback to both you and the learner to maintain your relationship with the patient while teaching. When discussing clinical information in the patient's presence, be sure to use language that the patient can understand.

As with any clinical teaching, you should have a focused purpose for teaching in the patient's presence. Using the technique of "priming" can help the learner (Alguire et al., 2008). Although priming can be used with any clinical encounter, it is especially helpful when you want to limit the time that the learner spends with the patient. Simply, you identify the tasks that the learner is expected to complete while with the patient and the time frame for completing the tasks. You will also want to explain what the learner will have accomplished through the encounter, for instance a problem-focused note or an oral presentation.

Teaching Through "Active Observation"

Demonstration plays an important part in clinical teaching. In demonstrations, you ask the learner to "Watch me take care of this patient." Rather than simply having learners passively observe your interactions with patients, use the technique of "active observation" (Wilkerson & Sarkin, 1998). In this teaching method, begin by identifying what the learner should learn from observing your interaction with a patient. You can use active observation with more novice learners to role model communication skills, interviewing and physical examination skills, and professionalism. This method can also be used in complex or difficult situations, in which the learner may not have the necessary knowledge or skills. Demonstrating communication skills in giving bad news to patients is an example. After identifying the learning objective, tell the learner what she should do during the encounter – What should the learner pay attention to? Be sure to prepare the learner for whether you will ask questions or have the learner repeat parts of the physical examination. After the clinical encounter, discuss what the learner observed and learned from watching you.

For example, you have a patient who is being prepared for hospital discharge. You would like your learner to observe how you counsel your patient about the medications she is being discharged on. You ask your learner to pay attention to how to "teach back" to make sure your patient understands the instructions you have given. After asking for the learner's observations, you might continue the discussion with, "How else could we have confirmed that the patient understood our instructions?"

The "Two-Minute Observation"

In addition to the opportunities for role modeling, teaching in the patient's presence allows you to observe your learner's clinical skills. Learners are rarely observed interacting with patients and families. Valuable opportunities for feedback are thus missed. Observations need not be detailed or time consuming. In fact, it is probably better to make multiple, short observations of your learner. In the "two-minute observation" the clinical teacher observes the learner interacting with the patient for 2 min (Wilkerson & Sarkin, 1998). The teacher and learner begin by establishing the objective for the observation. You may choose to focus on how the learner begins the patient interview and whether the learner uses open-ended questions to explore the patient's concerns. Or you may focus on how the learner counsels the patient on medications or lifestyle modification. Not matter what your objective is, you will need to explain to the patient that you are observing the learner and that you will return. You then make your observations and leave without disturbing the learner-patient interaction. The learner is now able to complete the patient visit. After the clinical encounter has concluded, give your learner feedback on your observations.

Special Considerations for Teaching Physical Examination Skills

Learners must perform four steps to make a correct diagnosis based on the physical examination: (1) Learners need to anticipate the physical exam findings, (2) perform the maneuvers necessary to elicit the findings, (3) describe the findings that are present, and (4) interpret the findings (Yudkowsky et al., 2009). In the first step, the learner needs to anticipate what physical exam findings to look for based upon the patient's clinical presentation. We know that exam findings are missed because learners did not think to look for them. When teaching physical examination, ask learners what key findings they would expect based on the two or three most likely diagnoses explaining the patient's symptoms. The second step is to correctly perform the physical examination maneuvers that are needed to elicit the physical findings. Demonstration of correct techniques, followed by observation of the learner's performance with feedback, are important teaching techniques. For complex skills, such as hearing heart murmurs, you may need to focus on only parts of the exam, for instance, "Listen in this area. Pay attention to what you hear between first and second heart sounds".

In the third step, the learner must be able to describe the exam findings. Asking learners to draw a picture of what they observed or to tap out a rhythm of what they heard can be helpful techniques to elicit their description of findings. You can help learners learn the technical terms used to describe exam findings. Finally, the learner interprets the exam findings in the context of the patient's history. As a clinical teacher, you should emphasize each of these four steps through asking questions, demonstrating correct techniques, and providing feedback.

Special Considerations for Teaching Procedural Skills

We use a four-step approach to teaching procedures. This approach can be used to teach relatively simple procedures such as peripheral intravenous catheter insertion, phlebotomy, or obtaining an electrocardiogram. These steps can also be used to teach other "procedures" such as physical examination skills. This approach allows learners to learn both the cognitive and psychomotor steps in performing a procedure. Even with this approach, a learner may not be able to completely master a procedure if there are not sufficient opportunities for practice and feedback.

Involving the patient in teaching procedures is crucial. You must explain the learner's role and your role in performing the procedure. It is your responsibility to obtain informed consent from the patient. You need to explain to the patient what is occurring while teaching or supervising the procedure.

In the first step, break down the procedure into its component parts (Peyton, 1998). This includes more than the individual steps in correctly performing the procedure. It also includes the indications and contraindications for the procedure, as well as proper preparation and positioning of the patient, and use of the equipment. Demonstrate the procedure to the learner in the second step. Perform your demonstration slowly – talking through each step. In the third step, you will perform the procedure, but the learner will talk through each part of the procedure. These two steps allow the learner to internalize the correct steps – without having to perform the motor skills necessary to complete the procedure.

The final step has the learner perform the procedure, talking through each step that they are taking. This allows the learner to add the motor skill component to the cognitive component. Depending upon the complexity of the procedure, some procedures are best taught and learned on models or simulators. A clinical skills lab allows practice, repetition, and feedback in a high fidelity, low risk environment.

The "Final" Step in Clinical Teaching – Using Feedback to Guide Future Performance

Feedback is crucial to learning. Feedback allows learners to learn about their current levels of competence and allows them to reflect on their strengths and weaknesses. Through feedback, learners engage in a dialogue with a clinical teacher in order to become more competent. Feedback is the information that is given to the learner that is intended to guide that learner's future performance (Lefroy et al., 2015). Feedback should be given regularly. As suggested by the OMP model, there are opportunities for feedback in every teaching encounter.

Helpful feedback is timely, direct, and clear. Don't wait too long after an event to give feedback. Your learner will be more likely to accept your feedback and make changes if you discuss feedback in a timely fashion. Be sensitive to the setting. Public areas are not conducive to well-received feedback – even if nothing "negative" is said. Learners are not always aware that you are giving feedback, so start by saying, "Let me give you some feedback." Establish a supportive tone. Asking your learner how the rotation is going is a good way to decrease some of the learner's anxiety. Then ask the learner to assess their performance by describing their perceptions of strengths and areas for improvement.

Feedback should deal with specific performances that you have observed. Too often we offer generalizations such as, "Good job!" Such feedback is uninformative. You should describe the specific behaviors that you observed and the consequences of those behaviors. Be constructive – ask the learner how they might do

Table 11.3 Keys to giving helpful feedback

•	Make sure that feedback is well-timed and expected.
•	Ask for the learner's assessment of her performance.
•	Deal with specific behaviors that you have observed.
•	Don't give too much feedback at one time. Instead, give feedback regularly.
•	Offer specific suggestions for improvement. Limit feedback to remediable behaviors.
•	Provide an opportunity for the learner to act on the feedback in another clinical encounter.

Lefroy et al. (2015)

things differently in a similar situation. Feedback should be based upon the goals and expectations for the clinical experience that you established during your orientation with the learner.

Feedback is not assessment. Summative assessment is the process that occurs at the end of a course, rotation, or clerkship. Even though you include feedback in every teaching encounter, you should also plan for a mid-rotation formative feedback session to review the learner's overall performance. Consult Chap. 13 for a more detailed explanation of formative and summative assessment. You may find it helpful to use the end-of-rotation evaluation form during this session. Plan to discuss to what extent the learner is meeting the objectives of the experience, what competencies the learners has demonstrated, and which skills need more work. Learners are typically concerned about the final assessment or grade. In these sessions, you can discuss how the learner is progressing and set goals of the remainder of the rotation. Table 11.3 summarizes keys to giving helpful feedback.

The Third Phase of Clinical Teaching – Reflecting on Clinical Experiences

Reflection is important in the learning process. Reflection on clinical experiences allows learners to formulate and refine clinical concepts. The process of reflection creates additional opportunities for constructive feedback. Through reflection, learners plan for and anticipate what they will do in future clinical encounters. Thus, reflection prepares learners for future learning.

Two specific strategies for reflection include "wrap-up rounds" and homework. During wrap-up rounds, the clinical teacher and learner review the patients seen during the session. Ask the learner to summarize the two or three most important points from the session. A useful question is to ask, "What did you learn today that was new for you?" Other tasks that require the learner to synthesize knowledge are making charts or diagrams that explain what the learner understands about the pathophysiology of the patient's clinical problem or outline the learner's approach to evaluating that problem. Ask your learner how they would explain the concepts learned during the session to their peers. It is also useful to ask the learner to make connections between clinical experiences and classroom learning. Ask, "What are you learning in your classes that related to patients you saw today?"

Giving homework assignments is another useful reflection exercise. Reading assignments encourage self-directed, independent learning. Have your learners keep track of the questions that they have about patients. Encourage them to make the question as specific as possible. The learner should select one question that they decide is most important to taking care of the patient to read about after each session. You may need to provide the learner some guidance on where to look for the answer. Have the learner prepare a summary of what was learned from the reading assignment. Don't forget to review the homework assignments with your learner. Occasionally learners need guidance from the clinical preceptor about choosing an appropriate question. For more advanced learners, homework assignments become an opportunity to build skills in evidence-based medicine.

Finally, we should consider the importance of what our learners learn from observing us, or from our role modeling. Role modeling is implicit – good role models inspire and teach while carrying out other tasks (Jochemsen-van der Leeuw et al., 2013). The language that we use and the stories that we tell are a powerful means of communicating professional values (Stern & Papadakis, 2006). Think about what is learned when we describe a patient as "a good patient" or "a difficult patient." Our stories can reveal how we struggle to meet the highest standards of professional behavior – succeeding in most cases and yet sometimes failing (Bryden et al., 2010).

To help our learners learn from our role modeling, we need to make explicit that which is implicit. Reflective practice begins with being aware of yourself – your clinical knowledge and skills, your attitudes, and your weaknesses. You also need to be conscious of the attitudes and behaviors that you would like your learners to develop. By talking through events, you help learners to pay attention to professional behaviors. You demonstrate how you want them to use what you have modeled to guide their own actions. Good role modeling can motivate learners by creating a positive environment for learning and improving.

Summary

In this chapter you have been introduced to teaching skills related to each of the key phases of teaching in clinical settings: planning for teaching, teaching during the clinical encounter, and reflecting on the clinical experience. Discuss the goals and expectations of the rotation – and the objective of each clinical encounter – with your learner. Ask effective questions to promote your learner's clinical judgment and problem-solving skills. Explicitly demonstrate communication skills, clinical skills, and professional behaviors. Make frequent observations of your learner's performance in each of these areas. Give regular feedback. Spend time with your learner reflecting on his clinical experiences. Enjoy the satisfaction of teaching learners and contributing to their professional development.

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Further Reading

Wearne, S., Dornan, T., Teunissen, P. W., & Skinner, T. (2012). General practitioners as supervisors in postgraduate clinical education: An integrative review. *Medical Education, 46*(12), 1161–1173.

This literature review of clinical supervision in graduate medical education describes the intertwined clinical and educational roles of supervisors. Educational activities within the supervisory relationship should provide flexible and personal support to meet post-graduate learners' learning needs and should also be appropriately challenging.

Aagaard, E., Teherani, A., & Irby, D. M. (2004). Effectiveness of the one-minute preceptor model for diagnosing the patient and the learner: Proof of concept. *Academic Medicine, 79*(1), 42–49.

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Salerno, S. M., O'Malley, P. G., Pangaro, L. N., Wheeler, G. A., Moores, L. K., & Jackson, J. L. (2002). Faculty development seminars based on the one-minute preceptor improve feedback in the ambulatory setting. *Journal of General Internal Medicine, 17*, 779–787.

These papers provide evidence for the effectiveness of the one-minute preceptor model presented in this chapter. In the first two papers listed above, preceptors viewed video-recordings of encounters in which the one-minute preceptor model was being used. Preceptors observing the videos rated the encounters as more effective than those in which the one-minute preceptor model was not used. Observers noted that teaching points using the one-minute preceptor model included a broader differential diagnosis, more discussion of the natural presentation of disease and of further diagnostic evaluation. Salerno and colleagues reported that participation in one-minute preceptor workshops increased the quality of feedback provided to learners and preceptor satisfaction with teaching encounters.

Wolpaw, T., Papp, K. K., & Bordage, G. (2009). Using SNAPPS to facilitate the expression of clinical reasoning and uncertainties: A randomized comparison group trial. *Academic Medicine, 84*(4), 517–524.

Wolpaw, T., Côté, L., Papp, K. K., & Bordage, G. (2012). Student uncertainties drive teaching during case presentations: More so with SNAPPS. *Academic Medicine, 87*(9), 1210–1217.

These papers provide evidence for the effectiveness of the SNAPPS model. Compared with learners who were not trained to use the SNAPPS model, learners who were trained to use SNAPPS provided more concise case summaries, included more diagnoses in their differentials, provided better justifications for their differential diagnoses, and asked more questions or expressed more uncertainties – all without significantly increasing case presentation time. When learners expressed uncertainties, their preceptors responded with teaching aligned to meet the learners' learning needs.

Archer, J. C. (2010). State of the science in health professional education: Effective feedback. *Medical Education, 44*(1), 101–108.

Archer presents a critique of the current literature on feedback related to health professions education. He argues for the creation of a "culture of feedback" based upon promoting a dialogue between teacher and learner, facilitating self-monitoring of behavior by the learner, and embedding feedback explicitly in all teaching activities.

Rudolph, J. W., Simon, R., Dufresne, R. L., & Raemer, D. B. (2006). There's no such thing as "nonjudgmental" debriefing: A theory and method for debriefing with good judgment. *Simulation in Healthcare, 1*(1), 49–55.

Rudolph and colleagues describe the "advocacy-inquiry" model of debriefing. In this model of reflective practice, debriefing is a conversation in which the teacher discloses her expert judgments about a learner's performance while also eliciting and exploring the learner's assumptions about the situation and reasons for acting as he did.

Watling, C. J. (2014). Unfulfilled promise, untapped potential: Feedback at the crossroads. *Medical Teacher, 36*(8), 692–697.

Watling suggests that efforts to understand the impact of feedback have historically focused on the feedback provider, yet it is the learner culture as well as a learner's perceptions of feedback that are key elements to determining whether feedback will be effective. Watling argues that, in addition to training teachers in delivering feedback and training learners in seeking out and in receiving feedback, a transition to a "coaching culture" is necessary for producing meaningful change in performance or behavior.

Chapter 12
Teaching with Simulation

Cate Nicholas and Tess Aulet

Abstract Simulation based medical education (SBME) imitates healthcare encounters to enable learners to practice and receive feedback in a safe, supported learning environment. SBME can be used to improve competence and performance in clinical skills and procedures, communication skills and teamwork, patient management and decision-making. When used thoughtfully and carefully, simulation can be a transformational learning experience. Medical educators can create effective simulations when they are based on learning theories and evidence-based strategies.

Introduction

Simulation based medical education (SBME) is a teaching strategy used to replicate healthcare encounters in which learners practice and receive feedback within a safe, supported learning environment. SBME can be used to improve competence and performance in clinical skills and procedures, communication skills and teamwork, patient management and decision-making. When used thoughtfully and carefully, simulation can be a transformational learning experience (Anderson et al., 2008). Medical educators can create effective simulations when they are based on learning theories and evidence-based strategies. This chapter will help you understand:

1. Why SBME is an important addition to medical education.
2. How SBME leads to effective learning.
3. Different types of simulation modalities and common simulation terms.

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4. How to use a step-by-step instructional design process for the effective use of SBME.
5. Basic evidence-based strategies used during a simulation from briefing to debriefing.

Why Is Simulation an Important Addition to Medical Education?

Simulation based education can help address challenges and emerging issues in healthcare and healthcare education. Four examples of these challenges are presented below, along with a description of how simulation can improve the learning and assessment experience.

- Decreased length of hospital stays combined with a systematic focus on patient safety and reduced time for bedside teaching has resulted in fewer opportunities for novice learners to take part in patient care. The result is learners with decreased competence in clinical skills (e.g., performing the cardiac exam with the inability to recognize common heart murmurs). Integrating simulation into your curriculum will provide learning and assessment on demand, i.e., by creating simulations that focus on the needs of your learner at the time that works for you and at the level that works for them. In a simulated clinical environment, learners practice and reflect on what occurred during the scenario. Actions taken during simulation that lead to poor outcomes can be discussed during the debriefing and no one is harmed in the process. In fact, simulation exercises that employ a concept called deliberate practice (repetitive practice of cognitive and psychomotor skills linked to specific and immediate feedback and assessment), have been shown to be superior to experience in the clinical setting (Barsuck et al., 2016; McGaghie & Harris, 2018).
- In recent years, the introduction of Entrustable Professional Activities (EPAs) into medical education has begun to transform learner assessment and curriculum development. An Entrustable Professional Activity (EPA) is a task or unit of professional practice that a trainee can be trusted to complete once they have demonstrated the necessary competence to perform the task unsupervised (ten Cate et al., 2015). In 2014, the Association of American Medical Colleges (AAMC) published 13 EPAs for medical school graduates and in their curriculum development guidelines stated that an ideal implementation and assessment system will allow learners to have repeated low-stakes opportunities for formative assessment. (http://members.aamc.org/eweb/upload/CoreEPACurriculumDevGuide.pdf)
- When considering implementation and assessment of EPAs, the above description is a natural fit for simulation. Simulation can be used as a modality to provide teaching, but also data on the competence of the learner. Use of simulation for teaching and assessment of EPAs can provide standardization required for

assessment that may not be present in real life clinical scenarios. (Salzman et al., 2016, 2019). Additionally, for tasks/skills or scenarios that are uncommon, simulation creates opportunities for learners that they are unlikely to see in the clinical setting (Thompson et al., 2017). A recent Delphi study suggested that existing simulation curricula might serve as a good place to start in implementing EPAs with a need for modifications and adaptations within each institution (Steinemann et al., 2019). EPAs have been created for both graduate and undergraduate medical education and help to ground our assessment of trainees to everyday clinical practice. (ten Cate et al., 2015; Aulet et al., 2020). Implementation of EPAs requires faculty development, opportunities for direct instruction, observation and assessment of learners, as well as delivering feedback. Simulation offers a robust platform for delivering and meeting these needs. (Gardner et al., 2018). While simulation can play an important role in this, ultimately when entrustment decisions are made considering performance in an authentic clinic setting is also important (Obeso et al., 2017).

- Ultrasound training has now become a necessary part of undergraduate medical training, with many recent approaches to incorporating this into curricula. The use of simulation to teach ultrasound is a growing area of interest (Cook et al., 2020; Zawadka et al., 2019). Simulation allows learners to have direct hands-on experience and practice with the technology. Several different curriculum formats have been described such as classroom based, web-based and a blended approach. (Damewood et al., 2018). Point-of-Care Ultrasound (POCUS) training among post-graduate learners using Standardized Patients (SP) demonstrated improved confidence among learners (Skalskiu et al., 2015). Mastery learning approaches to ultrasound simulators have demonstrated learners improved skill with the use of simulation alone.
- The events of 2019–2020 focused attention on long standing structural and scientific racism that resulted in gross social and health inequities for Black, Indigenous, and People of Color (BIPOC) (Buenconsejo-Lum & Maskarinec, 2004; Hoffman et al., 2016; Lester et al., 2020). Simulation based education can be used in cultural humility and biases training to help reduce health care disparities (Aeder et al., 2007; Berg et al., 2015; Weinick et al., 2011; Boudreau and Wabano, 2017) and to help BIPOC learners gain skills needed to counteract the impact of patient/family microagressions that they may experience in the clinical setting (Fanis et al., 2014; Eisenberg & Kieffer, 2019). While cases have been developed to address diversity/cultural humility, there is much work to be done to address equity issues. Conigliaro et al. (2020) and Foronda et al. (2020) provided us with the stark reality that a white-dominant narrative runs through simulation that resulted in an underrepresentation of racial diversity in manikins, body parts/task trainers, SPs and simulation staff and faculty. Lewis et al. (2017) Standards of Best Practice for SP Educators, calls for programs to create ethnically and linguistically diverse SP cohorts and in turn create safe and supported work environments for BIPOC SPs.

Table 12.1 Benefits of SBME teaching strategy

1. It is based on the level and needs of the learner
2. Learning and assessment available as needed for the curriculum; not dependent on patient census
3. Allows time for immediate and purposeful feedback and practice (deliberate practice)
4. No risk to patients and learners
5. Increases knowledge and skill acquisition through repetitive practice and reflection
6. Transfer of knowledge and skills to real world is increased

In summary, developing simulation using deliberate practice that is tailored to the level and needs of your learner is superior to relying on the chance that the kind of patient problem your learner needs to see will present itself in the clinical setting. Table 12.1 summarizes the benefits of SBME as a teaching strategy.

How Does SBME Lead to Effective Learning?

To appreciate how SBME is an effective teaching strategy, it is important to understand how learners learn from the simulation process. The process begins with linking learning objectives to an appropriate simulation activity. The learning objectives define the **desired performance**. The learners go through the simulation while being observed by the faculty. The difference between the desired performance and the **actual performance** in the simulation is the called the **performance gap** (Rudolph et al., 2008). During the **debriefing**, with the help of an expert facilitator, the learners identify which actions were taken during the simulation and reflect on the underlying reasons for the performance gap. This process allows the learner to think back to discover what thought or assumption may have contributed to the gap. Reflection requires the facilitator and the learner to return to the simulation experience, attend to the feelings associated with the experience (the emotional component), and reevaluate the experience (Schon, 2010). If the facilitator has created and maintained a safe and supported learning environment during this process, the learner will be ready to then accept and integrate new knowledge, skills, and behaviors in future simulation and in the clinical setting (**learning outcomes**). Figure 12.1 describes the simulation educational process.

Medical Simulation

Simulation works best when incorporated within an existing curriculum. The choice of simulators is driven by the curriculum, not the other way around. Understanding which simulators are needed for your curriculum prior to purchase saves time and resources. Medical Simulation includes non-human simulation and human simulation.

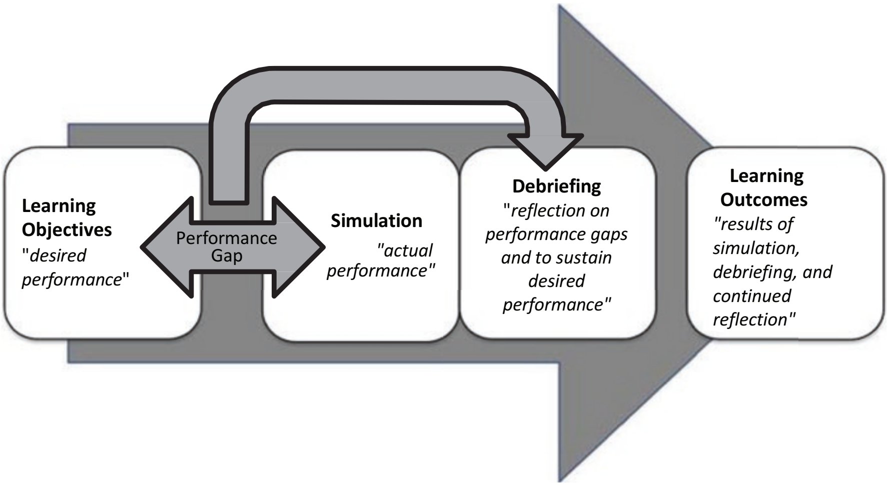

Fig. 12.1 Simulation education process

Non-human Simulation

Simulators are devices that mimic a real patient, part of the human body, system or process, and are capable of interacting with the learner (Gaba, 2004). The number and types of simulators available grows every year while the costs continue to go down. The possibilities of how to integrate non-human simulators into your curriculum are endless and limited by your imagination and resources. High fidelity manikins can be used in basic sciences lectures to demonstrate principles of basic science (Petrizzo et al., 2019). Task trainers can be used for central line insertion instruction for post-graduate learners, or Foley catheter models can be used to address patient safety issues. Complex task trainers like Harvey® The Cardiopulmonary Patient Simulator can be used to create a longitudinal cardiovascular curriculum for undergraduate, graduate and Continuing Medical Education (CME). Computer based simulation and virtual reality may allow you to overcome some of the logistical challenges of interprofessional education. Table 12.2 reviews different types of non-human simulation modalities.

Human Simulation

In the health and medical sciences, human simulation methodology provides a safe and supportive environment conducive for learning or for standardized assessment. Human simulation involves people who are trained to portray a patient scenario, or an actual patient using their own history and physical exam findings, for the instruction, assessment, or practice of a health care provider's communication and/or

Table 12.2 Non-human simulation

Types	Description
Complex task trainers	Complex computer generated environments which provide opportunity to practice complex skills. These programs can be found on screen-based programs or within partial task trainers like Harvey® The Cardiopulmonary Patient Simulator or other devices that simulate endoscopic devices and robotic surgical trainers, ultrasound trainers or arthroscopic trainers. Some of these trainers contain haptic systems which provide the learner with tactile or pressure sensation to increase the fidelity of the simulation.
Full scale manikin	Life-sized robot (adults, children, infants, birthing mothers) that mimics various functions of the human body, including respiration, cardiac rhythms, and pulsation. The low-fidelity manikins are used to practice simple physical maneuvers or procedures like CPR. The high-fidelity manikins have responsive airways and pupils, and physiologic responses to certain medications and interventions. These manikins can be used for complex, team training scenarios or can be used for demonstration of basic sciences principles in large group settings. Manikins are available as adults, children, birthing mothers, and preemies to newborns and young children.
Part of partial task trainers	Physical model that simulates a subset of physiologic function to include normal and abnormal anatomy. As the name implies, these trainers are used to teach specific tasks. Examples include intubation heads, IV arm and Foley catheter models.
Virtual Reality (VR)	Programs, exclusively computer-based, that allow learners to interview, examine, diagnose, and treat virtual patients in realistic clinical scenarios. VR may also be used to train and assess clinical reasoning skills and decision making.

Table 12.3 Human simulation roles

Role	Definition
Role player	A person who imagines themselves or another person in a particular situation (improvisation)
Structured role player	Provided with specific objectives and trained to follow a limited script (can add improvisation)
Embedded participant/ confederate	Person who is trained and scripted to play a role within a simulation in order to guide the simulation while avoiding unintended learner prompts (cueing)
Simulated patients	Provided with specific objectives and a script. Can use their own history and past experiences and respond flexibly to the needs of individuals' learning
Standardized patients	Used for assessment, carefully trained to portray a patient in a realistic and standardized way

examination skills. Table 12.3 summarizes human simulation roles. Commonly referred to as SPs, they serve as practice models, or participate in sophisticated assessment and feedback of provider abilities or services. Here are some of the ways to use this methodology in the curriculum.

- Case based teaching scenarios for one-on-one or small group teaching
- Demonstrations in front of large groups

- Teaching communication and interpersonal skills (giving bad news or sad news)
- Teaching history and interviewing skills
- Teaching patient education and counseling skills
- Teaching physical exam skills
- Clinical reasoning
- Telemedicine training
- Remote clinical skills training

As you read through the simulation literature, you will find many different terms to describe humans in simulation: standardized patients, simulated patients, simulated participants, embedded participants, and confederates. While there is currently little agreement within the community of practice, Gliva-McConvey et al. (2020) describes a model in which terms associated with SP methodology are linked to the training technique used and the level of standardization- the Human Simulation Continuum Model (Fig. 12.2). The model starts with the least standardized to the most standardized training/performance requirement.

Two types of specialty trained SPs are Gynecological Teaching Associates (GTAs) and Male Urogenital Associates (MUTAs). GTAs are women who are specifically trained to teach, assess, and provide feedback to learners about the breast, pelvic and rectal exams. MUTAs are men who are specifically trained to teach, assess and provide feedback to learners about the urogenital and rectal exams. Both use their bodies to teach and they provide a safe and supported learning environment while addressing communication skills necessary to provide a patient centered exam.

SP methodology and manikins can be used together in mixed modality simulations. The SP can play the part of the any family member of the manikin. Some faculty have trained SPs to play other professionals within the team e.g., doctors,

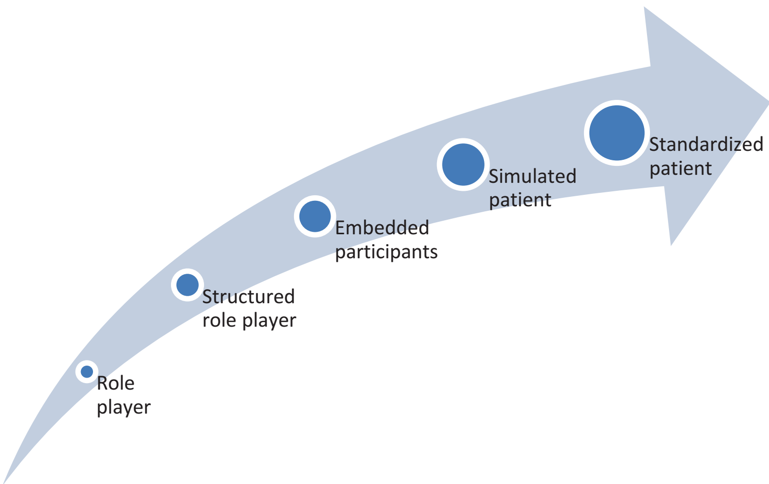

Fig. 12.2 Human simulation continuum model

nurses, or respiratory technicians. Training is required for an SP to play a participant in a simulation with a manikin to meet the level of realism required for the scenario. Hybrid simulation is when a SP has a part or partial task trainer attached to them. For example, an SP can have a simulated IV arm attached to them or they can have an IM pad attached to their arm.

Planning Stages of Simulation Based Medical Curriculum Design

Before you begin planning, acquaint yourself with the simulation resources at your institution. The size and scope of your simulation program are important factors to consider. The simulation faculty and staff are critical partners in developing your simulation. They are your content experts when it comes to simulation and standardized patient education and you might consider including them on your planning team from the very beginning. Quality SBME starts with good instructional design. Khamis et al. (2016) designed a simulation-based education model that is a modification on the Kern et al. (2009) 6-step approach for curriculum development.

Step One: Problem Identification and General Needs Assessment

You can do this before you meet with the simulation staff or they can walk you through a needs analysis during a planning session. Questions to answer during this step:

- What is the problem that you are trying to address?
- What is the current approach used?
- Is there an ideal approach based on review of the literature?

Step Two: Targeted Needs Assessment

Next, identify the specific needs of the learner and the context for learning: Is this a learning activity? Is this a formative or summative assessment? Are you addressing learning or skills gaps? Is this a new initiative or a research project?

- Learner: What is the level of the learner on the medical education continuum? What is the level of the learner for knowledge, skills or behavior being taught (novice to expert)? Are you working within a single discipline or with multidisciplinary program? Is this an interprofessional project?

- Resources needed: How many learners? How many sessions? How long is each session? Are there faculty who need to be trained in SBME? How many rooms will you need? What type of simulation? What type of simulation staff support?
- Prerequisites: What will learners be required to know, read, or view prior to the simulation?

Step Three: Develop Goals and Objectives

The next step is to identify the learning or assessment goals. Create one to three objectives for the simulation activity at the level of the learner and stated in specific and measurable terms. It is very important to match the objectives to the level of the learner. A first-year learner may be asked to obtain a patient history while a higher-level post-graduate learner will be expected to recognize a medical error and disclose it to a patient's family. The complexity and focus of the simulation will vary based on the learners. Here are additional examples:

- Assess a patient and participate in shared decision-making regarding treatment options
- Deliver sad or bad news
- Evaluate and triage mass casualty incidents
- Insert a Foley catheter
- Insert a central line
- Plan and prepare for discharge with the family and healthcare team (MD, nurse, OT, PT and home health care agency)
- Recognize an imminent crisis

Step Four: Choose Educational Strategy

Decide if you want to create a new simulation-based learning or assessment activity or adapt an existing one. Consider the type of simulation modality needed. Sometimes what you might have thought was most appropriate as a manikin simulation will work best with a SP or will work even better as a mixed modality. The addition of an SP as a family member or other participant can add the human dimension to your simulation. On the other hand, as your SP cannot simulate abnormal vital signs, you can add some of the simulator's technology for a more authentic clinical scenario. Seek out an experienced simulation/SP educator to help you adapt an existing simulation activity to meet your needs so you do not need to start from scratch. Many low and high fidelity manikins will come with simulation scenarios ready to use. Many cases can be found in the medical literature, via online searches and from simulation societies. If you cannot locate the appropriate activity, make use of a template to help organize your thinking and create a reusable asset for yourself and others. Examples of such templates have been compiled in the MedEdPortal, the AAMC online journal, and links to them can be found in the references at the end of this chapter. You can base your scenarios on a real patient case, critical incident report or patient safety goals so long as it is developed at the level of the learner and linked to your objectives. Achieving a good balance between developing scenarios to address specific learning objectives and allowing for unplanned moments to emerge (teachable moments) is critical in simulation (Alinier, 2011). Components include:

- **Details of the simulation scenario/SP case:** You are writing your scenario/case for two audiences: (1) the learners who need to understand what is expected of them and (2) the simulation technician(s) who will be operating the manikin or the SP who will be portraying the role. Thus, for each situation you need to provide an introduction to the simulation to the learner and a simulation design/SP case and logistical information to the simulation staff.
- **Introduction to the scenario**: Learners are usually provided with a limited amount of information about the patient prior to the beginning of the encounter in the form of a "hand off" or nurse's report or EMT report. The information can be provided orally or with written instructions based on the level of the learner or situation.
- **Scenario design:** The details of the scenario provide the faculty and the simulation technician with details about how the case should run and how the manikin should respond in certain circumstances.

1. What information the learners are provided or given freely if they ask
2. What the learners must ascertain during the simulation
3. Branch Points based on the action or inaction of the learner(s)

You must decide on the end point of the simulation but remember it may change with each group of learners based on their actions and your observations. Once engaged in the encounter, the scenario needs to have the flexibility to adapt to the action of the participants by either speeding up or slowing down the patient's symptom arc. If standardized participants play family members or staff, they can adapt the scenario in the moment as needed.

You can use preprogrammed settings on the manikin to progress the case or you can control the manikin manually based on the observed response of the learners. The choice is a matter of preference based on your experience, comfort, the scenario at hand, and working relationship with the simulation technician. Remember one advantage of simulation is that you can adjust a basic scenario to the level of the learner. For example, you can use the scenario of a patient presenting with acute abdominal pain for first-year medical learners today and with some fine tuning you can run the same patient case tomorrow for first-year internal medicine post-graduate learners. Working closely with the simulation technician who will operate the manikin will help guarantee a successful simulation for you and your learners. Some faculty eventually learn to run the manikin and the session at the same time. Only you will be able to make that decision once you have become more experienced in simulation. The details of the scenario will dictate which type of manikin you will be able to use although sometimes you will need to adjust your scenario to the type of manikin that is available in your simulation center.

Now, let's look at SP case development. The SP case is the building block for your program. Once you know how to develop one case, you can go on to develop a case bank from which you can build multi-station exams. If you create a good system to categorize your cases, you will be able to reuse them for different levels of learners and different types of learners more easily. There are many different approaches to developing cases. Some faculty members base their cases on real patients they have encountered, while some create fictional cases. Regardless, cases should be linked to the instructional goals and objectives. The case material is developed for the SP to memorize. Case material should be written in language that the SP can understand. SPs might sometimes be provided with background on chronic medical conditions included in the case to help answer questions if asked. Scripts become more detailed as the learners and the instructional and assessment goals become more advanced.

The case material not only contains factual information about the patient but also about affect and emotional reactions based on learners' actions. When writing a case, the basic idea is to give the SP more information about the patient they are portraying than they will ever be asked about by the learner. To be as authentic as possible, the SP has to know these patients as well as they know themselves so they could respond to any question asked of them by any learner as this patient might respond without giving an answer that might inadvertently mislead the learner. When you are creating the cases, be sure to specify if there are any specific body types or physical requirement, specific dress or props that should be present. For example, if you are writing an acute abdomen case, the SPs who are hired for the case cannot have had an appendectomy or any abdomen surgery that might mislead the learner.

Once you have written your SP case, you must pick the right SP to portray a particular patient case. Matching the SP to the case is as important as having a well-written case and training materials. Choose an SP whose profile is as close to the case description as possible. Ethnicity, age and gender are the three main characteristics to consider. **A word about age**: it does not matter what the SPs actual age is as long as they look within the age range of the patient profile. Selecting SPs who can play the same age makes exam administration easier as the age on the door instructions to the learners can all be the same, and it keeps the learner experience as close to standard as possible. The gender or ethnicity in a case can be varied, depending on the case goal and objectives.

Train all SPs who are doing the same case as a group to ensure their understanding of this patient, answer questions about the patient profile and share suggestions for portrayal. Standardized patients are very helpful in discovering problems in the case and bringing the patient to life. Together the instructor and patients reach consensus on how the patient is to be played, and how the patient will respond to the learner. In this way, we standardize the SPs in the way they think and present the patient to the learners.

SPs must be trained to appropriately and accurately respond to questions about the patient's problems. They must consistently reproduce any emotional and/or physical pain the patient is feeling while they are observing the learner's behavior. They also need to accurately recall those behaviors to complete a checklist and/or provide the learner with feedback over and over again. (Wallace, 2007). Once you have trained the case to performance level, ask another faculty member who is familiar with the case content to observe the SPs to validate the performance and correct the portrayal. Table 12.4 reviews the goals of SP training.

An equally important component is the logistics of the simulation. If you are doing this in a simulation center, work with the staff early to carefully plan the simulation. Attention to detail during planning will help the staff know how to prepare for your simulation. Elements to consider:

- Schedule: day, time, and frequency
- Specific patient rooms: inpatient, outpatient, operating room, emergency/trauma room
- Room amenities: phones, access to bathrooms, ability to monitor and record video
- Room set up: medical equipment, code carts, materials and supplies, EHR, etc.
- Handouts and materials: have adequate copies ready to distribute to learners on the day of the simulation
- Manikin/SP: initial set up position, presentation, dress, moulage (e.g., make up, blood), props, etc.
- Access to conference rooms and debriefing rooms.

Resources to help guide best practices in SP methodology and simulation practices can be found in The Association of Standardized Patient Educators (AASPE) Standards of Best Practice (SOBP) (Lewis et al., 2017) and the International Nursing Association for Clinical Simulation and Learning (INACSL) Standards of Best Practice^{SM} (Boese et al., 2013; Gloe et al., 2013; Meakim et al., 2013; Lioce et al., 2015; Decker et al., 2015)

Once you have made all of your decisions, the manikins are programmed, and the SPs are trained, the stage is set for a dress rehearsal. The simulation technicians, standardized patients, simulator, and faculty involved in the scenario should be brought into the simulation setting. The simulation should be run for a group of learners similar to your target group: a simulation of the simulation! Debriefing the dress rehearsal will be valuable. You will learn what you have forgotten to consider in the scenario script, what props you have left out, what does not flow, what a staff member does not understand or where a fellow faculty member is in disagreement.

Table 12.4 Goals and objectives of SP training

• Realistically portray the patient as written in the scenario
• Respond to the learner appropriately no matter what the learner says or does
• Observe and recall learner performance and accurately complete checklist
• Provide effective written or verbal feedback to the learner
• Standardize to other SPs in the same role
• Do 1–5 repeatedly in a teaching or assessment session

Even though the rehearsal takes time and resources, your simulation will be greatly improved. The less familiar you are with simulation, the more important the dress rehearsal.

- **Showtime**: After you have completed your preparation, conducted a dress rehearsal and/or piloted the simulation, you may feel confident about the simulation going smoothly. This is when it is important to remember that you are working with computers and humans, which often do not perform as expected. Even if you checked the simulator 10 min ago, there could be a problem the moment you need it to work. You need to plan for what you will do when the manikin is not working or the trained SP is unavailable or the faculty member you were counting on gets called away. What is your back up plan? Remember you work in health care or in the laboratory; you live with uncertainty every day so use that experience and make it work for you.

Before the simulation, make sure the learners have received clear instructions and written materials to help them prepare for the session. Everyone will be anxious. Any steps you can take to reassure them as to where they should be, and at what time, will go a long way to help them be ready to learn.

- **Components of a Simulation**

- There are three components of any simulation: briefing, simulation, and debriefing. Each is as important as the other. You have spent time and money planning the simulation. Equal attention must be paid to the briefing and the debriefing preparation and execution.
- ***Briefing: Make Room for Learning***

- You need to prepare your learners to feel safe to engage in reflection and self-examination. Therefore, the briefing before the scenario is crucial (Rudolph et al., 2014). Here are ten steps that can build trust among you and your learners:

1. Welcome each of the learners as they enter the conference/briefing room.
2. Introduce yourself and simulation staff (but not the SPs).
3. Introduce participants (if unfamiliar with each other).
4. Discuss care and comfort issues (restrooms, breaks etc.).
5. Review course objectives and format of the simulation.
6. Provide a tour in the setting of the simulation and let the learners explore and ask as many questions as needed for them to feel as prepared as possible.
7. Discuss and agree to the "Fiction Contract." This means that the learner willingly agrees to suspend disbelief and you will do your best to make the simulation as real as possible with the understanding that while manikins are not humans and SPs are not real patients, much can be learned that will be helpful in a real-world setting (Dieckmann et al., 2007).
8. State that the learning team (learners and faculty/staff) will provide each other with a safe and supported learning environment. This means the environment will remain predictable and secure. During debriefing, instructors will help

learners explore without risk and learners will engage in reflection and share their best thinking.

9. The learners agree to confidentiality and (if it is your policy) can sign a confidentiality agreement.
10. Make sure there are no questions or outstanding issues prior to beginning the simulation.

- ***Simulation***

- For standardized patient cases, instructions are usually posted on the examination room door and provide the patient's name, age, sex, and chief complaint. Based on the goals and objectives and the level of the learner, the door instructions then tell the learner what would they would be expected to do and how much time they have with the patient.

- While the simulation is taking place, you may have a choice of observing from inside the room or from a remote location (e.g., a control or conference room, hallway through a window, etc.), based on the setting or goals of the scenario. If you have a choice and it does not affect the goals of the scenario, choose the remote option. Learners will then have more autonomy to act and will therefore have a better learning experience. You will have a great opportunity to observe and gather data for debriefing from behind the one-way mirror or electronic monitor. Having your objectives in front of you and jotting down observations associated with each of them will be helpful for debriefing. Pay careful attention during the transitions that you have built into the scenario.

- When the simulation is completed, go into the room and simply say "The simulation is over." Often the learners will be so engaged in caring for the "patients" that you will have to reassure them that it is okay for them to leave. In this case it is helpful if the simulation technicians move close to the manikins or the SPs to take over from the learners. As soon as the learners begin to leave the simulation room they will begin to debrief with each other.

- If you have the ability to record the session, research shows video is a powerful learning tool that will be helpful in the next stage, debriefing. Table 12.5 lists tips for using recording to your advantage during a debriefing.

If you are debriefing as a team, it is best when you can take a few minutes to decide how to structure the focus of the debriefing. This is especially important if something happened during the simulation that you did not expect and you want to be sure to cover it during the debriefing. You will have to do this in a short period of time as you don't want to miss too much of the group's post scenario auto-debrief.

- ***Debriefing***

Debriefing is where learning takes place as learners reflect on the process and results of the simulation. The goal of the debriefing is to sustain or improve future

Table 12.5 Tips for using recording to your advantage for debriefing

1. Become familiar with the equipment (a) Fast forward (b) Book marking (c) Using 2–4 segments as springboards for discussion
2. Best segments to use (a) Near the beginning (b) Where there is a change in vital signs (c) Where you have scripted something to happen (d) Before a call for help (e) When help arrives (f) If an incorrect or correct diagnosis or procedure is started (g) 3–5 min into the scenario

performance by methodically reviewing what happened and why. The learners need to feel they are in a safe, supported learning environment so they can reflect on habits, techniques or approaches and evaluate their decision making. This debriefing process will allow them to accept and assimilate new knowledge, behaviors, techniques and approaches.

There are different phases to debriefing and styles of facilitation (Fanning & Gaba, 2007; Sawyer et al., 2016). The initial phase is to ask participants to share how they are feeling and to describe, in their own words, what happened and what they did. The second phase is to reflect on and analyze the experience and the third phase is to generalize the experience and apply the lessons learned to real life events. In the second phase of debriefing different techniques are employed. Some facilitators ask specific questions about certain actions, or let the group lead the way. Some facilitators will use the plus/delta technique: participants are asked to place all behaviors or actions they would change in the delta column and place all the examples of good behaviors or actions in the plus column for discussion. How much the debriefer needs to facilitate is dependent on the group and the skill of the debriefer. Ideally, you want the group to learn how to debrief themselves with minimum facilitation. The debriefer provides guided facilitation only when necessary to be sure the objectives are met. Eppich and Cheng (2015) presented a blended approach to debriefing called PEARLS (promoting excellence and reflective learning in simulation) which can be found at https://debrief2learn.org/pearls-debriefing-tool/.

Regardless of the specific debriefing method used for reflection after the simulation, Brett-Fleegler et al. (2012) identified six elements of good debriefing practices. In Table 12.6 you will find elements of good debriefing adapted to include all types of debriefing styles and methods.

Debriefing usually takes 30–45 min based on the learning objectives and other learning that may have emerged from simulation. The debriefer and the learners share responsibility during the debriefing session, which should be reviewed and agreed to during the briefing session. If at any time during debrief you have a participant who was unable to suspend disbelief, has broken the fiction contract and you are getting complaints about the realism, be sympathetic and do not argue. Redirect the conversation to a productive discussion using real world examples.

Table 12.6 Elements of good debriefing

Elements of good debriefing	The debriefer
1. Establish an engaging learning environment	Welcomes learners and attends to logistical details Introduces learning objectives and desired outcomes Orients to the simulation environment and clarifies limitations of the simulation methods Establishes confidentiality Obtains agreement that everyone will be respectful of each other's perspective Assures participants of psychological and physical safety
2. Maintain an engaging learning environment	Maintains participants' psychological and physical safety Helps participants move into, stay in and move out of the simulation
3. Structure the debriefing in an organized way	Has participants Share their reactions Describe events from their perspective Reflect/analyze on what went well and what could have gone better based on the objectives Close performance gaps Summarize key points made and take home messages
4. Facilitates engaging discussions	Uses specific examples of what was done well and not done well based on objectives for discussion Engages all participants in discussion through verbal and non-verbal techniques Recognizes when participants are upset and works with them Uses audio/video replay if available Provides direct feedback on performance gaps
5. Identify and explore performance gaps	Explores reasons for gaps by working with group to identify what "mental models" or frames (assumptions, feelings, goals, knowledge base or situational awareness learners were working with during the simulation that led to those actions and results Helps close the performance gap through discussion and teaching
6. Help participants achieve and or sustain good future performance	Meets the objectives of the session Shares knowledge of the subject

Table 12.7 Tips for working with learners who break the "fiction contract"

- Agree with them
- Be sympathetic- don't argue
- Redirect to a productive discussion about real world setting
- Clinical discussion to reestablish comfort

"What CAN we learn from this experience that would be helpful in a real world setting?" "Has anything like this happened in a real clinical setting?" If so, give a personal example. Using a clinical discussion often reestablishes comfort, (Rudolph et al., 2007). Table 12.7 reviews tips for how to work with learners who have trouble with simulation realism.

When the session is over, thank your learners for participating in the simulation and engaging in the debriefing. Make sure that there are no outstanding issues before concluding the session.

- **Techniques to Facilitate Debriefings**

Debriefing is an advanced skill and takes many sessions with feedback from fellow debriefers to improve. There are some techniques that you can use that will help your session run more smoothly as you improve your skills.

Make sure the room is arranged so everyone can see each other. If there are two debriefers (which is ideal) they should sit at the opposite end of the table (Cheng et al., 2015). Be sure to make use active listening skills, verbal and nonverbal. Nod your head, make eye contact and be very aware of body language. Use echoing and reflective listening: repeat or rephrase the speaker's words back to the group. Be careful not to put your words into the learner's mouth and don't interrupt. Be sure to involve everyone. Invite them into the discussion by name. Ask a learner in the group to comment on something said by another member of the group. Be comfortable with silence. If there is no response to a question, give the learners time to think and then follow up with another question if there still is no response. It is acceptable to allow and encourage the learners to talk and ask each other questions (Brett-Fleegler et al., 2012).

Even though you have outlined a set of learning objectives, learners will do unexpected things during simulation unrelated to the objectives (teachable moments) that you may want to use during debriefing. Learners will do something wonderfully clever, choose to do nothing at all or make a mistake you could never have anticipated. These should be discussed during debriefing as they add richness to the overall learning experience (Ziv et al., 2005).

Step Five: Learner Assessment

Summative feedback provides information about learning in high stakes situations like course requirements, graduation requirements, certification or licensure. Summative assessment relies on careful planning. Many tools are available and shown to be valid in the setting in which they were developed. Retesting for validity for your learner and your setting may be required. Assuring your learners and other stakeholders of the reliability and validity of your simulation and defensible standard setting process for summative assessment is paramount to the credibility of your program (McGaghie et al., 2011).

Formative assessment provides learner feedback for knowledge or skill improvement under low stakes conditions. After a simulation, we use debriefing to facilitate conversation among learners. They analyze their actions, thought processes, and emotional states to improve or sustain performance in future situations. The strength of simulation-based education lies with debriefing and the development of this reflective thought process. Schon (2010) defines reflection as a process that turns a person's experience into learning. During debriefing we ask learners to think back on what they did (reflection on action) in order to discover what might have contributed to an unexpected outcome. Boud et al. (2013) stressed that effective reflection on action requires the learner to return to the experience, attend to the feelings, and re-evaluate the experience. Research has shown this type of debriefing has improved performance and decreased clinical errors (Mamede et al., 2007).

Step Six: Program Evaluation

Identify how the simulation activity/program will be assessed by learners to aid in ongoing quality improvement. Kirkpatrick and Kirkpatrick (2006) developed four levels of evaluation for overall program effectiveness, which can be applied to simulation programs:

1. Reaction to the simulation experience: satisfaction, perception of program quality.
2. Learning: knowledge or skill acquisition/improvement or behavior change.
3. Behavior: application of knowledge/skill or behavior in the real world based on what was learned in simulation.
4. Outcome: long term impact on the learner, system, or organization as result of simulation.

It is vital that you evaluate every simulation session and debrief session. Decide when and how you want to get feedback from the learners about the simulation experience. Ideally you should leave some time at the end of the session for learners to complete the evaluation. If that is not possible they should complete the evaluation at a later date. For ongoing program improvement and feedback to your faculty, develop a form that provides similar information to allow for comparison.

Step Seven: Implementation

Gather materials together and record all the steps of design and delivery. Items can include

1. Administrative support
2. Necessary Resources
3. Administration of curriculum
4. Identification and approaches to barriers
5. Process improvement from pilot to implementation.

This step may be revised as you undertake a continuous quality improvement process.

Summary

This chapter has given you a basic overview of:

1. How SBME addresses challenges faced by medical educators today
2. An instructional design process for SBME
3. The steps of simulation from Briefing to Debriefing

There are two professional associations, The Association of Standardized Patient Educators http://aspeducators.org and The Society for Simulation in Healthcare http://ssih.org, that offer conferences and webinars in professional development workshops that will deepen your understanding of the knowledge, skills and behaviors needed to become an expert in SBME. The most challenging and most rewarding component is the art of debriefing. While most of the attention and money is spent on the manikins and the virtual hospitals, the actual learning takes place in classrooms and conference rooms in simulation centers around the world during debriefing. There is nothing more rewarding than being part of that transformative process. Just like your learners, you will want to do another simulation and debrief again and soon.

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Chapter 13
Assessment of Knowledge

Robert Malinowski and Brian Mavis

Abstract Assessment bridges the gap between teaching and learning. Assessing learner performance is a fundamental role in the life of a teacher and provides learners with valuable feedback. This information reinforces their areas of strength and highlights areas of weakness, allowing learners to direct their study strategies and improve their performance. For teachers, assessments define the levels of achievement expected of learners and provide the evidence necessary for progress decisions. This chapter describes the key features of the knowledge assessment methods most common to medical education, provides information for creating assessments that are reliable and valid, and offers construction tips for various question types.

Introduction

Assessment bridges the gap between teaching and learning. Perhaps second only to teaching, assessing learner performance is a fundamental role in the life of a teacher. Assessment is important because it provides learners with feedback about their performance; this information reinforces their areas of strength and highlights areas of weakness. Using this feedback, learners can direct their study strategies and seek additional resources to improve their performance.

From the perspective of the teacher, another equally important function of learner assessment is providing evidence necessary for decisions about learner progress. The various learner assessments define the types and levels of achievement expected of learners. As part of a course of study, learner assessments describe a developmental process of increasing competency across a range of domains deemed necessary for graduation.

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Any thoughtful teacher realizes the important role that assessments play in their lives, as well as in the lives of their learners. Less obvious are the principles of educational measurement underlying sound learner assessment practices. The purpose of this chapter is to describe the key features of various approaches for assessing knowledge. This chapter also provides information on how to create fair learner assessments, that is, assessments that are both reliable and valid.

Reasons for Assessing Learner Performance

The assessment of learner performance provides feedback to learners about what they have or have not learned and provides information that teachers can use in learner progress decisions. However, these are only two of many possible goals that can influence your selection of learner assessment strategies. As shown below, the goals that can drive the selection of learner performance measures are many and far reaching:

- Providing feedback to learners about their mastery of course content
- Grading or ranking learners for progress and promotion decisions
- Offering encouragement and support to learners (or teachers)
- Measuring changes in knowledge, skills or attitudes over time
- Diagnosing weaknesses in learner performance
- Establishing performance expectations for learners
- Identifying areas for improving instruction
- Documenting instructional outcomes for faculty promotion
- Evaluating the extent that educational objectives are realized
- Encouraging the development of a new curriculum
- Demonstrating quality standards for the public, institution or profession
- Articulating the values and priorities of the educational institution
- Informing the allocation of educational resources

Clearly, many of these goals are related directly to the interaction between teacher and learner. Nonetheless, this same information can be used by other stakeholders in the educational process for a variety of other important decisions (Shumway & Harden, 2003). From a practical perspective, it is unlikely that any single assessment strategy can provide information to support more than a few of these goals. The likelihood of misinterpretation or inaccuracy increases when learner assessment data are used for purposes other than those originally intended. The sheer breadth of the list of goals above also demonstrates the importance of considering the use of multiple strategies to assess learning.

In the curriculum development cycle presented in Chap. 16, learner assessment follows instruction and is the impetus for reflection, evaluation and curricular improvement. While this cycle might reflect how many teachers approach teaching, from the learner perspective, it is the assessment phase of the curriculum that drives learning. This is most often manifest when learners ask, “do we have to know this for the test?" For many learners their motivation is survival, and in an educational setting, one key element of survival is passing the test, whatever form these assessments might take. This is particularly true when results from assessments will be used for decisions about learner progress or other high-stakes outcomes.

Learning the Language of Assessment: A Few Definitions

Before getting much deeper into a discussion of learner assessment, it is important that we clarify a few key terms and their meaning in this context.

Assessment Versus Evaluation

Both assessment and evaluation refer to processes of gathering information for the purposes of decision-making. In medical education, assessment most often refers to the measurement of individual learner performance, while evaluation refers to the measurement of outcomes for courses, educational programs or institutions. Practically speaking, learners are assessed while educational programs are evaluated. However, it is often the case that aggregated learner assessments serve as an important information source when evaluating educational programs.

Formative Versus Summative Assessment

Formative assessments are used to give learners feedback about their learning. Practice test questions or problem sets, in-class peer-graded assignments and reviews of video recorded simulated patient encounters are examples of frequently used formative assessment strategies. Formative assessments are most valuable when they are separated from summative assessments, so that they are perceived to be low threat performance experiences. For conscientious learners, this represents an opportunity to document both strengths and weaknesses. However, some learners might dismiss formative assessments for their lack of consequences, and not put their best effort forward to use these experiences to maximal advantage.

Summative assessments are used to gather information to judge learner achievement and to make learner progress decisions (Miller et al., 1998). These assessments are very familiar to learners and teachers, and for learners, they often provoke anxiety. A substantial component of this anxiety comes from the learner progress decisions predicated on performance. However, to the extent that uncertainty about the summative assessment strategy itself is a source of anxiety, teachers can take steps to reduce learner anxiety. This includes providing information about the types of assessments to be used, their timing within a course, how they are scored and how each contributes to the final grade or progress decision.

Ideally, learning situations provide learners with multiple opportunities for both formative and summative feedback. Formative feedback helps learners *improve* their learning while summative feedback allows them to *prove* their learning. In practice, educators tend to focus on summative assessment, sometimes with little or no attention paid to providing opportunities for formative assessment. The obvious reason for this imbalance is the need to document learning for progress decisions, which is often coupled with limited instructor time and resources available for developing formative assessments. It is also true that many instructors do not appreciate the importance of practice provided by formative assessments, which can be a powerful tool to promote learning.

Competence

There has been a growing paradigm shift in medical education focusing on competence. The definition of competence provided by Epstein and Hundert (2002, p. 226) gives us a sense of the tip of the iceberg implied by this shift, "professional competence is the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice for the benefit of the individual and community being served." There are many resources for medical educators interested in understanding the complexities and nuances of competence, its operationalization as competency-based medical education, and how this has transformed current thinking about teaching, learning, curriculum design, learner assessment and program evaluation (ICBME, 2020; ten Cate, 2017; Lingard & Hodges, 2012).

Many models have been developed to provide a framework for competency-based medical education. In the United States, the Accreditation Council for Graduate Medical Education competencies (Batalden et al., 2002) have been influential, complemented by the development of Core Entrustable Professional Activities for Entering Residency for undergraduate medical education (Englander et al., 2014). In Canada, CanMEDS is the prevailing framework for outcomes-based education (Frank & Danoff, 2007). In the United Kingdom, the General Medical Council has described expected outcomes for graduate and postgraduate trainees (General Medical Council, 2015). The Scottish Doctor (Simpson et al., 2002) describes 12 domains of learning outcomes essential for competent medical practice. In Australia, the Confederation of Postgraduate Medical Education Councils has delineated five content areas within their curriculum framework for junior doctors (CPMEC, 2012).

A common feature of these competency frameworks is the centrality of knowledge acquisition. Knowledge is recognized as a key resource and prerequisite for effective, evidence-based care. Competent medical practice requires learners to effectively recall necessary science knowledge. As their education progresses, there is an increasing emphasis on the appropriate application of that knowledge to patient care. This underscores the importance of a thoughtful approach to knowledge assessment.

Key Features of Assessments

There are a number of factors to consider when choosing a method of learner assessment. Attention to these factors at the planning stage will go a long way to helping create a high-quality learner assessment. Five factors to consider are:

1. **Reliability**
2. **Validity**
3. **Feasibility**
4. **Acceptability**
5. **Educational Impact**

Reliability and validity are characteristics that generally refer to the process used to develop an assessment. Feasibility, acceptability and educational impact more often reflect contextual features of the assessment, which are related to when and how an assessment method is implemented (Mehrens & Lehmann, 1991).

Reliability

When talking about an assessment method in terms of reliability, we are referring to the consistency or repeatability of measurement. In practice, a reliable assessment will yield the same results when given to the same learner at two different times or by two different examiners. Tests consisting of multiple-choice questions are highly reliable; the results of the test are unlikely to be influenced by when the test is administered, when the test is scored or who does the scoring. On the other hand, reliability is an important concern when grading essay questions or other assessments requiring judgment or interpretation. In these situations, clear scoring criteria are needed to attain a high level of reliability. Writing clear questions and instructions improves the reliability of an assessment by reducing the likelihood that test questions or assessment tasks are ambiguous and open to interpretation by the learner. It also increases the likelihood that the assessment is testing desired knowledge, skills or attitudes rather than reading proficiency or verbal reasoning skills.

Internal consistency is another form of reliability that is frequently used to describe assessments based on multiple-choice questions. This term refers to the coherence of the test items, or the extent to which the test questions are interrelated. The primary difference between this and other estimates of reliability is that calculations of internal consistency involve only one administration of the test. For example, a set of multiple choice questions focused on assessing learners' knowledge of childhood immunizations should have high internal consistency. When questions testing other knowledge or abilities are added, the internal consistency is lowered.

Validity

Validity is the extent to which an assessment measures what it is intended to measure. Validity is related to reliability, insofar as a test with low reliability will have limited validity. A test with low reliability is subject to biases in interpretation and scoring, and when these biases are unrelated to specific content or learner performance, the validity of the assessment is diminished (Cook & Beckman, 2006).

The validity of any assessment depends on the context in which it is implemented. An assessment validated in a specific context or with a specific learner group may be less valid when used in very different settings. Validity is context-specific; inferences based on one setting may be more or less valid than when the assessment is used in a different setting.

Among the many types of validity discussed in education and social science research, content validity is the approach most commonly used to assure quality in learner assessment. Essentially, an assessment is valid when it samples representatively from the course content. A common method is to develop a table of specifications, often referred to as a test blueprint. The blueprint organizes course content by discipline (pathology, physiology, nutrition, etc.) or by objective (learners' ability to recall factual information, understand concepts or apply knowledge to new problems). In reality, any organizing structure that reflects the logic of the course content can be used as the blueprint. An example of a simple blueprint is provided in Table 13.1.

Ideally, the course content was initially designed around a blueprint based on the course objectives. In this way, the organization of the course informs the organization of the assessment content, creating a valid assessment (Anderson et al., 2001). In situations where there are no preexisting course objectives, it might be necessary to derive them from the content and reverse engineer a blueprint prior to creating the assessment.

Table 13.1 Example of a test blueprint

Discipline area	Content representation on exam
Tissue-based pathophysiology	12–18%
Kinesiology	25–30%
Exercise physiology	15–20%
Physical rehabilitation	18–22%
Surgical considerations	10–12%
Integrative medicine	6–10%

In general, sampling assessment content from the same blueprint that was used to define instructional content can enhance the validity of an assessment. Using multiple methods of assessment might be necessary when a complex performance involving a combination of knowledge, attitudes and skills is the focus of assessment. Further, some assessment methods are more appropriate for some types of performance than others, so choosing appropriate methods can increase validity.

Other Considerations: Feasibility, Acceptability and Educational Impact

The feasibility of an assessment method is a judgment of the resources needed to implement it in light of the information to be gained. The creation of a multiple choice test requires significant development time for question writing, but requires relatively little effort for administration or scoring. Conversely a reflective essay, while easily administered, often requires a significant amount of faculty time for scoring and feedback. Additional resources that can facilitate or constrain an assessment plan might include the need for examiners, simulated patients, proctors, technology, biological samples, curriculum time and classroom or other space.

The acceptability of an assessment is based on the responsiveness of faculty and learners to the assessment. If the assessment requires too much time from faculty and staff or requires too many resources to implement, its likelihood of success is jeopardized. Similarly, an assessment approach might be aversive to learners because of the timing, length, content or other features. In this situation, learners might not prepare as expected or might not think it valuable, possibly limiting the meaningfulness of the assessment.

The educational impact of an assessment is the sum of many influences. The thoughtful use of both formative and summative assessments can positively affect learning and subsequent learner performance. Educational impact also reflects the appropriateness of the match between the content and the assessment method. The use of multiple assessment methods can enhance the impact since relying on a single method tends to focus assessment on the content most amenable to the method, e.g., the use of multiple choice questions favors the assessment of knowledge over skills.

Methods of Knowledge Assessment

When choosing an assessment method, there are several factors to consider. One of the first considerations is the *type* of performance being assessed. Is the assessment focusing on knowledge, skills or attitudes? Is it being used for formative or summative assessment? A related concern is the reliability and validity of the method.

Another consideration is whether more than one assessment approach should be used. When choosing an assessment method, it is important to remember that no single method “does it all.” Some methods are more practical and less resource-intensive than others. For this reason, a multiple-methods approach will probably provide a more accurate picture of learner performance or achievement than a single approach.

There is a wide range of methods available when developing your approach to learner assessment. Listed below are the knowledge assessment methods most common to medical education and while not exhaustive, they represent the options available to faculty. Each of the methods is described in terms of (a) strengths, (b) limitations, (c) reliability and validity and (d) construction tips.

Multiple Choice Questions (MCQ)

Assessments based on multiple choice questions (MCQ) are one of the most common approaches to measuring learner performance. Typically, a multiple choice question consists of two parts: the question (stem) and the possible answers (response options or foils). Most MCQs include four or five response options and the learner is asked to choose the one best response. The stem also can make reference to tables, graphs or other information sources that the learner must use in order to determine the correct response. Here is an example:

Which of the following vitamins is involved in clotting factor synthesis?
(a) Vitamin A
(b) Vitamin B1
(c) Vitamin D
(d) Vitamin E
(e) Vitamin K

A. Strengths

- MCQs are familiar to most learners, given their common usage throughout most levels of education.
- MCQs provide broad coverage of content: it is relatively easy to build an examination using MCQs that covers a wide range of course content.
- MCQs can be simply written to test for recall of factual knowledge, or can make reference to graphs, tables or illustrations to test cognitive skills. MCQs also can be posed within the context of a science problem or clinical case to test knowledge application and problem solving.
- Scoring of MCQs is highly reliable and objective.

Scoring of MCQs can be automated, making scoring efficient and reducing the turnaround time for feedback to learners. Automated scoring also facilitates the calculation of psychometric properties of each MCQ.
MCQs are more flexible than True and False questions, which require absolute statements; MCQs require learners to choose the best answer from several possible options.

B. Limitations

- Good MCQs are challenging to write especially when the goal moves beyond knowledge recall to knowledge application and problem solving. The time saved in scoring an MCQ examination is reallocated to the preparation of the questions, requiring both time and careful consideration to avoid cueing learners about the correct response option.
- MCQs frequently focus on recall of factual information and rely on learners' recognition of the correct answer from among the options provided.
- Guessing can be a successful test-taking strategy for questions in which the learner can rule out one or more of the responses.
- MCQs are limited as a means of providing instructive feedback to learners since usually the only information provided is the correct response.
- The ease of use and economy of scoring associated with MCQs can lead to their overuse in situations when other types of assessment would be more appropriate.

C. Reliability and validity

- MCQ scoring is highly reliable in terms of consistency from one administration to the next. Scoring is consistent between examiners and is not dependent on who is scoring the exams.
- Validity of an exam based on MCQs is enhanced using a test blueprint, which assures that the distribution of examination content matches the instructional objectives.

D. Construction tips

- The response choices should be relatively brief, with the major content elements of the question included in the stem. The content can include graphs, images, clinical scenarios, research findings or other complex information that requires interpretation.
- Write each response so that it matches the grammar of the stem. Avoid grammatical cues that may inadvertently allow learners to eliminate some responses.
- Equally distribute the position of the correct response across a series of questions. For example, the correct answer should not always be in the same position. A strategy to avoid such bias is to always order your response options alphabetically or numerically. Knowing this, the learners cannot expect position bias. Many computer-based assessment systems include an option to automatically randomize all responses.
- Do not use "all of the above" or "none of the above" as a response option.
- Avoid questions worded with negatives or double negatives.

- The correct and incorrect responses should be about the same length.
- Avoid the use of responses that are irrelevant or silly. This increases the likelihood of guessing the correct response.

Extended Matching Questions

The extended-matching question format was developed to address some of the limitations of the MCQ format. The major advantage over MCQs is that the larger number of response options reduces the likelihood that the question will cue the learner to the correct answer; learners also are less likely to recognize the correct answer. In many ways, the strengths and limitations of extended-matching questions are similar to those of multiple-choice questions.

Extended matching questions are organized around themes, and include multiple response options, instructions and a series of stems. Here is an example:

Theme:	Endocrine Glands and Hormones		
Options:	A. Luteinizing hormone	E. Estrogen	I. Norepinephrine
	B. Vasopressin	F. Insulin	J. Prolactin
	C. Calcitonin	G. Testosterone	K. Oxytocin
	D. Glucagon	H. Melatonin	L. Progesterone
Instructions:	For each statement below, select one hormone that best fits the description.		
Stems:	1. Secreted by the thyroid gland		
	2. Stimulates ovulation and corpus luteum formation		
	3. Lowers blood sugar		
	4. Secreted by pineal gland		

A. Strengths

- Extended-matching questions can be used to construct an exam covering a wide range of content.
- Extended-matching questions can be used to test knowledge recall as well as knowledge application.
- Scoring is highly reliable and objective and, like MCQs, can easily be automated for efficiency.
- This question format is often used to test recall of factual information; there is less chance of learners recognizing or guessing the right answer compared to MCQs. It can also be used to test problem-solving skills such as clinical diagnosis or patient management.

B. Limitations

- Time and practice are needed to write good questions that take advantage of the strengths of this format but do not cue learners.

- These questions provide only minimal feedback to learners to enhance their learning.

C. Reliability and validity

- Like MCQs, this item format has high reliability because of the consistency of scoring over time and across examiners.
- The validity of an exam using extended matching questions is based on the representativeness of the test content compared to the instructional content. Like MCQs, questions derived from a test blueprint can assure a fair test in terms of content.

D. Construction tips

- Extended matching questions are usually written around a theme. When the theme is based on a clinical scenario, research abstract or an image, the questions can require learners to recall knowledge, interpret findings or suggest possible diagnoses.
- The response choices should be relatively brief, with the major content elements included in the question.
- Avoid questions worded with negatives or double negatives.
- Avoid the use of response options that are irrelevant or silly.

There is an excellent resource for extended-matching questions available free-of-charge from the National Board of Medical Examiners website (www.nbme.org). Under publications, look for "Item Writing Guide: Constructing Written Test Questions for the Basic and Clinical Sciences" by Miguel Paniagua and Kimberly Swygert (2016).

Essays and Modified Essay Questions

These types of questions are characterized by the requirement that the learner *constructs* a response rather than choose a correct response from the options provided. Essay and modified essay questions provide an opportunity to assess a learner's ability to apply knowledge to solve problems, organize ideas or information, and synthesize information. For example:

> You are treating Sandy, a 57 year old woman who was diagnosed six months ago with Stage 2 adenocarcinoma of the right lung. Until a few days ago, her pain has been well-controlled. You have reevaluated the pain control and decided to initiate treatment with sustained release oral morphine. Sandy's brother is coming to the next appointment; he has concerns that his sister will become addicted to the pain medication. What will you say to Sandy's brother?

A modified essay question is made up of one or more short answer questions. The learner is provided with basic science or clinical information and then asked to write brief responses. When a series of questions is presented, additional information about the original problem can be provided at each subsequent step, guiding the learners through an analytical process.

> David is a 26 year old computer programmer, who lives alone with his dog Max. He has come to your office complaining of a persistent cough.
>
> 1. What are three likely diagnoses?
> 2. five specific questions that would help you distinguish among these possibilities.
>
> David tells you that the cough started about 5 days ago, and that many people in his office have called in sick lately. He has felt feverish and had some chills yesterday evening. He has been coughing up a small amount of thick green sputum.
>
> 3. List two diagnostic tests appropriate for work-up of this case.

A. Strengths

- Essay questions can focus on content related to knowledge or attitudes, as well as written communication skills.
- Essay questions are best used to assess depth of knowledge within a limited area of content.
- This question format is familiar to learners, and fairly straightforward for faculty to construct.
- Essay and modified essay questions are well-suited for formative feedback, since learners can be provided with a model answer to help them understand their performance and prepare for future assessments.
- Modified essay questions require less time to score than traditional essay questions.
- Since learner responses tend to be shorter and more succinct, modified essay questions are less subject to scoring bias and can provide broader content coverage, both of which can increase the reliability and validity of the assessment.
- While essay questions can be used to assess higher levels of learner cognitive ability, modified essay questions are ideal for testing knowledge recall that is not based on recognizing the correct answer as in MCQs.

B. Limitations

- Reliability is a major concern and there is a need to assure consistency of scoring over time and when multiple individuals are involved in scoring. Scoring of written responses is more likely to be affected by general subjective biases of the scorer, often referred to as halo effects. In practice, halo effects occur when there is a possibility of giving some learners the benefit of the doubt more often than other learners. For example, learners who are known to be strong performers, or learners who have done well on other parts of the assessment, might be given the benefit of the doubt more often compared to weaker performers. The possibility of halo effects is more likely when learner identities are known to scorers or when a single scorer is used.

- More time is required for scoring these responses than other formats.
- Assessments based on essay-type questions are more limited in their content coverage because of the length of time required for learners to respond to the questions as well as the length of time required for scoring.
- Essay questions require written communication skills. If this is not the focus of the assessment, learners who know the content but have poor communication skills may be disadvantaged.

C. Reliability and validity

- Reliability is a major concern with these types of questions. The individuals scoring written responses might need to make some inferences about what the respondent meant to write because of poor written communication skills including organization, grammar and vocabulary, or due to vague wording. The opportunity for inference tends to reduce reliability.
- When possible, all of the answers to one question should be scored at the same time, by the same person. If multiple people are scoring the exam, then each should grade all of the responses to a single question. Many assessment platforms allow questions to be randomly assigned to multiple graders and also anonymize the identity of the learners to reduce the likelihood of bias.
- Each essay question or set of modified essay questions should be graded independently from other parts of the exam.
- To create a test with high validity, it is important to make sure that the essay questions address important content as indicated by the course objectives and overall course plan. Having several content experts review the model answer to each question can strengthen the validity of the assessment. This is particularly true when the question asks learners to integrate concepts from across several content domains, which might not have been taught by the same instructor.
- Reliability can be increased by having a clear scoring scheme developed prior to grading the questions. One approach would be to create a model answer and then allocate points to specific features of the answer, such as mentioning specific key content, presentation of a logical argument, recognition of a counter-argument or alternative explanations, or whatever else is appropriate to the question.
- A detailed scoring rubric can facilitate grading and assure consistency between graders. The rubric should specify each dimension that is being evaluated and the requirements to achieve each performance level. An example is provided in Table 13.2.

Table 13.2 Example of a scoring rubric

Dimension	Excellent (4 pts)	Good (3 pts)	Fair (2 pts)	Poor (0 pts)
Understanding of statistical tests	Able to correctly identify all tests used and what was assessed	Able to correctly identify all tests used, but not what was assessed	Identified some, but not all, tests	Unable to identify any tests or what was assessed
Identify statistically significant findings	Able to identify all statistically significant findings	Able to identify most of the statistically significant findings	Able to identify half of the statistically significant findings	Unable to identify any of the statistically significant findings
Understanding of statistical significance	Correctly defines p-value, alpha level, Type 1 error and Type 2 error	Correctly defines 3 statistical terms	Correctly defines 1–2 statistical terms	Unable to correctly define any statistical terms

D. Construction tips

- Write questions that outline a specific task for the learners. Asking learners to discuss a content area is not as clear or helpful as asking learners to compare and contrast, describe, provide a justification, or explain.
- To improve reliability and the sampling of course content, it is more effective to use a large number of modified essay questions requiring short answers than to use a more limited number of essay questions requiring long written answers.
- Prepare a model answer and scoring rubric after constructing the test question. This helps to increase scoring consistency by assuring that the answer you expect is reasonable given the question, and clarifies how points are assigned to content and presentation of the answer.
- To reduce bias and improve consistency, score only one essay question or set of modified essay questions at a time and, if feasible, have separate scorers for each essay question. When this is not possible, rescoring a small set of answers can help maintain consistency. The subset of rescored answers should be sampled from throughout the set of examinations to make sure that the application of the scoring criteria did not change over time.
- When used for formative assessment, learning can be enhanced by providing learners with a model answer as well as feedback about common errors observed when scoring.

Short Answer Questions

Short answer questions require learners to provide brief answers to questions. The responses usually require only a few words or a brief phrase. Short answer questions are sometimes presented as fill-in-the-blank questions.

> A middle-aged financial planner presents with a several month history of stomach discomfort. He has found limited relied with over-the-counter antacids, although these are now less effective than before. His discomfort is aggravated by caffeine, alcohol and late-night snacking. What is the likely differential diagnosis for this patient?
>
> In planning the diagnostic work-up for this patient, list two tests you would definitely include to aid in your diagnosis.

Like essay questions, short answer questions require learners to provide a response rather than choose or recognize a response from the list of possibilities provided. However, because short answer questions require briefer responses, more questions can be included within an exam, achieving greater content coverage than with essay questions (Rademakers et al., 2005).

A. Strengths

- High content coverage is possible.
- This question format is familiar to learners.
- This question format has high reliability and validity.
- Faculty find it relatively easy to construct short answer questions.

B. Limitations

- These types of questions tend to focus on knowledge and are used to test knowledge recall and comprehension rather than higher level abilities.
- Scored questions indicating the correct answers provide limited feedback to learners to improve their learning.
- This question format requires more time to score than MCQs but less time than essay or modified essay questions. Some assessment systems can automate the scoring of short answer questions if the response exactly matches the pre-defined key. Multiple correct answers may also be included. Variants of a correct answer (e.g., misspellings or responses not defined in the key) are flagged so instructors can determine if they receive credit.

C. Reliability and validity

- Reliability can be achieved by writing questions that are clear to the learner. Also important are clearly written model answers to each question. The distribution of points for the responses should be clearly specified. While bias is less likely to apply to scoring short answer questions, the likelihood of halo effects can be minimized by the same procedures described for essay and modified essay questions.
- Using a blueprint to create short answer questions that representatively sample from the course objectives and content is important. As mentioned previously, having several content experts review the model answers can strengthen the

validity of the assessment. This is particularly true when there might be multiple possible correct answers for a question, or when the correct answer can be described in multiple ways.

D. Construction tips

- Write questions that are clear and specific.
- Prepare the short answer questions and the model answers at the same time. Afterwards, reread the questions and answers again to assure that the expected answer is reasonable given the question.
- To reduce bias and improve consistency, score all the answers to a single set of questions at the same time. Rescoring a small subset of answers can help maintain consistency throughout the scoring process.
- Score the answers to the questions with the identity of the learners anonymous if possible.

Oral Examinations

An oral examination requires learners to answer a series of preselected questions; these are typically based on standard stimulus information such as a patient case. For example, based on the patient information provided, the examiner can ask questions about differential diagnoses, pertinent missing data, additional testing, patient management as well as clinical reasoning, data interpretation or basic science content underlying the learner's responses (Mancall, 1995). The length of time per case can vary depending on whether breadth or depth of understanding is desirable, as well as whether the exam is being used for formative or summative assessment.

David is a 26 year old computer programmer, who lives alone with his dog Max. He has come to your office complaining of a persistent cough.

1. List three diagnoses that you would include in your differential diagnosis.
2. List five specific questions that would help you distinguish among these possibilities.
3. List two diagnostic tests appropriate for work-up of this case. What is the rationale for each?

A. Strengths

- Oral exams can be used to assess knowledge and attitudes.
- This assessment format can be used to assess higher order clinical problem-solving such as application and synthesis of knowledge, ability to prioritize features of a patient case and evaluate treatment options and outcomes.

- Oral exams provide insights into learners' organizational and verbal skills.
- When used in formative settings, oral exams can be used to provide learners with immediate feedback and provide instructors with information about learners' approaches to problem-solving and reasoning.

B. Limitations

- Reliability can be problematic as a result of rater factors such as poor standardization, inconsistent expectations, and halo effects.
- Like essay exams, oral exams provide limited coverage of content and cases, which can limit the validity of the assessment.
- Oral exams require verbal and language skills. Learners that are non-native speakers may be less able to communicate their content knowledge using this type of assessment.
- This format is not familiar to many learners, which increases their anxiety.
- Time is required for scoring the results of an oral exam, particularly when a large number of examiners is involved.

C. Reliability and validity

- Significant training of the examiners is required for reliability to be achieved. The training must address performance expectations and standards, as well as the use of structured rating forms to record learner performance. The use of multiple examiners is recommended to reduce halo effects and other rater biases.
- Because oral examinations are limited in the amount of content that can be covered, longer exams are more valid than shorter exams. It is also important that the exam is standardized in terms of the content to be covered and the specific scoring forms used by examiners.

D. Construction tips

- An effective strategy to improve reliability is the use of paired or tripled examiners for each question. Thus, each learner will have a different group of raters for each oral exam question. Each examiner should grade or rate the examinees independently.
- To improve the validity of this exam, the selection of the cases to be covered should focus on important content; longer exams are more valid than shorter exams because of the increase in content coverage.
- When cases are used as the stimulus for the oral exam, the same cases and questions should be used for all examinees to maintain standardization. However, the order of questions can be varied among examinees.
- As with essay exams, model answers and explicit grading criteria for each question should be developed prior to the oral exam. All raters should be familiar with the grading criteria and rating form.

Portfolios

A portfolio is a collection of evidence organized around specific themes as a means of assessing knowledge skills and attitudes that allows learners to demonstrate their learning and achievement to others (Challis, 1999). The major components of a portfolio include a statement of purpose, examples of evidence selected by the learner to document performance, as well as a reflective statement by the learner regarding the portfolio content. The main benefits of portfolios are improvements in knowledge and self-awareness, engagement in reflection and improved mentor relationships (Challis, 1999). A portfolio also can be a journal or educational diary chronicling learner experiences and insights over time, beginning or ending with a reflective self-assessment of the assembled experiences.

A. Strengths

- The task of selecting representative evidence of achievement provides an opportunity for reflection and self-appraisal.
- A wide range of evidence can be included in a portfolio including written documents and projects, letters of appreciation or recognition, presentations, digital media and resources, citations, logbooks of patient encounters, assessment results, reflective self-assessments and survey results.
- The assembled evidence provides insight into the learner's ability to apply their knowledge and skills in integrative tasks, as well as the growth of their knowledge and abilities over time.
- Central to most portfolios is an integrative reflective essay that provides insight into higher level cognitive abilities as well as the learner's own ability to self-assess their achievements and what has been learned.
- Portfolios can be used for formative or summative assessment, and can be an important source of information when combined with faculty mentorship.

B. Limitations

- The task of selecting, organizing and interpreting the representative evidence of achievement is time consuming.
- Presumably the examples selected for inclusion in the portfolio are the best evidence the learner has of their performance, and therefore only a selective sample of performance is presented.
- This format is unfamiliar to many learners and faculty, both in terms of assembly and making judgments from a portfolio.

C. Reliability and validity

- As with other forms of assessment, clear specification of the purpose and content of the portfolio is important to assure validity. The relationship of the portfolio to learning objectives or promotion criteria enhances validity. Clear instructions can help define the types of evidence appropriate for inclusion, the number of examples to include, and the content of the reflective essay.

- Reliability is achieved with multiple ratings of the portfolio content, as well as the use of multiple forms of evidence included in the portfolio to demonstrate specific educational outcomes or performance.
- Also important is an understanding by learners and raters of the criteria by which the portfolio will be judged as well as the rating form, derived from these criteria, which will be used as a basis for the judgments.
- Because the assessment of the portfolio is ultimately made using rating forms, the issues associated with the reliability and validity of rating forms also have bearing here.

D. Construction tips

- Providing learners with the responsibility to meaningfully choose the evidence to include in the portfolio enhances their ownership of the portfolio. Another way of promoting ownership is involving learners in the discussion of how the portfolios will be evaluated: the criteria and standards to be used.
- Portfolios can include a wide range of evidence such as: abstracts or brief descriptions of research or educational projects; publications or presentations; case studies; self- or peer-assessments; awards and letters of recognition or appreciation documenting learner achievements; letters or documents describing service contributions to professional or community organizations; awards; materials from websites or digital media that have been developed; personal reflections on specific achievements, activities, ethical dilemmas, challenging patients, etc. Almost any type of evidence might have value in a portfolio depending on its purpose. A critical aspect of portfolio construction is reflection on what was learned, when and how it was learned, and why the experience was valuable (Zubizarreta, 2008).
- Software tools have been developed to assist in the compilation of evidence into an electronic portfolio. These tools range from blogs, wikis, online learning management systems to specific portfolio systems. For example, evidence can be curated using a taxonomy of competencies, with learner progress tracked and presented via a dashboard interface.
- Criteria for judging the content of a portfolio often focuses on the learner's reflective essay regarding the achievements represented by the assembled evidence. The evidence can also be interpreted in terms of the breadth and depth of content, comparison of different types of content, areas of strength, weakness or achievement not represented within the portfolio. Another use of the portfolio is as a stimulus for discussion between learners and instructors or mentors.
- An assessment derived from a portfolio can focus on the skills, knowledge or attitudes in judgments of the technical achievements represented by the evidence, as well as the application of theory or the ethics and values inherent in the content.'
- There are circumstances when standard criteria for assessing portfolios might not be desirable, such as when the portfolio is implemented as a means of documenting the achievements and progress made by individuals as part of an individualized educational plan for independent study or remediation.

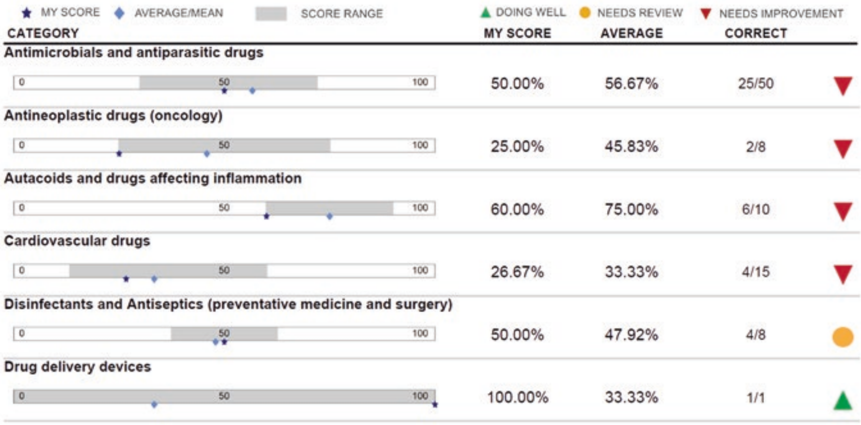

Fig. 13.1 Example of a customized strength and opportunity report

Reporting and Feedback

Feedback to Learners

As mentioned earlier in this chapter, an important feature of assessment is that learners receive feedback about their learning. Some of these assessments are also well-suited for providing learners with detailed information about their strengths, as well as areas for improvement. It is this level of detail that provides learners with the greatest opportunities for learning from their assessment experiences and building confidence in their abilities. Formative feedback is also important for building confidence and reducing anxiety when learners are confronted with forms of assessment that are unfamiliar to them. Some computer-based testing platforms can generate customized strength and opportunity reports (Fig. 13.1), giving learners information about their performance in each of the content areas on the exam blueprint. The reports may also include detailed answers, grading rubrics and reference materials.

Depending on the assessment, feedback can take the form of detailed model performance such as model answers for essay and oral exams, or sample portfolios. Other forms of feedback include summaries of the most common errors made by learners during an assessment, and information about why a specific response choice was right or wrong. Of course, written comments related to the learners' specific responses are very helpful but can be very time consuming to generate. Another strategy is to have learners self-assess their performance as a means of comparison with instructor feedback.

To optimize the value of assessments as feedback experiences for learners:

- use clear criteria for grading performance
- provide feedback in a timely manner

- include both positive and negative feedback when practical
- make feedback as specific as possible

Feedback to Faculty

It is important that aggregated learner performance information be available to the institutional committees responsible for curriculum oversight. Aggregate performance information can be used to provide evidence of the success of new programs, curricula or modes of instruction. Another important use of aggregated learner performance data is to provide valid evidence for decision-making and supplement the perceptions of learners or faculty. It provides a systematic approach to data collection that can be used to answer specific questions about effectiveness and outcomes, and perhaps give rise to further questions about the curriculum. Such evidence can be crucial in the face of personal testimonials or opinions derived from one person's experience with a specific learner or educational experience. This information can be part of an ongoing effort to monitor an educational program or diagnose curricular problems as part of a systematic program review.

Summary: A Self-Test

Now that you have learned the key features of the knowledge assessment methods most common to medical education and have gained insight into creating assessments that are reliable and valid, we invite you to examine the sample questions in the self-test below.

What issues do the following questions have? How could they be improved? The answers can be found on the following page.

1. A 42-year woman is found unconscious in her backyard by a neighbor. After being admitted to the emergency department and intubated, she should be given an IV administration of:

   A. MRI of the head
   B. Dextrose
   C. Complete physical examination
   D. Naloxone
   E. Mannitol

2. Protein is required by athletes for maintaining red blood cell volume and muscle turnover. What percentage of the metabolizable energy of the diet should consist of protein?

   A. 20–25%
   B. 40–50%

   C. 25–30%
   D. <40%

3. All of the following statements are true regarding clotting factor levels at birth EXCEPT:

   A. All clotting factors are normal at birth.
   B. Factor II levels are abnormal at birth.
   C. Factor V levels are abnormal at birth.
   D. Most clotting factors are Vitamin K dependent at birth.

4. What is the primary advantage of cardiac imaging with Fludeoxyglucose F18?

   A. The ability to identify areas of poor perfusion
   B. The ability to identify areas of scar tissue
   C. The ability to identify areas of fatty acid metabolism
   D. The ability to identify areas of inactive myocardium

Self-Test Answers

1. Grammatical mismatch. Choices A and C cannot be administered intravenously and would be quickly eliminated by the learner.
2. The responses are not mutually exclusive. Choices A and C overlap at 25%. Choice D encompasses A and C. The choices are not presented in a logical order.
3. Question is worded with a negative ("except"). The choices are not presented in a logical order.
4. Repetition in the choices. Redundant text should be moved to the stem.

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Chapter 14
Assessment of Skills

Clarence Haddon Mullins and Brenessa Lindeman

Abstract Assessments in education aim to link the gap between teaching and learning. Not only should they be driven by an end goal to the teaching and learning experience, but they should also incentivize the entire educational enterprise towards a common purpose. They act as a form of structured feedback that highlight a learner's strengths and also guide improvement for future performance. The purpose of this chapter is to provide an overview of key assessment techniques along with the pedagogical principles needed to choose or create skills assessments for learners. In particular, the rise of the Entrustable Professional Activity is explored within the context of more traditional formats. Regardless of method, the role of educators in achieving a public-minded educational program for the future remains the same, to drive the practice of medical education into the future to create an efficient, valuable, and vibrant community for learner and teacher alike.

Introduction

Assessments in education aim to link the gap between teaching and learning. They should not only be driven by the end goal of the teaching and learning experience but should also incentivize the entire educational enterprise towards a common purpose. For the teacher, assessing student performance is fundamental, second only to the act of teaching itself. At its core, assessments are simply a structured form of feedback, highlighting a learner's strengths and weakness to guide improvement in future performance. Secondarily, assessments are also critical for teachers to use in stratifying and defining student achievement. These definitions can then be extrapolated to identify those ready for progression verses those in need of remediation.

On the surface, the ubiquity of assessments in education obviates the need to explain their presence for either teachers or learners. Less obvious, however, are the

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pedagogical principles that underpin different types of assessments. While Chaps. 13 and 15 will address assessments of knowledge and attitudes and behaviors respectively, this chapter will focus on assessment of skills. Skills assessments pose unique challenges in that, ultimately, the true testament of safety and efficacy in medical education involves performing the skill in real-time on a patient in need of that particular skill. As safety of the patient is the highest priority, providing appropriate levels of introductory education and supervision is a critical precursor to any skills assessment (Kogan et al., 2017). In addition, as will be discussed, the expansion of simulation techniques for training and assessment has changed the paradigm of skills assessments for many contexts. The purpose of this chapter is to provide an overview for some of these key principles with a particular focus on how teachers may apply pedagogy when choosing or creating skills assessments for their learners.

A Question of Competence

Competency has become a deep and nuanced focus of the medical education research community, and its definition is inherently linked to assessment. One definition provided among this discussion is that "professional competence is the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served" (Epstein & Hundert, 2002).

While competency can be thought of as an end result for an educational program, it can also be used as a model to define and approach different levels of learner achievement. In defining one of these models, George Miller described competency with relation to the increasing ability of a student to perform independently in a clinical setting (Miller, 1990). The first level defined by what students *know* is a measurement of their mastery of the theoretical principles and indications of the skill being performed. At the next level, students demonstrate that they *know how* to use and apply their knowledge appropriately and within the correct context. Following, assessments may aim to measure that students can *show how* they perform said skill, and for the highest level of competency described, students demonstrate by *doing* what they would in a real-life clinical encounter.

In a key attempt to apply this model, the Accreditation Council for Graduate Medical Education's (ACGME) Outcome Project sought to define competencies for the assessment of residents-in-training, ultimately outlined as patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice. These competencies aim to encompass the entirety of a resident's ultimate role as an independently practicing physician and have been implicated in widespread change among medical school and graduate medical education curricula alike (Swing, 2007). The intended scope of the project included all residency programs, regardless of specialty, in an effort to standardize and generalize recommendations for movement into a competency-based era of education that would not be limited to specialty-specific initiatives.

Entrustable Professional Activities

For some educators, however, the use of competency as the core construction for medical education is viewed as too general and ethereal to be assessed within a single patient care encounter. In response, core competencies were integrated into a more specific, contextual form of assessment via entrustable professional activities (EPAs) (ten Cate & Scheele, 2007). EPAs involve the combination of multiple, individual acts of competency to create "professional activities that together constitute the mass of critical elements that operationally define a profession."

Taken together, EPAs represent a framework for assessment consisting of multiple formative micro-assessments providing a large base of data from which to make a more formal, summative decision about whether a learner can be entrusted to practice the given activity with the next layer of supervision going forward. The advantage of the EPA framework is that it aligns formative competency assessments with a more global picture of the role learners will ultimately play as physicians and places public and professional trust as its centerpiece. For skills assessments, EPAs are uniquely positioned in that the "activity" can encompass not only the technical aspects of a certain skill, but also include an understanding of indications or needs requiring said skill to be performed and the follow-up or patient education required afterwards. Notably, the EPA framework is currently being adopted by a multitude of professional organizations including the Association of American Medical Colleges (Englander et al., 2016) and various medical specialty boards including the American Board of Pediatrics (Schumacher et al., 2020) and the American Board of Surgery (Brasel et al., 2019) in attempts to create a paradigm shift for assessment and advancement in medical education, and as such, will undoubtedly have a wide-ranging impact on the medical education community as a whole (Brown et al., 2017).

Choosing and Building a Skills Assessment Method

Choosing a method of skills assessment can be a highly nuanced activity and should first consider what is being assessed. Another factor is whether the assessment is to be used in a formative (primarily for instruction and education) or a summative (for promotion and advancement) context. In addition, the context is directly related to the reliability and validity of an assessment, and as such, should be taken into consideration. Is the assessment primarily simulation or lab-based, or will it be conducted during a real clinical encounter with a patient?

When choosing a method, it is important to remember that it is highly unlikely to find that one method alone captures a complete picture of student performance. As such, a multi-method approach should always be considered, and certain methodological decisions can be made to allow the chosen assessment methods to maximize and complement one another.

While the below methods and their applications are common in medical education, this listing is by no means exhaustive or definitive. Each method is described in terms of (a) strengths, (b) limitations, (c) reliability and validity and (d) tips for construction.

Global Ratings

Global ratings of skills performance summarize an evaluator's overall impression of a student for a predefined time period or for a specific "skill." Often broken down into two separate components of "duty" and "expertise," these impressions are, by nature, highly subjective, but are easily tracked over time or aggregated. In addition, these ratings often reflect how teachers naturally observe and reflect on student performance, providing a translational and transparent view of student performance.

Strengths

- When based on observation, whether in real or simulated contexts, global ratings tend to have high validity
- Can assess general, concrete skills performance in blocks that are easily understandable to both learner and teacher (Central venous line placement, neurological exam, laparoscopic appendectomy, etc.)
- Can be formative or summative in nature

Limitations

- Reliability can be highly variable from rater to rater, and can often require multiple, independent raters in multiple scenarios to achieve desirable reliability
- Resource intensive in that faculty must take time to supervise and provide feedback in order for rating to be valid
- Ratings are subject to bias based on rater-trainee interaction

Reliability and Validity

- Raters must be "normed" or standardized to the scale being used, and a consensus among raters must be achieved in terms of what actions constitute particular ratings
- Expertise among the rater is necessary for the judgement of skill performance to be valid

Construction Tips

- Ratings must be based on observable behaviors, and should be frequent enough to reduce resource burden on faculty raters
- As observations mature, expect to find a "hawk vs. dove" phenomenon, where some raters are generally more critical, while others are more lenient. Assessment developers should be prepared to adjust or re-norm raters
- Provide specific details, if possible, beside each rating on the form in attempts to standardize rating practices
- Allow for multiple, independent raters in multiple contexts to complete the form in order to increase reliability and decrease subjective bias

Workplace-Based Assessments

Workplace-based assessments occur when observable behaviors are assessed by expert raters in a real clinical environment with real patients. Whereas global ratings may take place in simulated contexts, these must occur within live clinical encounters. In addition, these assessments often exist in the form of a checklist or form that is more detailed and expansive than those that characterize global faculty ratings (Fig. 14.1). As detailed below in the dedicated EPA section, EPAs represent one type of workplace-based assessment, but many others are narrower and more focused than the global ratings scales commonly used in EPA micro-assessments.

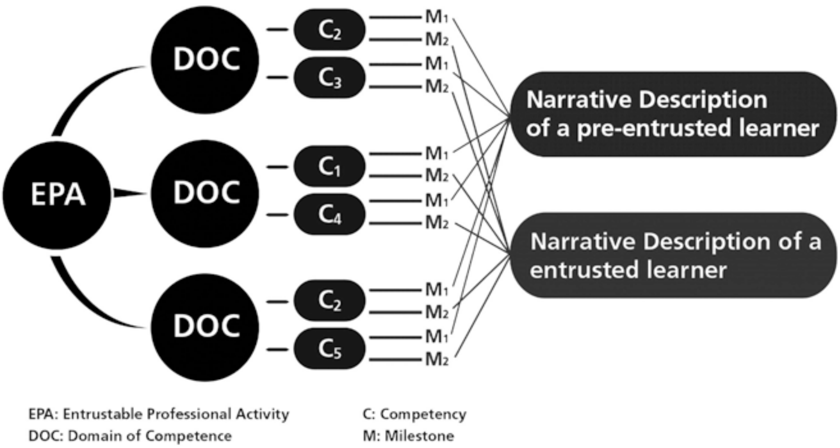

Fig. 14.1 Relationship between EPAs, Competencies, and Milestones. (Copyright Association of American Medical Colleges, 2016. Reprinted with permission)

Strengths

- These ratings can be highly valid in that they are based on direct observation of the skill of interest, often broken down into discrete components or steps, depending on the skill being observed
- Can be applied from technical skills, including operative steps, to history-taking of physical examination and presentation skills
- The checklist itself can be immediately reviewed by the learner and discussed upon completion, providing actionable, timely feedback

Limitations

- Rater bias can inhibit high reliability, and a "halo-effect" or the act of raters "whipping the survey" can create a de facto global assessment rating
- While these are often beneficial for novices, the practice of breaking down more complex skills into discrete, measurable steps becomes highly nuanced

Reliability and Validity

- Clear definitions and expectations as defined on the form itself can increase reliability and obviate the need for an experienced professional to perform the observation and assessment
- Validity is high when based on discrete, observable skill performance
- The forms can easily and quickly be provided as forms of feedback and can be used for debriefing
- As learners become more advanced, the step-by-step guides or evaluation become less concrete and the performance of the trainee becomes more nuanced. As such, global ratings may better serve the more advanced or experienced learner

Construction Tips

- Limiting the number of checklist items can improve reliability. These items ideally should be scored on a 2-point (done or not done) or 3-point (done well, done incorrectly, not done) scale, particularly for novice learners

Standardized Patients and OSCEs

Standardized patients are laypeople (or real patients) that interact with learners in an immersive, but simulated, context in order to assess clinical skills such as history-taking and physical exam or communication skills. The goal of the standardized patient is to allow for similarly presented clinical scenarios to be used to compare learners across a spectrum for basic competencies and judge performance, often for summative assessment and licensing purposes.

As part of the larger objective standardized clinical examination (OSCE), standardized patients act as the subject upon which students must demonstrate skills that may not be amenable to testing via more traditional paper-based or electronic means. For a typical OSCE, a student encounters a series of standardized patients, each with a unique clinical complaint, where they must communicate appropriately, take a thorough, focused history and perform a physical exam. Students are assessed via checklist, similar to the workplace-based checklists described above, detailing whether or not certain expected aspects of the history and physical were performed. Since their inception, the OSCE has also been incorporated into physician licensing processes for both the United States and Canada. Additional discussion on the use of standardized patients is found in Chap. 12.

Strengths

- Simulations aim to reenact real-life scenarios in a safe environment for training and assessment. It can integrate multiple skills simultaneously, useful for global rating schemes, or can be used to meticulously assess completion of physical exam skills. In addition, simulations can involve group participation exercises for teambuilding or leadership skills
- Learners can be provided immediate feedback via debriefings or through video review if available
- While standardized encounters or simulations are necessary for licensing purposes, individual institutions may also customize or build exercises specific to their educational curriculum and goals

Limitations

- Students must be willing to accept the simulation as real in order to fully participate as they would in an actual patient encounter
- Simulations and simulation centers are often highly resource intensive and require a team of individuals dedicated to operating and maintaining equipment and scenarios
- Simulation as an assessment tool is less familiar to students and learners alike and may require education sessions to norm assessors as well as to orient students

Reliability and Validity

- Increasing the length of scenario and number of scenarios observed increases the reliability and validity

- The specific assessment form used for each observation may differ and must be validated within the specific context and scenario of that particular simulation

Construction Tips

- While valuable in the summative setting, simulations are powerful forms of formative assessment and can provide immediate feedback individually or in groups on skills directly related to the clinical goals of students
- If checklists are to be completed from memory (as in standardized patient encounters), it is best to keep the checklist as concise as possible to increase reliability and decrease rater fatigue

Technology-Based Simulations

Technology-based simulations are similar to those in which standardized patients are used in that they aim to provide reproducible scenarios for training and assessing learner skills in a high-fidelity environment. In contrast, however, technology-based simulations employ the use of mannequins or virtual reality consoles and devices to recreate a real-world context rather than human volunteers (Tekian et al., 1999). This format is particularly advantageous for training and assessing invasive procedures or skills related to high-risk clinical scenarios (e.g. central venous line insertion, cricothyroidotomy, closed cardiac massage) as there is no risk to patients or those involved in the scenario. As with standardized patients, feedback may be given immediately based on direct observation in an individual setting or as a group. In addition, virtual or technology-based simulations may be used in conjunction with standardized patients to create longer or more immersive clinical scenarios.

Strengths

- Mannequin simulations and virtual reality tools are ideal for procedural skills assessment and team-based critical care decision-making skills
- As learners are directly observed in a controlled situation, formative feedback and repetition can be targeted to individual learners for rapid improvement
- Simulations in this context can be used for summative and formative assessments depending on curriculum goals

Limitations

- While technology-based simulations often require a higher degree of belief suspension by students compared to standardized patients, they are ideal for skills demonstration that will involve risk or potential discomfort to patients
- Virtual reality and mannequin technology are often highly resource intensive to obtain and maintain

Reliability and Validity

- While these tools can be highly standardized, and therefore highly reliable, the extent to which reliability and validity are achieved is largely based on the assessment checklist, which must evidence for its validity collected within each particular context
- Some assessments may include quantitative data (e.g., time to completion) but again, these data must be validated within the context for which it is being used

Construction Tips

- The goal of any simulation must be that it tests the accurate completion or performance of a particular skill (validity). While simulations that are "high-fidelity" with relation to real-life clinical scenarios may increase validity, it is not always a required prerequisite
- Particularly for basic procedural or physical exam skills, certain "low-fidelity" simulations may provide a cost-efficient and equally valid alternative when more expensive tools are unavailable

Entrustable Professional Activity

Entrustable professional activities (EPAs) were proposed by ten Cate and Scheele (2007) as a way to focus the concepts of competency based medical education (CBME) around the "critical elements that operationally define a profession," which can be commonly thought of as units of work for a physician. While many types of assessments can be used for EPAs, they are all conducted as workplace-based assessments that occur within the context of real-life clinical encounters. Importantly, depending on the specialty and context, EPAs may encompass the entire encounter from diagnosis to treatment (e.g., recognize a patient requiring urgent or emergent treatment and initiate management) or only one phase of a care encounter (e.g., the pre-operative phase for evaluation and management of a patient with gallbladder disease), and may include cognitive as well as technical skills (Table 14.1) (DaRosa et al., 2013). EPAs are uniquely positioned to link training

Table 14.1 "Zwisch" Workplace-based assessment of operative autonomy

Zwisch stages of supervision	Attending behaviors	Resident behaviors commensurate with this level of supervision
Show and tell	Does majority of key portions as the surgeon. Narrates the case (i.e., thinks out loud) Demonstrates key concepts, anatomy, and skills	Opens and closes First assists and observes
Cues to advancement		
Smart help	Shifts between surgeon and first assist roles When first assisting, leads the resident in surgeon role (active assist) Optimized the filed/exposure Demonstrates the plane or structure Coaches for specific technical skills Coaches regarding the next steps Continues to identify anatomical landmarks for the resident	When first assisting, begins to actively assist (i.e., anticipates surgeon's needs) The above plus: Shifts between surgeon and first assistant roles Knows all the component technical skills Demonstrates and increasing ability to perform different key parts of the operation with attending assistance
Cues to advancement		
Dumb help	Assists and follows the lead of the resident (passive assist) Coaching regarding polishing and refinement of skills Follows the resident's lead throughout the operation	Can execute the majority steps of procedure with active assistance The above, plus: Can "set up" and accomplish the next step for the entire case with increasing efficiency Recognizes critical transition point issues
Cues to advancement		
No help	Largely provides no unsolicited advice Assisted by a junior resident or an attending acting like a junior resident Monitors progress and patient safety	Can transition between all steps with passive assist from faculty The above plus: Can work with inexperienced first assistant Can safely complete a case without faculty Can recover most errors Recognizes when to seek help/advice

and practice in that their formative use can directly inform the ultimate, summative use and eventual independent practice.

Strengths

- EPAs are often more intuitive and less burdensome forms of work-place based assessment

- They are directly related to the practices, requirements, and trust necessary of working physicians and may be easily modified to reflect scope of practice, experience, or level of training
- Can be assessed using a brief micro-assessment tool or other, pre-existing workplace or milestone-based assessments
- Potentially, EPAs not only change approaches to assessment, but may be used to guide curriculum changes as an "outcomes" approach to curriculum design for medical education

Limitations

- While EPAs can be resource intensive to build and design and may require personnel with formal training in medical education, many EPAs are readily available for implementation, in particular those through the Association of American Medical Colleges (AAMC) and many specialty boards for graduate and continuing medical education
- There remains ongoing debate regarding their use and definitions throughout the medical education community at-large and may be inconsistently defined or conflated with other educational approaches

Reliability and Validity

- The reliability of EPAs is high by nature and is arguable its chief intention, as it aims to directly link each activity to performance outcome and professional skill.
- Reliability may vary as real-world clinical scenarios are difficult to standardize and raters may have differing sources of bias or interpretation. Increasing the number of observations and the number of different raters can help improve reliability

Construction Tips

- EPAs should be based on direct observation of clinical skills in a real-world context, with the ultimate goal that the learner is able to complete said activity independently and without supervision
- Levels of entrustment for each EPA should be tied to clear behavioral descriptors, often with examples or vignettes as necessary, to improve reliability
- In building EPAs at the institutional level, it is recommended that educators consult a professional with prior experience in the design or implementation of EPAs

Diversity and Inclusion in Skills Assessment

As can be seen in many of the aforementioned assessment tools, skills training and assessment often relies on external observations. As opposed to assessments of knowledge, assessments of skills are rarely amenable to quantitative, objective assessment tools designed to limit bias and be highly reliable. Assessments of skills, whether in a standardized, simulated environment or in an actual clinical environment, can be highly dependent upon prior interactions between rater and ratee of the expectations of the rater with respect to the skill being performed (ten Cate & Regehr, 2019).

With the assessments most often performed via faculty observing students (regardless of assessment method used as described above), implicit biases may be reliably controlled via a diverse faculty workforce. In addition, as described above, many of these methods increase their reliability with each independent observation. In assuring that diversity is a core component of clinical educator recruitment, it would naturally follow that increasing the number of independent observations would also increase the diversity associated with rater-ratee relationships and limit any implicit biases that may threaten assessment validity (Lucey et al., 2020).

On a more technical note, many of the skills performed in the clinical environment may be performed with varying stylistic preferences. The approach of one rater may be slightly, or even grossly different than another rater. While clear definitions and orientation of raters may be used to limit this variability and increase reliability, it is often the case that an understanding of and insight into different ways achieving similar results may be beneficial to learners from a cognitive standpoint. In ensuring that learners are exposed to a diverse group of faculty educators, they may learn to incorporate best practices form multiple perspectives or be able to adjust their approach based on personal preference or ability (Labbe et al., 2020).

Summary

In closure, skills assessment in medical education may take a variety of forms, each with its own advantages and disadvantages. With the rise of simulation technology and standardized patient encounters, these offer unique and highly valuable formative as well as summative assessment approaches for learners. Their ability to safely and reproducibly mimic clinical encounters and scenarios, from high stakes encounters to technical skills and invasive procedures, is becoming a core component of many curricula. Unfortunately, these simulations often require dedicated staffing and space to be highly effective, making them relatively resource intensive to create and maintain. Still, they can be invaluable once established and advances in the technology surrounding virtual reality may only serve to increase their applicability while hopefully decreasing costs and increasing accessibility.

EPAs, on the other hand, are designed to be implemented within the clinical environment and combine the best of both global and workplace-based assessments. The push to incorporate EPAs into medical education has been met with varying results, most successfully in the area of transition from UME to GME through the AAMC's 13 Core Entrustable Professional Activities for Entering Residency (Brown et al., 2017). As their use expands into UME and GME, these assessment tools have the potential to change not only approaches to assessment, but to curriculum design as well. The maturation of EPAs will create a need for educators well versed in their application and implementation, and the use of EPAs in procedural and technical skills will be most likely serve as early potential targets, particularly for critical care, emergency, and surgical specialties.

For physicians, the link between knowledge and application of that knowledge through skills often represents and key barrier between training and practice, and assessment of successful transition from one to the other is critical to achieve a public-minded educational program for the future. It is of utmost importance that, regardless of assessment approach used, that their reliability and validity be meticulously assessed not only for the skill in question, but the context in which the assessment tool is being applied. It is here that the roles of the educator and researcher connect, and must continue to connect, in order to drive the practice of medical education into the future to create a more efficient, valuable, and vibrant community for learner and teacher alike.

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Chapter 15
Assessment and Teaching of Professional Attitudes and Behaviors

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Abstract In this chapter we discuss ways in which students' professional attitudes and behaviors are defined, taught, and assessed. Various models of professional behavior reported in the literature are identified and discussed together with pros and cons of each model. This is followed by a brief discussion of methods and approaches to teach professional attitudes and behavior. A wide range of assessment techniques are reviewed with recommendations for uses across the medical education continuum. We conclude with recommendations for future work to improve both the development of and assessment of professional attitudes and behaviors in the future.

Introduction

A core tenet of physician training is the development of professional attitudes and behaviors. Indeed, in the context of a medical school students are expected to exhibit professional attitudes and behaviors with all stakeholders including fellow students, faculty, administrators, staff, and patients. However, the definitions of professional attitudes and behaviors, and how to assess them, can vary markedly among faculty, administrators, and students as well across institutions and cultures (Ho et al., 2011). Thus, a key first step in understanding how to assess, teach, or study attitudes and behaviors is to operate from a clear definition of such traits.

An attitude is defined as a tendency to act or react in a favorable or unfavorable way toward an object. Whereas a behavior is defined as an individual's observable responses, actions, or activities. Intuitively, one would expect a direct relationship between attitudes and behaviors, however attitudes do not reliably predict behavior

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when taking social pressure and environmental context into consideration (Wallace et al., 2005). Indeed, the relationship between attitudes and behaviors is complicated. In situations where the social pressure is equivalent to the behavior difficulty, the mean correlation between attitudes and behaviors is r = 0.41 (Wallace et al., 2005). However, in situations where the social pressure and behavior difficulty increase by one standard deviation, the correlation between attitudes and behaviors decreases to r = 0.30 (Wallace et al., 2005). This means that student's attitudes may be reflected in their behavior in lower pressure, lower stakes environments. Whereas in higher intensity environments, with bigger stakes, students may be more likely to behave in a way that does not reflect their attitudes (Rees & Knight, 2007). This is underscored by the observation that some students who harbor unprofessional attitudes may fake professional behavior in the presence of observers (Rees & Knight, 2007).

A significant factor that is thought to drive the disconnect between attitudes and behaviors is the so-called "hidden curriculum." The hidden curriculum encompasses non-formal culture and values that emanate from outside of the formal curricular teaching and is more a product of replicating the culture of medicine rather than from curricular derived knowledge or techniques (Hafferty & Franks, 1994). For example, this can include teachers and staff offering their values, opinions, judgments, jokes, and stories. In some cases these encounters can perpetuate negative gender, racial, cultural, and disability stereotypes (Hafferty & Franks, 1994). These are powerful forces that can create higher pressure, socially challenging environments that can skew the relationship between a student's attitudes and their resultant behavior in that context. As a consequence of immersion in this morally and socially challenging environment, students can emerge with a medical morality that may be antithetical to what is formally conveyed as being professional (Hafferty & Franks, 1994). Importantly, this is not to say that the hidden curriculum is all negative, but it presents a challenge for professionalism assessment and training. Indeed, Martimianakis et al. (2009) argue that because of the sociological context considerations, when trainees are in their natural, clinical habitat of professional attitudes and behaviors, simple lists of behaviors or qualities do not explain how professional or unprofessional behavior actually arises. Rather they suggest that professionalism be viewed as a role where professional behavior is socially constructed and maintained by institutional structures and practices (Martimianakis et al., 2009). Thus, the takeaway from these studies is that, to develop an accurate picture of medical students' professionalism, attitudes, behaviors, and the social environments they participate in need to be considered when choosing a mechanism to detect, assess, or teach professionalism.

In general professional attitudes have been reported to be stable across years of medical education and training (Batenburg, 1996). Interestingly, patient-centeredness and humaneness appear to be higher with female students compared to male students (Batenburg, 1996; Roberts et al., 2004). Medical students and residents see the need for professionalism and desire more training (Roberts et al., 2004). Fortunately, despite the temptation to think that attitudes and behaviors are fixed in adulthood, multiple lines of evidence suggest that they are in fact modifiable, particularly early on in medical training (Batenburg, 1996). Indeed, attitudes can be formed and modified via acquisition of information, self-reflection, and even testing. This suggests that early identification of students with unprofessional attitudes and behaviors may offer an opportunity to remediate these students before they enter clinical practice.

In the past, little attention was given to assessing or deliberately and formally teaching students professionalism (Batenburg, 1996). In the present time, however, more attention is dedicated to ensuring medical students accrue such skills. Many schools now actively incorporate coursework and experiences that specifically provide students with training in professionalism. Nevertheless, finding a tool or strategy to classify and capture unprofessional attitudes and behaviors is challenging (Goldie, 2013). Furthermore, the types of resources and remediation that should be leveraged to "teach" the unprofessional student how to act and respond professionally to real-life situations is also far from certain. This is further complicated by the dearth of data-driven studies. Of the studies that have examined the effectiveness of interventions aimed at teaching professionalism, they found little to no impact or the effects are temporary (Martin et al., 2002). Below we will discuss the field of research as it stands, the tools and strategies that have been developed, together with suggestions for their use and future needs.

Efforts to Define and Operationalize Professional Attitudes and Behaviors

The concept of professionalism and its core attributes have been the subject of countless efforts seeking to define, frame, or operationalize it for the purposes of clarifying what should be assessed and taught. There are a number of definitions that have been promulgated (Cruess et al., 2004). However, there is not one, universally agreed upon definition. A systematic review of published literature on definitions of professionalism underscores these challenges (Birden et al., 2014). Birden et al. (2014) identified 195 papers that met their exclusion criteria. Of these 195 papers, 156 were viewpoints or opinion articles, 19 were book chapters, 3 were systematic reviews, leaving only 14 qualitative methods papers, and 3 quantitative methods papers. Herein lies a core issue with defining professionalism. There are many opinions on defining professionalism but little data-driven research on implementation of different definitions of professionalism.

Despite the lack of uniform consensus, many of the definitions are closely aligned and thus they can serve as useful guides for faculty and institutions. For example, a frequently cited normative definition by Herbert Swick articulates nine sets of behaviors as part of his normative professionalism definition (Swick, 2000). Nichols et al. (2014) have discussed strategies for operationalizing professionalism using these traits described by Swick, with medical residents. Many of the teaching and assessment methods they discuss for residents can be easily applied to medical students. The key point is that they articulate an approach to transform abstract definitions and traits into a practical system that could be used in the training of medical students. Wilkinson et al. (2009) classified common themes and subthemes that emerged from multiple definitions or interpretations of professionalism in the literature and created an assessment blueprint that mapped tools to the element of professionalism that each can measure. Themes and subthemes include:

- Adherence to ethical practice principles, *including but not restricted to*:
  - Honesty/integrity
  - Confidentiality
  - Moral reasoning
  - Respect privileges and codes of conduct
- Effective interactions with patients and with people who are important to patients, *including but not restricted to*:
  - Respect for diversity/uniqueness
  - Politeness/courtesy/patience
  - Empathy/caring/compassion/ rapport
  - Demeanor
  - Including patients in decision making
  - Maintaining professional boundaries
- Effective interactions with other people working within the health system, *including but not restricted to*:
  - Teamwork
  - Respect for diversity/uniqueness
  - Politeness/courtesy/patience
  - Empathy/caring/compassion/ rapport
  - Demeanor
  - Maintaining professional boundaries
- Reliability, *including but not restricted to*:
  - Accountability
  - Punctuality
  - Taking responsibility
  - Being organized
- Commitment to autonomous maintenance and continuous improvement of competence in:
  - Self, *including but not restricted to*: reflectiveness, personal awareness, seeking and responding to feedback, lifelong learning, dealing with uncertainty
  - Others, *including but not restricted to*: providing feedback, leadership, people management
  - Systems, *including but not restricted to*: advocacy, advanced knowledge

Similarly, the development of professionalism frameworks is a practical pathway for implementing training, assessment, and remediation into a medical school's curriculum. In 2016, Irby and Hamstra described the three dominant frameworks for describing professionalism; the virtue-based/ethics framework, the behavior-based framework, and the professional identity formation framework (Irby & Hamstra, 2016). Broadly, they compare the focus, assumptions, and strengths for each of the frameworks before going on to outline specific curricular, pedagogical, and assessment strategies for each. Many of these specific strategies for implementing the different frameworks are similar to those discussed by Nichols et al. above.

The virtue-based/ethics framework is most closely associated with humanism. That is to say, this framework is centered on the physician as a moral agent who places the interests of patients above their own self-interests. This framework is rooted in morality. Physicians must keep patient information confidential, disclose conflicts of interest, display altruism, be honest, reliable, and show respect for others. Of the three frameworks that they outline, this framework is most closely related to the normative humanism posited by Swick discussed above. They note that these ethical principles, at the heart of the virtue-based/ethics framework, are inherent in rules and processes that need to be learned and adhered to including informed consent, disclosure of conflicts of interest, and confidentiality of patient information. This framework is often presented to students through honor codes, white coat ceremonies, direct instruction, reflective writing and other activities that emphasize ethics, moral development, communication, and humanism. Irby and Hamstra (2016) note that the virtue-based/ethics framework is frequently assessed via written exams, reflective writing exercises, self-assessment, and observation with feedback. Likewise, remediation is provided by encouraging the learner to reflect on the root causes of their unprofessional behavior, the goals of professionalism, and how to develop their personal moral reasoning abilities.

The behavior-based framework is the most common professionalism construct employed at medical schools and adopted by many accrediting bodies (Irby & Hamstra, 2016). This is because behaviors can be clearly defined in a way that allows them to be observed and measured or assessed. Professional behaviors in response to specific situations can also be taught and modeled (Irby & Hamstra, 2016). Direct instruction, role modeling, the use of case studies, simulators, coaching from peers and instructors, and writing exercises are all used to teach students professional behaviors using this framework (Irby & Hamstra, 2016; Lee, 2016). In this framework, remediation is more concrete and is accomplished by developing a remediation plan with the student that entails a period of compliance monitoring. Mental health screening, professionalism assignments, professionalism mentorship, and behavioral counseling are also used to help the unprofessional student under this framework (Irby & Hamstra, 2016).

Finally, the professional identity formation framework is centered on the process of identity evolution including values, dispositions, and aspirations. The principle way professional identity develops is through participation in communities of practice, observation of role models, direct instruction, coaching, and assessment with feedback (Irby & Hamstra, 2016). The key here is that the learning is developmentally appropriate when students transition to different levels of training and learning. Assessment such as moral reasoning assignments and multisource feedback, test acquisition of professional identity from self-assessment activities, reflective writing, and appreciative inquiry, which is a collaborative discussion technique that focuses on individual and institutional strengths (Irby & Hamstra, 2016). In a similar fashion to the structure of the learning, remediation coincides with the learners developmental phase (Irby & Hamstra, 2016).

When taken together it appears that no one framework captures all of the attributes or features of professionalism. Thus, multiple frameworks should be considered across the continuum of activities encountered in medical training. It is important to keep in mind that professionalism is socioculturally influenced so the curriculum, pedagogy, and assessment methods chosen must reflect the values and goals of the institution and health system in which it is situated. Whereas carefully designed studies comparing the application of definitions or frameworks in an educational context are lacking, it becomes clear that the methods available for teaching and assessing professionalism are similar across frameworks. Promising and useful tools and strategies for assessment will be discussed in more detail below.

Approaches to Teach Professionalism and Remediate the Unprofessional Student

Several modalities have been used to teach professionalism in both the UME and GME setting. Common methods include didactic instruction through workshops, lectures, and seminars, which are most helpful when teaching the cognitive knowledge base of professionalism. Other methods include small-group/case-based discussion, simulation, reflection, and role-modeling with mentorship. Most institutions use multiple modalities to teach professionalism. Birden et al. (2013) found that role modeling and opportunities for reflection were the most effective strategies for learning professionalism in the UME setting. Berger et al. (2020) found that in the GME setting instruction focused on well-being and professional values enhanced learners' knowledge, self-reported attitudes and behaviors, as well as observed behaviors in educational settings. Many factors can undermine the effectiveness of professionalism training that exist at the individual level (e.g., disinterest in the students), faculty level (e.g., lack of understanding of what professionalism is), institutional level (e.g., lack of consistent training, faculty development or administrative support; difficulty assessing professionalism fairly), and at the system level (e.g., hidden curriculum). Ong et al. (2020) describe ways to overcome these factors such as enhancing learner interest, providing a platform to discuss discrepancies in what is taught versus what is observed in the clinical setting, and getting support and buy-in from faculty and the institution.

There are recommendations to teach professionalism longitudinally and integrated throughout the curriculum starting with the cognitive base in early training and then reinforced and internalized through experiential learning (Cruess et al., 2006). Ong et al. (2020) propose a 7-stage, structured, competency-based approach that includes longitudinal feedback and assessment with the use of portfolios. This allows professionalism to be nurtured in a manner relevant at each stage of learner's development. Learners move through stages that build upon each other: (1) building knowledge through didactic programs, (2) embracing a professional identity through case-based discussion and formal events (e.g., white coat ceremonies), (3) contextualizing the concept of professionalism through small group discussions, (4) gaining knowledge of good (and bad) professional conduct through role modelling, (5) practicing professionalism and developing interprofessional skills through simulation, (6) portraying professionalism within the clinical setting through interaction with patients and families, and (7) deepening professional traits by engaging in reflective practice with feedback and holistic support throughout all of the stages in the learning process. However, nurturing professionalism through this approach requires clearly defined milestones to guide assessments, clarify expectations and responsibilities of learners and ensure timely, specific, and longitudinal support and feedback. This aligns with previous work that suggests teaching professionalism in the absence of assessment has little effect on student attitudes (Goldie, 2013).

Tools and Strategies to Assess Professional Attitudes and Behaviors

A first step to overcoming barriers to professionalism training can be developing and integrating a system for assessing professionalism throughout the continuum. Assessment often drives learning, so including professionalism on high-stakes assessments shows students, faculty, and all stakeholders that it is important and valued by the institution. Assessment of professionalism is challenging for many of the reasons already noted above: professionalism is difficult to define; opportunities to observe professionalism can be rare and affected by social desirability since the learner is aware of being observed and assessed; and assessors might operationalize professionalism differently, requiring a need for faculty development and multiple assessors over multiple occasions for each learner (Norcini et al., 2016). Overcoming these challenges requires a system of assessment using multiple methods that can capture changes over time.

To guide a system of professionalism assessment, Miller's (1990) pyramid provides a useful framework for thinking about which assessments to use at various times and in different contexts (Goldie, 2013; Norcini et al., 2016; Wilkinson et al., 2009). The pyramid consists of four levels: knows, knows how, shows how, and does. The "knows" level is focused on cognitive knowledge. The "knows how" level focuses on the application of cognitive knowledge and also attitudes and values of learners. The "shows how" level focuses on how learners demonstrate skills while being observed. The "does" level focuses on how one behaves as a practicing healthcare provider in the clinical setting.

While most assessment of professionalism focuses on learner behavior, attitudes, and values, there is also core knowledge, mostly related to ethics, legal standards, multiculturalism and confidentiality of patient data (Goldie, 2013; Norcini et al., 2016) that can be assessed by written tests. Knowledge tests measuring professionalism usually consist of clinical vignettes with multiple-choice questions. Lee (2016) propose to capitalize on the benefits of retrieval practice to enhance long-term retention of professionalism knowledge by administering vignette style multiple-choice formative quizzes spaced over time throughout medical school and residency training. As with any assessment tool, reliability and validity of the instrument need to be carefully considered. See Chap. 13 for information on item development practices including gathering reliability and validity data.

There are knowledge assessments of professionalism that have demonstrated reliability and validity strengths in certain contexts. The Barry Challenges to Professionalism Questionnaire (Barry et al., 2000) consists of patient-based multiple-choice items focused on conflict of interest, confidentiality, physician impairment, sexual harassment, honesty, and acceptance of gifts. The Matriculating Medical Students' Knowledge of Professionalism (Blue et al., 2009) consists of medical vignettes and multiple-choice questions measuring knowledge about subordinating self-interest, professional responsibility, managing complexity and uncertainty, professional commitment and humanism. The critical incident reflection method does not consist of multiple-choice questions, but rather asks the learner to reflect on a self-identified observed incident involving professionalism; it is dependent on the type of incident which aspect of professionalism knowledge is assessed (Baernstein & Fryer-Edwards, 2003; Rademacher et al., 2010). Keeping the reflection focused on *what is the best thing to do* ensures assessment of knowledge. All of these methods can assess underlying knowledge of professionalism, but cannot assess what one might actually do in practice.

Assessment methods that align with the "knows how" level of Miller's pyramid attempt to predict how a learner will act in certain situations by measuring attitudes, personal attributes, and values. These are typically self-administered rating scales. There are several instruments with acceptable characteristics. The Jefferson scales (Veloski & Hojat, 2006) are designed to assess attitudes towards empathy, teamwork, and lifelong learning. Extensive research has been done with these scales that reveal high reliability and validity. The Groningen Reflection Ability Scale (Aukes et al., 2007) assesses skills related to self-reflection, empathetic reflection, and reflective communication. The Penn State College of Medicine Professionalism Questionnaire (Blackall et al., 2007) measures seven factors of professionalism: altruism, duty, enrichment, equity, honor and integrity, and respect. Additionally, reflections on critical incidents that are focused on *what would you do and why* or *what could have been done* can assess attitudes or values. The "knows how" methods highlight professionalism as an interpersonal process or effect where professional behavior grows out the individual's attitudes and problem-solving skills within particular learning and practice contexts (Norcini et al., 2016).

Simulation and workplace-based observation methods of assessment of professionalism align with the "shows how" level of Miller's pyramid. Both methods involve the learner being observed during either simulated or actual patient-care situations. A common simulation involves the use of standardized patients (SPs), actors who are given scripts and trained to play the role of the patient. Using a simulated patient rating scale, several studies have found SPs to be reliable and valid means of assessing certain aspects of professionalism such as honor, integrity, abuse of power, respect for patients (van Zanten et al., 2005) and compassion, responsibility, integrity (Klamen & Williams, 2006). SPs are often incorporated within an objective structured clinical examination (OSCE) (Mazor et al., 2007). Other simulation techniques include high-fidelity human-patient simulators and virtual reality, both of which encourage the learner to try new techniques with immediate feedback; these are best used for formative assessment.

The mini-Clinical Evaluation Exercise (CEX) is the most common assessment of professional behavior observed during a clinical encounter in an actual patient-care setting. Following the clinical encounter, an observer completes a structured rating form and offers feedback to the learner. The original mini-CEX asks for a global rating of humanistic qualities and professionalism, but is mostly focused on other clinical skills. The Professionalism Mini-Evaluation Exercise (P-MEX) was created to assess four discrete areas of professionalism: doctor-patient relationship skills, reflective skills, time management, and interprofessional relationship skills. Other direct observation tools exist, such as the Standardized Direct Observation Assessment Tool used in emergency medicine (Shayne et al., 2006), but both the mini-CEX and P-MEX have demonstrated the best reliability and validity evidence.

Regardless of the “shows how” method used, there is research evidence to suggest that learner performance is case- or patient-specific (Norcini et al., 2016). For example, how one behaves with one patient or team may not necessarily relate to interactions with a different patient or team. Multiple observations over time are needed for accurate assessment. With simulations, this is usually done by students rotating through multiple SP encounters or OSCE stations. With workplace-based assessments, learners are observed during multiple patient encounters over time and by multiple assessors. Simulation has the advantage of assessing unusual encounters with no potential harm to patients, which may be most helpful for learners at the beginning of their training. However, simulations are resource intensive and require adequate space, equipment, and personnel. Workplace-based assessments have high fidelity and are less resource intensive, but require adequate training and buy-in of the assessors.

At the highest level of Miller’s pyramid is “does” which represents how one behaves as a healthcare provider. Methods to assess this level include collated ratings by supervisors, peers, and coworkers, opinions of patients, and tracking incidents of unprofessional behavior. Multisource feedback or 360° evaluations involve gathering data from multiple stakeholders, including supervisors, nurses, allied health professionals, clerical staff, and others one frequently works with in the clinical setting. There can be issues with peer assessment such as moderate inter-rater reliability, high intercorrelations across items, and halo effects (Arnold, 2002), but these can be mitigated by using rating forms restricted to observable behaviors, obtaining a wide range of data both in numbers (to increase reliability) and types of colleagues (to increase validity), and gathering data anonymously (Arnold, 2002; Norcini et al., 2016).

A global rating by a supervisor is often used to provide assessment results to a learner in both the UME and GME setting. When this summary view is reported on a form with predefined criteria and is based on data gathered over time from multiple assessors and/or assessments, it functions like multisource feedback. Examples of such forms include the Evaluation of Professional Behavior in General Practice (EPRO-GP) (de Haes et al., 2001; van de Camp et al., 2006) and the Amsterdam Attitudes and Communication Scale (de Haes et al., 2001; van de Camp et al., 2006). However, many institutions create their own global rating forms aligned to institutional values and competencies. To increase reliability and validity, only include observable behaviors on the rating form, include specific descriptions for each rating point, use multiple raters, and conduct observations over time. Faculty development is needed to train all assessors how to use the form and to come to a shared understanding of how professionalism is defined and exemplified at the institution. Sharing the form with learners can help to set expectations. The examples presented above are used in the clinical setting; however, peer, self, and supervisor assessment are also used in the pre-clinical years, often associated with student professionalism behavior in problem-based learning (PBL) groups.

The multisource feedback approach is a useful method for assessing behaviors that might be concealed within a formal assessment, but the process can be labor intensive. Technology can provide opportunities to facilitate gathering data in real-time and also in making the definition of professionalism and its components more explicit to faculty and students. Cendán et al. (2017) found that using the mobile platform PROMOBES (Professional Mobile Monitoring of Behaviors) helped faculty to provide feedback in context and record observations in real time, realize the benefit of having multiple observers provide feedback over time, and gain a better understanding of the framework for professionalism assessment.

Patient opinions are routinely captured in many healthcare systems, and sometimes included in 360° evaluations. Patient surveys usually measure more than just professionalism, but most contain items related to respect and communication. Specific surveys focused on areas of professionalism include the Royal College of Physicians' Patient Questionnaire that focuses on interpersonal skills, communications skills and professionalism (Mackillop et al., 2006), the Humanism Scale that measures patients' perceptions of their family physician's level of humanism (Hauck et al., 1990), and the Wake Forest Physician Trust Scheme (Hall et al., 2002) that contains items focused on fidelity, competence, honesty and confidentiality. While patients are an important stakeholder, there is evidence that suggests patient-generated data have weak psychometric characteristics and a large number of evaluations are needed for robust assessment (Donnon et al., 2014).

Incidents of observed unprofessional behavior are often tracked within medical schools and healthcare systems. An overview group monitors reports to determine if a pattern of behavior is apparent and to decide if next steps are needed. Research has shown that reports of unprofessional behavior can predict future patterns of subsequent unprofessional behavior (Krupat et al., 2020). While these reports are helpful in identifying deficiencies, this method does not provide data about professionalism for the majority of learners.

Portfolios have the potential to assess professionalism as a developmental process. Learners can choose what to submit to their portfolio that demonstrates professional behavior. Portfolios also encourage reflective practice by including critical reflections on learners' behaviors, experiences, and insights over time. When paired with feedback from a faculty mentor, portfolios are a useful tool for formative assessment.

The assessment methods described above can identify lapses in professionalism, but action must be taken to remediate the behavior. Depending on the seriousness of the issue, there are several actions that occur. For many incidents, a meeting is enough of a wake-up call to change behavior. However, for more serious issues an individualized remediation plan is needed. The plan should list goals and expectations of the learner, administration, and institution with a clear timeframe, process for monitoring progress, and consequences of failure. Several therapeutic techniques can be used during the process, such as feedback interventions, motivational interviewing, and cognitive behavior therapy or taking a root cause analysis approach common within health care systems. Regardless of method, the plan should include identifying underlying causes of the behavior and providing feedback to the individual during the remediation process (Norcini et al., 2016).

Given that professionalism is multifaceted and there are multiple methods of assessment, each with its own strengths and weaknesses, a system of assessment is needed for professionalism. A single method is not sufficient to assess all aspects of professionalism across all contexts, to provide feedback for reflection, and to make decisions about whether learners are safe and competent (Goldie, 2013; Norcini et al., 2016). To help guide establishing a system of assessment see Table 15.1, which lists common professionalism assessment methods, along with typical uses, strengths, limitations, and tips for use across the curriculum. Professionalism is a process and should be assessed longitudinally using multiple methods to assess knowledge, attitudes, and behaviors throughout medical school, post-graduate training and beyond.

Future Work

As the definition of professionalism continues to evolve and intertwine with professional identity formation, future work is needed to improve the quality and validity of both teaching and assessment tools. Suggestions for future work include:

- Given the multitude of curricular and assessment tools available, consider adapting previously tested tools and tailoring them for specific purposes and settings throughout the educational continuum. Gather additional reliability and validity data on the assessment tools and evaluate the impacts of professionalism curriculum on real-life outcomes to add to the literature on best practices for assessment and instruction

Table 15.1 Uses, strengths, and limitations of professionalism assessment methods

Method	Uses	Strengths	Limitations	Tips
Multiple choice test	Measure cognitive knowledge Summative Assessment	Can achieve high reliability and validity Low cost Easy scoring	Knowledge does not always relate to behavior	Follow guidelines for good test construction
Reflections	Measure cognitive knowledge, attitudes, and/or feelings	Promotes reflection Learner-centered	Subjective Rater biases Focus varies by learner Knowledge, attitude, and values do not always relate to behavior	Use qualitative codebook or rubric to guide scoring Reflection focused on *what is the best thing to do* measure cognitive knowledge Reflections focused on *what would you do and why* measure attitudes, values, and feelings
Self-administered rating scales	Measure attitudes, values and/or feelings	Low cost Promotes reflection	Reliability and validity varies	Choose a highly researched scale with acceptable reliability and validity evidence Conduct validation study if adapting existing scale to a new context
Standardized patients (SPs)	Measure behaviors and/or skills	Realistic yet safe Provides feedback to learners	Resource intensive Case/patient specific	Combine with structured checklists to increase reliability
OSCEs	Measure behaviors and/or skills	Can be focused on desired educational outcomes	Can be perceived as artificial Resource intensive	Include multiple stations and assessors and combine with structured checklists to increase reliability
High-fidelity/virtual reality simulation	Formative assessment	Realistic yet safe Promotes trial and error with feedback	Artificial experience Emotional/social distance	Include debriefing sessions to provide feedback to learners
Workplace-based direct Observation	Measure behaviors and/or skills	First-hand data Provides feedback to learners Authentic High-validity	Rater biases Inter/intra rater reliability Time intensive	Combine with structured checklists and provide rater training to increase reliability

(continued)

Table 15.1 (continued)

Method	Uses	Strengths	Limitations	Tips
Multi-source feedback (360 evaluation)	Measure behaviors and/or skills	Can assess skills and behaviors that could be concealed within a formal assessment	Leniency bias/halo effects Interrater reliability	Gather data anonymously Obtain data from a large number and many types of colleagues
Patient surveys	Measures behaviors	Provides data from "direct customer"	Low validity	Gather data from a large number of patients
Global observer rating	Measure behaviors and/or skills Formative assessment with feedback	High validity	Inter/intra rater reliability Time intensive Halo effects/subjective bias	Provide rater training to increase reliability Only include observable behaviors on rating form Include specific descriptors for each rating point Use multiple raters and conduct observations over time Share rating form with learners to indicate expectations
Records of incidents of unprofessional behavior	Identify need for remediation	Can predict future professionalism lapses	Cannot provide data on all learners	Use committee to monitor reports and intervene with next steps when needed
Portfolios	Formative assessment Reflective practice	Comprehensive Actively involves learner Promotes reflection Fosters development of learning plans	Time intensive Requires faculty to give ongoing feedback	Include reflection on attitudes and behaviors over time Pair learners with a faculty mentor and use portfolio content to stimulate discussion and feedback

- Further research is needed on how best to capitalize on the use of portfolios that include reflection in all stages of professionalism assessment (knows, knows how, shows how, and does) and professional identity formation. This approach allows for timely assessment with consistent feedback longitudinally throughout the curriculum
- Little research has been done on aggregating or weighting results of multiple assessments. This is important in a system of assessment where different aspects of professionalism are assessed in different ways over time and by multiple assessors

- Frye et al. (2020) encourage us to further examine how professionalism education addresses the issue of racism in medicine and in society at large

Summary

Faculty and administrators need to carefully evaluate what it is they hope to accomplish at their institution and the outcomes they wish to achieve in regards to professionalism. This will in turn guide the model, teaching approach, assessment strategy, and remediation strategy from the aforementioned array of options. Attainment of professional attitudes and behaviors is not a quick nor simple process, and takes a sustained commitment across multiple levels of development during medical student education as learners progress from undergraduates to residents.

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Chapter 16
Course Design

N. Kevin Krane and Jennifer W. Gibson

Abstract Courses are organizational units of content delivered over a period of time in a curriculum. In medical education, courses are created to meet institutional and accreditation needs and are often multidisciplinary and varied in length. This chapter will discuss the principles of overall course design, emphasizing the concept of backward design: outlining what learners should be able to do by the end of the course and then determining what they must learn in order to achieve the target levels of knowledge and performance. From this specification comes the course goals and objectives, which must be consistent with the institutional curricular goals and competencies. Learning resources and course pedagogy must be carefully chosen based on the defined outcomes and should support learner attainment of them. Finally, but equally important, is the selection of the appropriate assessment and feedback approaches to confirm that objectives have been met, and that learners have acquired the foundational knowledge and competencies to effectively and independently transfer these skills to the practice of medicine.

Introduction

Almost all fields of study have a curriculum that is comprised of a series of courses, where a course is defined as the designated unit taking place over a specific period of time in which learners are expected to achieve a set of educational goals and objectives. The Liaison Committee on Medical Education (LCME), the accrediting body for medical schools in the United States and Canada, requires that all schools have formal medical education program objectives that determine the selection of curricular content. Moreover, these standards dictate that the curriculum must contain content from the biomedical, behavioral, and socioeconomic sciences, and

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provide learners with sufficient opportunities to apply this content to individuals and populations. As long as these educational requirements are met, each medical school has the autonomy to determine how this content should be organized, taught, and assessed. While this organizational unit has traditionally been labeled a course, the terms module, block, and clerkship are also used, all referring to a designated learning sequence with specific goals and objectives. Medical school courses are also often designated as basic or clinical science, but almost all courses include content from both domains even if referred to as one or the other. For consistency, this chapter will use the term "course" to refer to the organizational unit that schools use to define or describe specific content, and will review best practices and principles involved in creating a medical school course, whether predominantly basic or clinical science.

Like all curricula leading to a degree, the medical school curriculum is designed as a set of courses that allow the future physician to (1) meet the institutional educational objectives of that school, (2) meet all standards set by the accreditation agency, and (3) be prepared for their individual postgraduate residency programs. Therefore, while the organization of content may vary among medical schools, each school must demonstrate that their graduates have the requisite knowledge, skills, and attitudes to be successful in residency. In contrast to undergraduate education where the curriculum may consist of courses taught independently, the medical school curriculum is expected to integrate content both vertically and horizontally. Professional educators, many of whom have acquired specialized training in educational fundamentals, contribute to the development and delivery of the curriculum, often teaching alongside physicians and scientists. While some medical schools still have individual courses run by either a single faculty member or faculty in only one department, curriculum content is more typically delivered to learners as multidisciplinary or integrated courses, commonly called blocks or modules, with many faculty and departments contributing to both content and teaching. This integration of content across multiple disciplines has transformed the traditional discipline-based approach into one in which courses are organized around one or more biologic systems (e.g., the cardiovascular system) and which are often taught by faculty from both basic and clinical science departments. Regardless of how the content is organized, a course still refers to an ordered progression of material dealing with a particular subject. In the medical school setting, this can be as specific as gross anatomy or as general as the renal system. A survey of the AAMC's Curriculum Inventory showed that while the majority of medical schools use a systems-based approach to organize courses, many courses remain discipline-based, with a few schools organizing courses primarily by patient presentation or symptoms (AAMC, 2020). Content may be offered in discrete time units such as 3 weeks or 3 months, or may be delivered longitudinally across an entire academic year. Moreover, the instructional focus has changed from teaching, where the instructor conveys the basic facts of a discipline, to learning, where the instructor's primary role is to guide learning and foster long-term understanding rather than rote memorization. Regardless of how the content is organized or labeled, it is these organizational units, the ‘courses,’ which remain the fundamental building blocks of each medical school’s curriculum.

Thomas et al. (2016) described a six-step approach to the medical school curriculum that begins with problem identification and needs assessment. In the context of a course, this involves not only identifying what learners need to learn, but more importantly, what learners are expected to do with the content. Content delivery should involve a decreased emphasis on factual knowledge and memorization and a greater focus on long-term understanding and the development of appropriate behaviors and skills (competencies) critical to the practice of medicine. These competencies or outcomes are based on defined goals and objectives, educational strategies focused on appropriate pedagogy and implementation, and finally assessment, both formative and summative. The remainder of this chapter will use Thomas and Kern’s framework to outline how to design a medical school course.

Initial Considerations

Accredited medical schools must demonstrate compliance with their accreditation organizations’ standards. Thus, for LCME-accredited medical schools, it is essential that the educational standards relating to curricular content and management are factored into the course design process. LCME Standard 8, Curricular Management, Evaluation, and Enhancement, specifies that the medical school curriculum must have a set of formally adopted medical education program objectives that serve to guide the selection of curriculum content (LCME, 2020), guidance that is appropriate for any medical courses. Therefore, before course planning begins, consideration must be given to the school’s educational program objectives – the overarching objectives that specify the competencies expected of all learners graduating from that institution. Within medical education, program objectives are typically written as competencies or observable skills/abilities that learners are expected to master by the end of the MD program. Specific competency domains fundamental to the practice of medicine have been identified by organizations such as the Institute of Medicine (IOM), Accreditation Council for Graduate Medical Education (ACGME), Royal College of Physicians and Surgeons of Canada, and the Association of American Medical Colleges (AAMC). Many schools have either adopted or adapted these pre-defined competencies to fit the core values/mission of their institution.

When creating a new course, it is important that a school’s program objectives/competencies guide course design. While a specific course or curricular segment may not address all or even most of the institutional program objectives, it is necessary to review and determine institutional gaps in knowledge/skills (needs assessment) and to situate the new course within this context in order to meet program goals. For example, if a goal of a multi-disciplinary longitudinal course on the introduction to clinical medicine is for learners to develop communication skills to effectively interact with patients from varied social and cultural backgrounds, this goal would serve to direct the needs assessment for the course.

Goals and Objectives – The Building Blocks

Undergraduate medical education programs must provide a carefully choreographed sequence of courses (organized learning activities) wherein the goals of each course inform the sequence of learning for the overall curriculum. This approach emphasizes the importance of working backwards. Once there is a clear understanding of the accreditation requirements and the school's program objectives, "backward design" allows for purposeful design of the new course and ensures its fit within the overall educational mission of the school. Wiggins and McTighe (2005) emphasize that backward design involves a three-stage approach: (1) identifying the desired results; (2) determining the acceptable evidence; and (3) planning learning and instruction accordingly. In the first stage, the course goals, purpose, and expectations for learning are defined. What is the intent of the course? What should learners know and be able to do at course completion? How do these course goals explicitly align with the medical education program objectives? Course outcomes should focus not only on medical knowledge but also other competency domains where applicable, such as professionalism and communication skills. While goals are broad statements of the overall outcomes, objectives are specific statements that set the learning priorities and provide a roadmap of where the learning is headed. They are learner-centered, specific, and measurable (rather than broad and intangible), and give clear criteria for achievement (Mager, 1962). Thus, the learning objectives will function as stepping stones to meeting the overall course goals, and will ultimately inform the content, instructional methods, and assessment techniques.

To develop the objectives for a new course one must consider five key elements organized around the learner and what they are expected to do with the content (Thomas et al., 2016):

1. Who
2. Will do
3. How much (or how well)
4. Of what
5. By when

These five elements must be clearly articulated, using action verbs that not only describe the expected performance, but also the criterion for success. Bloom's taxonomy (Bloom, 1956), a hierarchical ordering of cognitive skills, can serve as a useful tool to guide the creation and classification of objectives and can help ensure that the objectives encompass all relevant learning domains. This hierarchy is depicted in Fig. 16.1 and consists of six levels of increasing difficulty or depth representing the following cognitive domains:

Ultimately, the goal is to create a well-written and manageable set of learning objectives that align with the course goals, map to the competencies outlined in the medical education program objectives, and drive the selection of content, instructional methods, and assessment techniques. The creation of these objectives may require the participation of faculty across multiple departments, particularly in

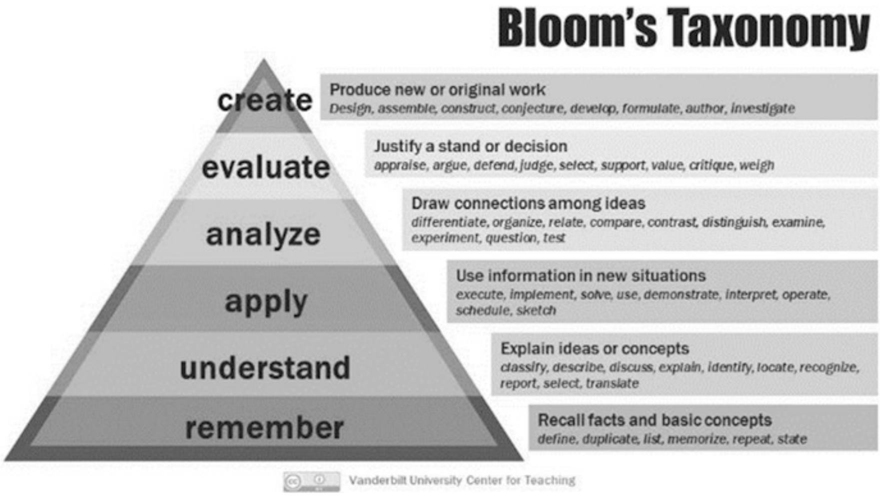

Fig. 16.1 Bloom's Taxonomy (Vanderbilt Center for Teaching, licensed under CC BY 2.0)

medical education where courses are often multi-disciplinary. Everyone must embrace the course goals to ensure that all faculty are teaching to a common goal. For example, goals and objectives developed for a multidisciplinary course on cardiovascular disease should include a basic understanding of physiologic principles, relevant clinical skills, and principles of communication and professionalism important in the prevention of cardiovascular disease. Every course objective should map to an institutional program objective for the overall medical school curriculum; if it cannot, it should not represent a course objective.

Ensuring a Course Is Coordinated and Coherent

Courses in health professions education differ significantly from those in undergraduate education; therefore, there are different considerations when identifying content and learning resources for medical school courses. In undergraduate education, learners typically complete a series of courses taught by individual course directors who work independently in designing and implementing a program of study. Medical school courses not only have course directors, but often co-directors, particularly for multidisciplinary courses where the course director(s) is coordinating a team of faculty from multiple departments. These faculty join institutions because of their specific expertise in either basic or clinical science, and teaching is often viewed as a secondary activity. Over the last 30 years, there has been some shift in this paradigm, as schools have begun to place greater emphasis on faculty development and reward, and advanced degrees specific to health profession education have become available (Irby & O'Sullivan, 2018). More importantly, medical schools are now recruiting faculty, particularly basic science educators, with advanced educational skills in addition to their content expertise. In most new medical schools, this challenge is being addressed by organizing teaching faculty into one centrally governed administrative unit. Nonetheless, many course directors, particularly in clinical courses, e.g., clerkships, rely on full-time and part-time clinical faculty, most of whom do not have backgrounds in educational principles or theory, for learner training. Furthermore, because these clinical faculty have significant pressures to meet the demands of research and practice activities, ensuring that they have the protected time to fulfill their teaching responsibilities is critical (Schiekirka-Schwake et al., 2017; Abrahamson, 1996). Given these potential obstacles, course directors must be grounded in the educational principles necessary to guide and lead a diverse group of faculty and must also have the protected time and administrative support needed to be effective in their role. Providing faculty development to ensure that all faculty are able to meet the expected pedagogy is essential.

Given the challenges of running a course that is often multidisciplinary and taught by both basic and clinical science faculty from different departments, it is imperative that the course director set clear expectations. Once the course goals and objectives are established, the course director can then determine the practical elements necessary for learning as well as the appropriate pedagogy. Pedagogy includes the course content or design, instructional methods, and assessment techniques, and should be grounded in the principles of adult learning theory. Objectives often contain many elements that go beyond the traditional expectations of knowledge acquisition, frequently incorporating skills required for lifelong learning and collaborative care. Thus, the pedagogy should incorporate opportunities for learners to achieve behavioral objectives (e.g., collaborative and/or team skills), by utilizing instructional activities that require demonstration of these abilities (e.g., problem-based learning and team-based learning).

For multidisciplinary courses, determining content requires input from faculty members as a team. Content should be integrated across all disciplines and must take into account learners' prior knowledge and how this knowledge will be used in subsequent courses. For example, in an interdisciplinary course in pulmonary disease, learners' prior knowledge of pulmonary physiology and anatomy must be considered. Time would then be allotted for the development of the clinical skills necessary to learn and apply this material in preparing for an internal medicine clerkship.

Providing Learning Resources

Based on the course objectives and content, the appropriate level and types of learning resources must be made available to learners. Learning resources can be any materials that help learners and faculty achieve the course objectives. Print materials have traditionally been the standard for learning resources, with textbooks serving as the primary resource; however, journal articles and other didactic materials can be used as well. The ability to deliver all print materials online has dramatically enhanced access to these resources. The increasing accessibility of educational technology has led to the availability of an extensive array of open source or commercial online materials. As a result, learners often seek or purchase their own educational materials and resources, including online content from other schools, presentations from YouTube™ and other videos, and commercial products specifically designed to help them prepare for licensing exams. Therefore, it is particularly important for the course director to be aware of and review the most commonly used resources, even if not recommended, to provide the best guidance to learners in achieving objectives. In addition to the use of external resources, easy-to-use software now allows faculty to create their own video presentations, which can be prerecorded and/or created as a series of podcasts or "mini-lectures." Once the objectives and learning resources are established, class time should focus on helping learners apply knowledge so they can learn and retain material more effectively. This "flipped classroom" approach (Hew & Lo, 2018), discussed in Chap. 5, is an ideal way to achieve these instructional goals.

Structuring Course Learning Activities

According to LCME Standard 8, Element 8.1, the medical school curriculum must be both coherent and coordinated (LCME, 2020). This implies that content must be integrated, not only within modules or systems blocks each academic year (horizontal integration), but also across academic years (vertical integration). Thus, knowing the content of courses that both precede as well as follow a course will help ensure appropriate sequencing and scaffolding of information. For example, if learners in a family medicine clerkship are expected to know how to screen for prostate cancer, then the preclinical Genito-Urinary Module must ensure that learners learn the most current guidelines for using the prostate specific antigen (PSA), how to discuss the PSA guidelines with patients, and how to do a prostate exam. It is also important to select learning materials/activities that support attainment of the course objectives. Faculty should begin with basic, previously acquired knowledge and then introduce terms and topics that build on it. Learners should always know where the learning is headed, and daily sessions should be sequenced in a logical order so learners can make connections between prior learning and new learning. Additionally, while it is important to avoid unnecessary duplication, it is beneficial to revisit topics at varying levels of difficulty. Moreover, providing early opportunities for learners to receive feedback and demonstrate success is essential. In terms of content delivery, the ultimate goal is for learners to acquire knowledge, make sense of and construct meaning from that knowledge, and then transfer learning independently (Wiggins & McTighe, 2011). This goal must take into account the distinction between theories of learning and theories of teaching. While theories of learning deal with how an individual learns, theories of teaching describe how a teacher influences learning behavior (Gage, 1972, p. 73). Knowles et al. (2015) summarized many of the concepts necessary to understand adult learning theory and concluded that adult learning is “a process through which learners become aware of significant experiences” (p. 21). This is very important in medical education given the maturity of the learners, and requires incorporation of adult learning principles that build on preexisting experience to incorporate new knowledge and behaviors to achieve defined tasks. Both Bloom’s taxonomy and Miller’s pyramid provide these frameworks (Taylor & Hamdy, 2013). Using adult learning theory requires faculty to consider the backgrounds of the learners and the experiences they bring to the classroom. The teacher must address specific background information that will not only guide the course design but establish the ideal learning activities:

1. Who are the learners in the course? What prerequisite knowledge, skills, and attitudes do they have or need when the course begins?
2. How many learners will be in the course and at each session, and how will the design of the learning address the number of learners?
3. What is the venue in which the teaching will occur? Based on the venue, what type of learning methodologies are likely to be most effective for the content to be conveyed, for the level of learners, and for the type of physical space to be used?

Examples of specific course activities include problem-based learning (Chap. 9), team-based learning (Chap. 6), and lectures (Chaps. 4 and 5), all of which can be delivered virtually, either synchronously or asynchronously, or in-person, and are addressed in other chapters of this book. Regardless of the pedagogy chosen, these principles guide educators in maximizing learning to ensure achievement of both course and institutional educational objectives, whether the course consists of a single topic (physiology) or is a multidisciplinary unit of instruction.

Course Assessment

While assessment is often thought of as the final phase of the course design process, it is actually one of the earlier considerations in designing a course. Having utilized backward design and determined the goals and objectives, one must then develop an assessment plan that ensures these objectives have been met. Critical to the assessment process is choosing assessment methods that are appropriate for the specific course learning objectives and align directly to them. Accreditation standards dictate that medical schools use a variety of outcome measures to demonstrate learner achievement of course and institutional program objectives. Thus, while well-written multiple-choice questions can assess basic knowledge, other methods are better suited for assessing attitudinal and clinical skills. For example, if learners are expected to perform a basic prostate examination (patient care), communicate the role of prostate cancer screening to a patient (communication), and understand differences in the medical literature regarding the use of prostate screening tests (practice-based learning), they need to be able to demonstrate these skills in a real-world context. Appropriate assessment methods may include direct observation, evaluations by peers, patients, and other healthcare professionals, and techniques such as simulation and standardized patient interactions.

Assessments can be formative or summative; striking the right balance between the two is critical for learning and growth. Summative assessments, which typically occur at the end of a course or unit of learning, are used to determine mastery of the learning objectives and to guide decision-making regarding learner advancement. Formative assessments, in contrast, occur early and often, and provide learners with feedback regarding their current state of knowledge and skills. Formative assessments allow learners to gauge their progress towards course objectives and can encourage self-directed learning to address gaps in knowledge and skills (Konopasek et al., 2016). Moreover, formative assessment provides important feedback to teachers who can use performance data to make adjustments to instruction. While summative assessment (assessment *of* learning) is an important component of the assessment system, formative assessment (assessment *for* learning) is integral as well. By providing multiple opportunities for learners to apply their knowledge in real-world contexts, there is a greater likelihood that learners will show growth in skills and improvement in performance. A comprehensive discussion of assessment methods is included in Chaps. 13, 14 and 15.

Course Roadmap: The Syllabus

Once the course has been created, the course director(s) must set expectations for how learners will engage in the course, sharing this information through a presentation on the first day of class and in information posted online, sometimes in advance of the course. The information must be outlined in a comprehensive but concise reference document that provides a roadmap for the entire course. This roadmap, or syllabus, should include a course description, an outline of the course expectations, recommended and/or required resources, learning activities and schedule, resources, grading system, and assessment methods. Delineation of how the course objectives fulfill one or more of the institutional program competencies should also be provided, including how attainment of these outcomes will be determined (i.e., exams, clinical performance rating scales, objective structured clinical exams, etc.). Contact information for the course director(s), faculty, and key administrative staff should also be provided. Most institutions will require use of a standardized template to ensure appropriate coverage and inclusion of the aforementioned components, as well as key policies and procedures concerning attendance, inclusivity (Lyles & Bridges, 2017), academic integrity, and access to support services. For clinical courses, the syllabus should also include information regarding required clinical experiences, clinical sites/locations, as well as duty hour expectations and other relevant institutional policies. Ultimately, the syllabus serves as a complete reference guide for the learner. If constructed properly, the syllabus can also serve as an effective aid to learning.

Summary

In summary, this chapter has discussed the principles of overall course design, emphasizing the concept of backward design: outlining what should learners be able to do by the end of the course, and then determining what they must learn in order to achieve the target levels of knowledge and performance. The course design process is depicted in Fig. 16.2. The course goals and objectives are derived from stated expected outcomes, and must be consistent with the overall institutional goals and objectives. Learning resources must be identified, and the appropriate pedagogy must be determined. Finally, but equally important, appropriate assessment and feedback approaches must be selected. Each of these steps will be influenced by the resources available and often by institutional policies and politics as well. While these guiding principles provide an overview of medical course design, the course director and teaching faculty must maximize course effectiveness by taking into account the needs of the learners, the institution, and the profession, focusing the course design and methodology on the end results: the acquisition of foundational knowledge and competencies, and the ability to effectively and independently transfer these skills to the practice of medicine.

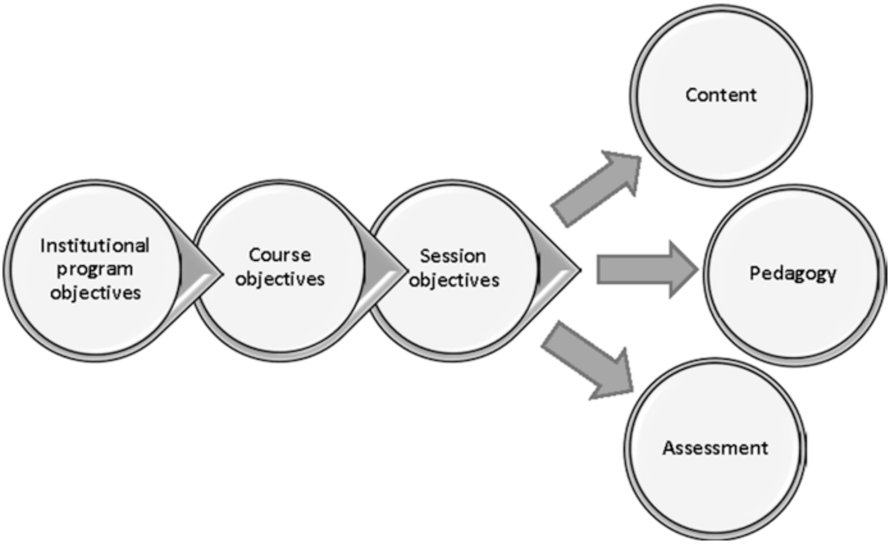

Fig. 16.2 Course design process

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Chapter 17
Distance Learning

Tracy Chapman

Abstract Since its inception in the late 1800s, distance education has continually evolved, incorporating new technologies and fine-tuning pedagogies, to reach students physically separated from the instructor. A small percentage of post-secondary students and instructors have experience with distance education therefore, planning and preparation specifically designed for teaching and learning at a distance are necessary. This chapter will discuss strategies for preparing instructors and students to engage in distance education. Additionally, the application of basic teaching principles and proven instructional design strategies adapted for distance education are described. The importance of thoughtful technology selection as well as regular and meaningful learner engagement are also addressed. Key considerations related to equity and inclusion in the distance learning environment are highlighted.

Introduction

Distance learning is far from a new concept. The University of Chicago established the first major program of correspondence education in the late 1800s. This new form of education was designed to increase access to education, to reach individuals outside of the elite class and those not able to afford full-time residential education. Although disparaged as inferior to traditional education, the country's emphasis on addressing equity in access to education drove the evolution of correspondence education throughout the decades to today's technology mediated, interactive, and media rich distance education models (Association for Educational Communications and Technology, 2001).

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Throughout this evolution, each new form of distance education was criticized; the quality of the education was questioned and doubt that students would actually learn was prevalent (Stella & Gnanam, 2004). However, evidence of the effectiveness of distance education is well documented. For example, the US Department of Education's meta-analysis of online education states, "…on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction" (Means et al., 2010, p. ix). Another example is findings by Allen et al. (2004) noting the use of distance education did not result in a reduction in educational effectiveness. However, the importance of attending to the factors necessary to ensure quality is recognized (Angolia & Pagliari, 2016).

This chapter builds on previous chapters and addresses factors underpinning quality distance education. Preparation of students and instructors for the distance education environment, the application of proven pedagogies and instructional practices, assessment and academic integrity, and equity and inclusion are discussed.

Definitions

Distance education has assumed many forms and has had many labels over the last few decades; distance education, online education, blended, hybrid, Massive Open Online Courses (MOOC), and the list goes on. Names and descriptions assigned to models of distance education vary by accreditation agency, by state education board, by Federal agency, by higher education institution, and by authors of publications. Given the myriad of definitions and the lack of consistency in definitions, it is no wonder faculty members are often suspicious of these new models. This lack of clarity also creates confusion about terminology and the implications for educational delivery and effective implementation. and implementation. After all, aren't we taught to be suspicious, or at least cautious of, information that appears to be inconsistent, even contradictory? The importance of definitional clarity is evident. For the purposes of this chapter the following definitions are used.

- Correspondence education means (1) Education provided through one or more courses by an institution under which the institution provides instructional materials, by mail or electronic transmission, including examinations on the materials, to students who are separated from the instructor. (2) Interaction between the instructor and the student is limited, is not regular and substantive, and is primarily initiated by the student. (3) Correspondence courses are typically self-paced. (4) Correspondence education is not distance education (US Department of Education. Accreditation in the United States, 2020).
- Distance education means education that uses one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students and the instructor, either synchronously or asynchronously (US Department of Education. Accreditation in the United States, 2020).

- Online education is often used synonymously with distance education. As noted in the definition of distance education, several technologies may be used to deliver distance education. For the purposes of this chapter, online education is defined as distance education which uses the Internet as the technology to deliver instruction and support regular and substantive interaction between the students and the instructor.
- A distance education course is a course in which the instructional content is delivered *exclusively* via distance education. Requirements for coming to campus for orientation, testing, or academic support services do not exclude a course from being classified as distance education (National Center for Educational Statistics, 2012).
- A distance education program is a program for which *all* the required coursework for program completion can be completed via distance education courses (National Center for Educational Statistics, 2012).

The rapid transition from classroom-based education in response to the spring 2020 COVID-19 pandemic resulted in additions to the litany of distance education terms including HyFlex education and remote education. HyFlex and remote education can be viewed as types of distance education as they use technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students and the instructor. However, these terms were used to distinguish courses hastily created during spring 2020 from distance education courses that existed prior to the pandemic and which provide thoughtfully constructed and facilitated education. Susan Grajek of Educause, the association of education technologists, described the spring 2020 use of remote learning as a "…quick, ad hoc, low-fidelity mitigation strategy" (Gardner, 2020). HyFlex is another new addition to the family of distance education terms. During the summer of 2020 faculty began to consider the likelihood of delivering fall 2020 classes in-person *and* via distance education to students not able to return to the physical classroom. HyFlex was coined as a new form of distance education, an "instructional approach that combines face-to-face (F2F) and online learning. Each class session and learning activity is offered in-person, synchronously online, and asynchronously online. Students can decide how to participate. The flexibility of the HyFlex model demonstrates a commitment to student success, and that flexibility can also enable institutions to maintain educational and research activities during a disruption" (Milman et al., 2020). Given the sustained growth and maturation of distance education (Seaman et al., 2018), this chapter focuses on distance education as defined by the US Department of Education, the use of one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction.

Making the Transition to Distance Education

Consider the years of experience faculty and students have with in-person education. The layout of a campus (a central mall area, buildings containing classrooms, administrative offices, dorms, etc.), the composition of thoughtfully designed buildings (classrooms, labs, offices, designed to facilitate traffic flow throughout the day), and the configuration of classrooms and labs for instruction and student engagement are familiar. Although we may not be familiar with a particular campus, building or classroom, we are familiar with how the environment "works." A student knows how to locate a building and classroom for each class; they know the norms for how a class will be conducted and for classroom behaviors (sit at a desk, instructor provides information and guidance, raise hand for a question, etc.). The distance education environment presents an unfamiliar environment for most faculty and students. The physical, emotional, psychological, and educational aspects are new and require different planning, skills, and strategies for faculty and students (Palloff & Pratt, 2007). Therefore, intentional and thoughtful preparation of faculty and students for the distance education space is warranted.

Readiness to Be a Distance Learner

Many, if not most, students lack experience in the distance education environment and they are likely unaware of how to engage in distance learning in a manner that positions them for success. Evaluation of students' readiness for distance learning provides instructors, advisors, and the students themselves important information about the areas in which a student is well prepared and those in which the student would benefit from additional preparation.

Evaluation of student readiness may involve fee-based, nationally normed evaluation tools such as the SmarterMeasure™ Learning Readiness Indicator, (Smarter Services, 2021) or evaluations created internally by a post-secondary institution such as that offered by the University of Arkansas Online. Distance education units, teaching and learning centers, and instructional design/technology offices often are good resources to identify strategies to assess student readiness for distance education. Evaluations typically ask students to respond to a series of Likert scale type items to discern an individual student's situation. Examples include:

- life factors and individual attributes such as time-management skills, tendency toward procrastination, persistence, willingness to ask for help, dedicated time and place to study, support network (family, friends) and perception of self-efficacy related to academic skills;
- student learning preferences such as visual, verbal, social, solitary, physical, logical and aural;
- on-screen reading rate and recall, typing speed and accuracy;

- technical competency and knowledge such as technology usage in daily life, technology vocabulary, ability to conduct basic troubleshooting; and
- personal computer specifications, daily access to a reliable, high speed Internet connection.

These evaluations are often automatically scored and results include recommendations to remediate areas of weakness. A review of students' results by advisors, student success specialists, or instructors identifies students warranting additional monitoring. Assessment of readiness for distance learning is particularly important for students with learning differences and those from economically disadvantaged backgrounds.

Although distance learning can be beneficial by providing students with anytime-anywhere access to learning materials, it can also be a disadvantage for students with learning differences as it may add another layer of stress and uncertainty. Students new to distance learning find themselves in an unfamiliar learning environment, one in which the predictability of a classroom setting (i.e., class occurs at the same time, same location, and works in a familiar way) is absent. The distance learning space may add to a student's anxiety and increase the time required to understand how to learn effectively. Additionally, accommodations to address learning differences may be unlike those used in the in-person classroom and may require more preparation time. The Course Design and Accessibility section of this chapter provides some specific recommendations and resources to address development of distance learning for students of all abilities.

Students from economically disadvantaged backgrounds may benefit from the additional flexibility afforded by distance education; however, these same students may encounter unique challenges with learning from a distance. Students from lower socioeconomic backgrounds are often time-poor (Delvin et al., 2012). They may be balancing financial pressures and part-time jobs with the demands of school. Add to this, the additional time requirements for learning how to be a distance student, becoming familiar with a new learning environment and new tools for learning. The importance of intentionality to assess and support student readiness is evident. Furthermore, consider the importance of daily access to reliable, high-speed internet connection for distance education courses. To manage expenses, students may be relying on a shared connection to the internet, such as in an apartment complex, a coffee shop, or a public library. Students may live in an area in which high-speed connectivity is simply not available, or is not reliable. Additionally, owning a late model computer with capabilities sufficient for accessing all electronic course resources may be a financial challenge. As the integration of distance education into medical education matures, continually reviewing and planning for technology to ensure it is inclusive and obtainable will become increasingly critical.

Instructional design principles and course planning recommendations discussed in this chapter address strategies for inclusive practices to support students from a variety of socioeconomic backgrounds and students with learning differences. Advance notification to students regarding course modality (distance education), requirements for computer functionality and internet connectivity, and support resources to prepare for learning at a distance are especially critical to help ensure success.

Instructor Preparation

Although faculty members teaching in a medical education program have at least two decades of experience as a student, the vast majority of this experience occurred sitting in a traditional classroom or in a traditional laboratory setting. It is safe to say, during their tenure as students, medical education faculty experienced good teaching and poor teaching. They know what helped them learn and what did not, they strive to emulate the teaching that worked well for them. However, very few faculty teaching in medical education have experience with distance education, being a distance learner or teaching a distance course; therefore, preparation for teaching in this environment is necessary.

The good news is that good teaching principles apply regardless of the modality. *Seven Principles of Good Practice for Undergraduate Education* is an often-cited summary of basic teaching principles by Chickering and Gameson (1987). Research of the application of these seven principles to the distance education environment resulted in an adaptation informed by adult learning theory (Sorensen & Baylen, 2009). The modified teaching principles include:

- student-teacher contact: distance education should include interaction between a student and instructor on a regular basis;
- cooperation among students: education is a social activity, distance education should include intentionally constructed opportunities for students to work together, doing so facilitates the learning process;
- active learning: students are active participants in the learning process, they engage in meaningful learning activities;
- prompt feedback: regular, timely, and specific guidance and feedback helps ensure students are on the right track in terms of meeting course learning objectives;
- time on task: students are provided assistance and guidance for managing their time in a distance learning environment;
- communicate high expectations, a principle based on the theory that when instructors communicate to their students about high expectations for the course, students will aim to meet these expectations; and
- respect diverse ways of learning: a variety of instructional strategies are necessary to meet the diverse needs of distance learners.

Faculty preparation for teaching at a distance typically addresses the application of these seven teaching principles to the distance education environment. Preparation for distance teaching is frequently delivered via a distance education seminar or workshop; faculty learn how to apply the seven principles while also experiencing what it is like to be a distance learner. Faculty preparation may also include pairing a faculty member with an instructional designer. Designers are typically master's-prepared staff members responsible for working with faculty members to apply "…instructional theories and models to design and develop content, experiences, and other solutions to support the acquisition of new knowledge or skills" (Association for Talent Development, 2020). The designer and faculty member collaborate to design the course for the distance environment. Faculty preparation often includes introduction to distance course design rubrics that guide the incorporation of the seven teaching principles into the development of a distance education course. Faculty without access to an instructional designer, or those seeking instructional design guidance beyond this chapter, may find Smith's (2014) Conquering the content: A blueprint for online course design and development useful.

Distance Course Design: Principles of Instructional Design

The term instructional design refers to "…the systematic and reflective process of translating the principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation." (Smith & Ragan, 1999). Faculty members have likely experienced good instructional design, they can recall a favorite teacher, one who was particularly effective in advancing learning. What made that teacher more effective than others, the use of proven methods for making instruction effective, good instructional design. The previous chapter, Course Design, discussed the key principles of overall course design with an emphasis on backward design. These same principles apply to the distance learning environment. However, implementation of these principles differs from the in-person classroom.

Over the last two decades distance education researchers and practitioners developed a body of knowledge focused on the application of instructional design principles to the distance education environment. Principles derived from this body of knowledge have been used to create distance course design rubrics. These peer-validated rubrics provide a framework to assist in the development of distance education courses. Widely employed rubrics include Quality Learning and Teaching (California State University-Chico, 2019), Course Design Rubric Standards (Quality Matters, n.d.), and the Open SUNY Course Quality Review (OSCQR) (Online Learning Consortium, n.d.). Key design principles commonly present in the distance course design rubrics are summarized in the following sections. These instructional design principles guide the implementation of the seven teaching principles for distance education noted by Sorensen and Baylen (2009).

Course Design and Layout Are Predictable and Easy to Navigate

Among the most important factors associated with a positive distance learning experience is a *predictable and consistent* course structure with clear expectations. The organization and structure of well-designed distance courses are intuitive and easy to navigate. A course overview lets students know how the course is structured, provides recommendations for navigating the course web site and for using the course materials. The course layout makes policies and course expectations easy to find. Easy-to-navigate distance courses are arranged by modules that may cover one or more concepts or themes. Modules should contain all the information – including links to all necessary readings/content and required tools, information about all required activities, and (if appropriate) the distinct learning outcomes of the given module – within the module structure. Modules (1) provide an organizing principle for the course (similar to instructional units or course segments in an on-ground course); (2) communicate the expected time/pacing of course instruction to learners (without the course meeting days/times of an on-ground course, it is important to provide learners with clear instructions about when new content/activities begin and end); and (3) create virtual "containers" for all the content and activities within a given unit of instruction (an important element of online course design as it facilitates learners' completion of required tasks within each unit of instruction).

In addition to the design and layout of an individual distance course, consistency across distance courses within a given year (e.g., M1, M2, M3 and M4) is important. Consider an M1 student with four courses using distance learning. If each instructor uses a different location to house instructional materials, different technologies for instruction and learning, and different ways to submit assignments, the student could easily be required to navigate, and keep track of, 12 technologies and resources, and therefore have less time to focus on learning. An agreed upon layout, set of technologies, and tools for assignment completion and submission results in fewer questions to instructors and more time for student learning.

Learning Outcomes Are Measurable and Specific

As with on-ground courses, distance courses should include measurable, specific student learning outcomes. As noted in the previous chapter, measurable course learning outcomes precisely describe what students are to gain from the educational experiences within a course. Measurable means that the learning can be observed or demonstrated through learners' work. Course-level learning outcomes should be clearly connected to the learning activities and assessments contained in the course. Learners benefit from explicit articulation of the relationship between course-level learning outcomes and course activities/assessments; providing this information will improve students' understanding of how the course content, assignments, and assessment help them achieve the course outcomes.

Course Learning Materials and Assignments Clearly Align with Learning Outcomes

The variety and ready access to digital learning resources makes it tempting to include more than is necessary in a distance learning course. Ensuring the course materials and assignments clearly contribute to the achievement of the stated course learning outcomes help prevent the addition of unnecessary materials and assignments. Optional resources and activities should be clearly identified as such. The backwards design process discussed in Chap. 16 can be used to ensure assignments are directly connected to a learning outcome. In addition to alignment with course outcomes, be careful to consider compliance with the copyright and intellectual property regulations of the country where the institution is located.

The advent of technology mediated distance education and increased use of digital learning materials highlighted the need for updating federal copyright regulations. The Technology, Education, and Copyright Harmonization (TEACH) Act was enacted to address the application of copyright regulations to distance education. The Act provides increased access to the use of copyrighted materials; in exchange, the TEACH Act requires academic institutions meet specific requirements for compliance (American Library Association, 2019). The TEACH Act language is somewhat vague and open to interpretation. A university librarian is typically responsible for interpretation of the Act; therefore you should contact library personnel to assist with ensuring copyright compliance under the TEACH Act.

Alignment of technologies to course outcomes within a distance education course is equally important as congruence between course materials and learning outcomes. The smorgasbord of readily available distance education technologies presents opportunities to create media-rich learning resources and to employ a variety of technologies to engage and educate students. However, remember to adhere to the backward design model when selecting technologies, starting with the end in mind. To help maintain the focus on supporting student learning, consider the following when selecting technologies.

- Learning outcome first, technology second. The rapid pace with which new technologies are available makes it challenging to stay focused on how a technology will advance student learning. Focus on the learning activity and outcome, then evaluate the technologies available to support the learning activity. Students collaborating on a project may benefit from using shared documents or a video discussion with a shared whiteboard. The application of a concept to a new situation may involve using an interactive simulation or problem-based learning module that tasks students with applying knowledge.
- Start small. The "small change approach" to adopting technology suggested by educational scholars Flower Darby and James Lang (2019) can help avoid faculty becoming overwhelmed by the tools and options at their disposal. This approach recommends instructors take a gradual approach to incorporation of technologies, and make minor modifications and adjustments as needed.

Consider, for example, the desire to replace text-based lectures or slide decks with high-quality video lectures. Start small by creating a few short, informal lectures, fine-tune the video production based on student feedback and your experience, and create a few more lectures and continue to fine-tune the process and the product.

- Predictability and consistency. Consistent use of a technology throughout a course and a given educational year (e.g., M1, M2, M3, M4) will optimize the time invested by students and instructors to become fluent with the technology. For example, M1 instructors agree on a single visual discussion and shared whiteboard technology to be used for small group project work. The technology becomes predictable, students and instructors become fluent with the available features, they know how to conduct basic troubleshooting, and become comfortable using more advanced features of the technology. Additionally, the consistent use of technologies across courses allows the school to provide students a comprehensive list of *required* technologies prior to the start of a term. Students can ensure their computer has the necessary requirements to run the technology and they are able to purchase any licenses or software necessary for the term. Furthermore, the cohesive planning helps the school in coordinating to assist students who may need help in acquiring the technologies. Also, students with learning differences can test the technologies required for each class, to work with the office of disability support to proactively address accommodations, and to be more prepared for the start of the semester.

Learner Engagement and Interaction Are Present Throughout the Course

Incorporating activities to promote interaction into the distance course motivates students and promotes learning. Distance courses should include *meaningful* learner engagement clearly designed to facilitate the learner's achievement of the stated outcomes. Avoid including "busy work," assignments that require interaction, but not explicitly connected to the student learning outcomes. Engagement should include learner-learner (e.g., small group projects, case-based learning, peer critique/feedback), learner-instructor (e.g., synchronous discussions, assignment submitted for instructor feedback), and learner-content engagement (e.g., assigned readings/media, reflections/journaling). The course should include clear information regarding the instructor's plan for response time and feedback on assignments. Frequent feedback from the instructor increases learners' sense of engagement in a course, and timely feedback on assignments promotes learning. Learners are better able to manage their engagement in a distance course when they know when to expect instructor feedback.

Students new to the distance education environment benefit from intentional, phased introduction to engaging with other distance learners. The Phases of

Table 17.1 Phases of engagement

Phase	Instructor role	student role	Process
Connect	Social negotiator	Newcomer	Activities are interactive and allow leaners to become acquainted. Instructor provides expectations for engagement, orientation to the course and keeps learners on track on a one-to-one basis.
Communicate	Structural engineer	Peer partner	Instructor forms student dyads and provides activities requiring critical thinking, reflection, and sharing of ideas.
Collaborate	Facilitator	Team member	Groups formed of three to *five* students, groups collaborate, solve problems, and reflect on experiences; also establish a group contract on group expectations, and determine final group project.
Co-facilitate	Community member/subject matter expert	Initiator/ partner	Activities are learner initiative or learner-led. Learners direct discussion and facilitate interaction. Projects are developed collaboratively with instructor guidance.
Continue	Supporter	Contemplator	Activities are focused on the transformation of the distance learner that has occurred as a result of the engagement activities.

Engagement introduced by Conrad and Donaldson (2012, p.11) are a proven framework for helping students learn how to effectively collaborate in the distance education environment. A summary is provided in Table 17.1; see Conrad and Donaldson (2012) for additional details regarding strategies for implementing the phases of engagement.

In addition to the facilitation of learning and student persistence, purposeful and regular interaction between students and the instructor is important to differentiate a distance course from a correspondence course. As noted earlier, the primary distinction between a distance course and a correspondence course is *regular and substantive interaction between students and instructors, initiated by the instructor* (US Department of Education, 2019–20, p.17).

Faculty new to distance education often ask how attendance is taken in a distance course. Attendance taking in the traditional sense is not well suited for the distance education environment. Most distance courses are asynchronous in nature, meaning they include regular student engagement and due dates for assignments throughout the course but the instructor and student are not interacting at the same time. However, federal regulations in the US do address attendance in distance education courses for the purposes of establishing eligibility for federal financial aid. These regulations require students to establish a record of participation in academically related activities. Specific requirements and documentation vary by institution. Consult your dean or chief academic officer to ensure compliance with institutional requirements.

Formative and Summative Assessment of Student Learning Is Included Throughout the Course

The M2 class is in session in Brouster Hall. Dr. Sully is lecturing and stops periodically to ask the students questions. Very few students respond to the questions, in fact students start to ask lots of their own questions about the concept being presented. Dr. Sully notices many students look confused and frustrated and she surmises that students are not understanding the concept. Instead of proceeding with the lecture, Dr. Sully continues discussing the current concept, providing examples and sample problems for students to work through together in class.

Learners need both formative assessments (in which the task and feedback on the task are meant to inform future work in the course) and summative assessments (in which learning is evaluated at the end of a module or a course). Assessment activities must be designed to provide a broad perspective on students' mastery of the content, but also allow individual students to evaluate their own learning throughout the course. Previous chapters in this book address assessment of knowledge, skills, attitudes, and behaviors. Although the acquisition of skills and attitudes is quite possible in the distance education environment, courses that focus on knowledge acquisition are most common. Therefore, this overview of assessment will focus on knowledge acquisition courses.

Assessment of knowledge within distance education courses can be accomplished through a variety of methods, similar to those used in traditional in-person courses. However, the absence of non-verbal cues in the distance classroom underscores the importance of providing students frequent opportunities to check their knowledge and confirm they understand the course concepts. Formative assessments, or knowledge checks, should be frequent and low-stakes. Examples of formative assessments or feedback in distance education include

- Quizzes that are automatically graded and include feedback with each answer choice
- Interactive games and simulations that have feedback built in
- Practice written assignments or problem sets with solutions provided
- Peer reviews and critiques
- Model papers or essays
- Sample answers or answer keys
- Required virtual meetings with the instructor to discuss progress in the course

As with on-ground courses, all course learning outcomes in distance courses should be assessed at some point during the course, though they may not all be assessed in the same way. Additionally, assessments should align with the level of learning outcome the assessment is designed to measure. For example, assessment of a learning outcome at the understanding level should require students to explain, interpret, or illustrate, not deduct, critique, or evaluate, which assess students' knowledge at the evaluation level. Effective course design depends upon assessments being consistent with stated outcomes.

Students' lack of experience with distance education may result in higher levels of anxiety, particularly regarding assessments and grades. Therefore, transparency about how learners' work will be evaluated is particularly important in distance education. Clear descriptions of the criteria to be used to evaluate students' work and participation in the course not only help alleviate student anxiety and stress, but also lead to fewer requests for clarification about assignments. Rubrics are particularly useful in distance education as they provide more detail about instructor expectations than is typically found in a course syllabus. Rubrics are beneficial to instructors and students as they "…promote consistency in scoring, encourage self-improvement and self-assessment, motivate learners to achieve the next level, provide timely feedback, and improve instruction" (Boateng et al., 2009, p.46). Rubrics typically have four parts: (1) description of the task, (2) the scale to be used, (3) the dimensions of the task, and (4) the description of each dimension on the scale (Stevens & Levi, 2013). Well-designed rubrics provide clearly stated descriptions of what is expected for an assignment. They describe high, average, and low levels of performance, thereby helping to ensure the students understand instructor expectations.

Faculty are often concerned about maintaining academic integrity, particularly for summative assessments when teaching distance education courses. How does the instructor know the student enrolled in the course is actually the student doing the work and completing the assignments? Promoting academic integrity can be addressed through the design of the learning environment and assessments as well as the use of technologies. *Best Practice Strategies to Promote Academic Integrity in Online Education* by WICHE Cooperative for Educational Technologies, University of Texas TeleCampus, and the Instructional Technology Council (2009) summarizes approaches to address academic integrity from the institutional, curricular, instructional, faculty, student, and assessment design perspectives. Table 17.2 provides a sampling of these strategies.

Table 17.2 Strategies to promote academic integrity in online education

Institutional context and commitment
Require student logins and password to access online courses and related resources
Exhibit an institutional commitment to academic integrity and support faculty and staff addressing issues of academic integrity
Regularly highlight the importance of academic integrity at student orientation programs and events
Curriculum and instruction
Include the academic integrity policy within the distance course
Include a lesson on avoiding plagiarism
Ask follow-up questions to assignments such as, "expand upon this statement you made," "tell me why you chose this phrase, description or reference," and "expand upon the ideas behind this reference."
Select one or two difficult concepts from the paper and ask the student to restate/rewrite the information.

(continued)

Table 17. 2 (continued)

Student support
Provide information and examples to help students understand the difference between collaboration on assignments and cheating
State how much collaboration is permissible on each assignment.
Indicate assessments may require follow-up documentation, questions or assignments
Faculty support
Incorporate academic integrity strategies into professional development
Publish guidelines for handling/reporting individual student infractions
Assign a department academic integrity liaison to support faculty
Assessment and evaluation
Provide rubrics, or detailed grading criteria, for every assignment at the beginning of the course so students understand how they will be graded
Provide training on the use of the settings in the learning management system to reduce cheating
Emphasize assignments that require written work and problem solving (e.g., essays, papers, online discussions)
Use a variety of assessment strategies (quizzes, short and long papers, test questions) that require the application of a theory or concept
Make assignments cumulative (students turn in parts of a project or paper throughout the semester)

Information About Learner Support Resources Is Readily Available

Providing distance education students clear descriptions of, and links to, support resources within the course allows students to spend more time focusing on learning activities and less time figuring out how to access support resources. Provide information about accessing technical, accessibility, academic services, student services support, policies, and frequently used points of contact to increase students' comfort level with the distance education environment and lessen their anxiety and time spent searching for this information. Providing this information also decreases the number of emails to instructors asking for assistance to connect with resource units. Clear and readily available information for accessing library resources from a distance is particularly important.

Course Design Addresses Accessibility

The Office of Civil Rights at the U.S. Department of Education defines accessible as "…a person with a disability is afforded the opportunity to acquire the same information, engage in the same interactions, and enjoy the same services as a person without a disability in an equally effective and equally integrated manner, with substantially equivalent ease of use" (Curry, 2020). Section 504 of the Rehabilitation

Act of 1973 (US Department of Education, Office of Civil Rights, 2020) and Web Content Accessibility Guidelines (Worldwide Web Consortium, 2018) address accessibility of web-based content, including distance learning resources. These guidelines are detailed and require a fair amount of expertise to implement in distance learning courses. Institutions typically provide training and resources for creating accessible distance learning materials. Instructional designers are good resources to assist faculty to ensure distance learning courses align with accessibility requirements. It is beyond the scope of this chapter to address the breadth and depth of design requirements to ensure distance education content is accessible. However, an overview of the basics of accessible distance learning is provided.

The University of Washington's Center on Accessible Distance Learning (AccessDL) is a valuable resource to guide the development of accessible distance learning courses and programs. The Center's list of 20 tips for teaching an accessible online course (University of Washington Center on Accessible Distance Learning, 2020) incorporates key guidelines from the Web Content Accessibility Guidelines and instructional design principles noted previously in this chapter. Examples include:

- Use clear and consistent layout for content
- Use text alternatives for images such that screen readers can describe the image
- Use descriptive wording for hypertext links to describe the link source
- Provide captions for audio and video content
- Use a small number of technologies and ensure they include accessibility features
- Provide adequate opportunities for practice, i.e., to apply new information
- Provide feedback frequently and on parts of assignments; offer corrective feedback

If you are creating distance courses visit the Center on Accessible Distance Learning to learn more about accessible design strategies. Also, consult instructional designers and your institution's office of disability services.

Summary

This chapter introduced some of the many facets of distance education. The blending of in-person and distance learning models continues to present new opportunities for leveraging the best of both types of education. Continual and accelerated advancement of technologies provides instructors with an ever-evolving toolbox from which to select resources for supporting student learning. However, educators must be vigilant to ensure selection of distance education tools and resources take into account evidence of advancing student learning, the diversity of students being served, and best practices. The maturing body of evidence-based literature helps guide the adoption of effective distance education strategies. As the literature continues to demonstrate, the basic principles of effective teaching remain the pillars of effective instruction, and therefore student learning. Those seeking more in-depth information about online teaching and learning may find The Online Teaching Survival Guide by Boettcher & Conrad (2016) or Teaching Online: A Practical Guide by Ko & Rossen (2017) beneficial.

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Chapter 18
Interprofessional Education (IPE)

Kelly Karpa

Abstract In this chapter, we discuss educational ideas that promote collaborative care through interprofessional education (IPE). IPE can use any educational pedagogy, provided that learners from different professions have opportunities to interact and learn from each other. Here, the aim is to maximize students' opportunities to learn about other professions, communicate effectively across professions, and function effectively as a member of a team – as opposed to necessarily focusing on specific "content." This chapter introduces the definition and basic tenets of IPE, discusses faculty development, provides examples of IPE across the educational continuum, and shares ways to assess learners and evaluate the effectiveness of your IPE endeavors.

Introduction

One of the most significant advancements in IPE occurred in 2010 when the "Framework for Action of Interprofessional Education and Collaborative Practice" publication was released by the World Health Organization (WHO). This document made a case for training health professions students differently – with IPE defined as educational settings in which "*students from two or more professions learn about, from and with each other to enable effective collaboration and improve health outcomes*" (WHO, 2010). In practice, team-based care is widely touted to improve outcomes, enhance the healthcare experience for patients, reduce healthcare costs, and decrease provider burnout. However, knowing one's role on a team, communicating effectively across professions, and working as an effective team member does not happen as soon as one graduates or receives a professional license. Thus, IPE is a means to address those concepts with health professions learners at the

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pre-licensure stage, in hopes of graduating a workforce that is collaborative practice-ready.

IPE Definition and Misconceptions

We certainly want to emphasize the definition of IPE as outlined by the WHO – that of bringing students from two or more professions together to learn with, from, and about each other to improve patient outcomes. Yet, due to misconceptions that surround IPE, it is also important to address what IPE is *not*.

IPE is *not* represented when a lecturer from one professional background (e.g., pharmacy) teaches a group of learners from a different profession (e.g., nursing students). IPE is also *not* occurring in a large lecture hall in which medical students, physician assistant students, and pharmacy students are jointly learning physiology together. In the first example, there is only one group of professional students represented, hence the definition of IPE is not met. In the second example, although learners from multiple professions are gathered together, there is little opportunity for learning with, from, and about each other, in a standard lecture hall setting. An additional common misconception is when IPE is said to be occurring when joint trainings or combined simulation scenarios are designed for medical residents representing different specialties (e.g., Departments of Surgery, Anesthesiology, Hepatology, Nephrology, etc.). While the benefits of joint training across specialties certainly has merit, it does not meet the definition of IPE since all individuals represent the same profession – that of medicine.

Principles of IPE

In the United States, it is common to use the core competencies established by the Interprofessional Education Collaborative (IPEC, 2016) as a guide for establishing IPE activities (Fig. 18.1).

Broadly speaking, the four core interprofessional competencies defined by IPEC are (IPEC, 2016):

- **Values/Ethics for Interprofessional Practice**: Work with individuals of other professions to maintain a climate of mutual respect and shared values.
- **Roles/Responsibilities**: Use the knowledge of one's own role and those of other professions to appropriately assess and address healthcare needs of patients and populations.
- **Interprofessional Communication**: Communicate with patients, families, communities, and other health professionals in a responsive and responsible manner that supports a team approach to maintain health and treat disease.

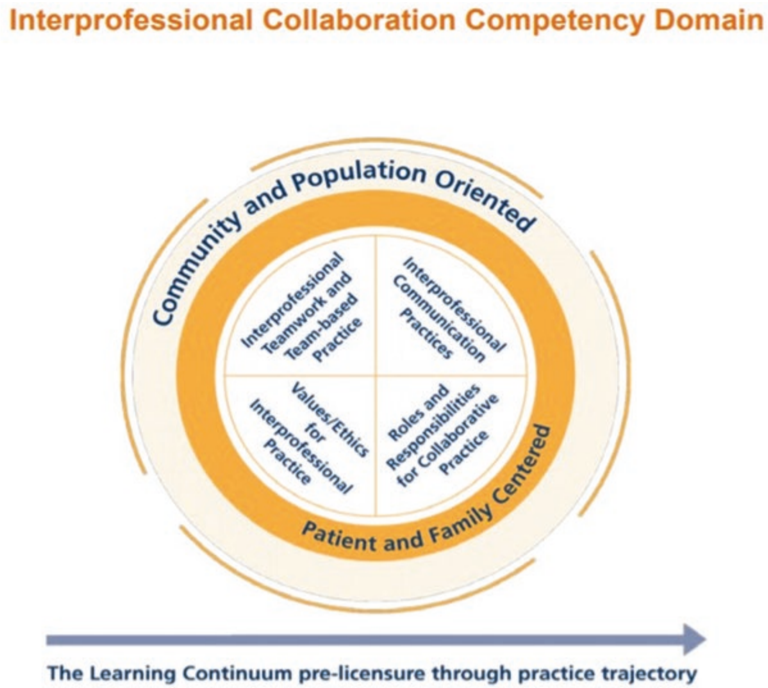

Fig. 18.1 The four primary interprofessional competencies across the learning continuum, as depicted by the Interprofessional Education Collaborative is reprinted with permission from the Association of American Medical Colleges

- **Teams and Teamwork**: Apply relationship-building values and the principles of team dynamics to perform effectively in different team roles to plan and deliver patient- and population-centered care that is safe, timely, efficient, effective, and equitable.

In addition to each broad competency category, each competency contains between eight and eleven sub-competencies that provide further details for ways that students can demonstrate collaborative practice readiness. Furthermore, from this figure, it is noteworthy that these competencies are suggested to represent a continuum of learning about interprofessional collaborative practice that begins prior to licensure but continues throughout training and into practice.

Some institutions have added additional core competencies to their specific IPE training programs. For example, one institution has added a fifth competency relating to intercultural humility. This competency is stated as: “Acquiring self-awareness and recognition of one’s own beliefs, biases, and behaviors that impact all aspects of team-based patient-centered care and population health, resulting in the ability to customize services when working with diverse individuals or populations” (personal communication, Frank Ascione, University of Michigan).

Getting Started with IPE

Using a backward design model (Wiggins & McTighe, 2006), planning of IPE endeavors is best accomplished by: (1) determining what interprofessional competencies students should demonstrate and (2) deciding how learners can best be assessed. Once armed with answers to these questions, instructors will be better prepared to move forward in developing instructional plans to design a learning experience that will best support the desired outcomes.

IPE activities can be classified in several different ways. For example, activities might be separated based on educational pedagogies used, intended outcomes, or even the IPE core competencies addressed by the endeavor. Given that interactivity is inherently required for IPE, common pedagogical approaches involve small group discussions, simulations, as well as point-of-care, authentic patient experiences. An instructor's intended outcomes will drive the type of IPE activity that will be best for each situation; the activity will differ depending upon whether the goal is to *expose* the learner to a different profession, *immerse* the learner in activities with another profession, have learners *integrate* concepts and behaviors interprofessionally, or have learners demonstrate mastery of interprofessional collaborative *practice* (El-Awaisi et al., 2016). When addressing IPE competencies such as interprofessional values and ethics or roles and responsibilities, outcomes associated with exposure and immersion may be appropriate. On the other hand, tackling interprofessional competencies of communication and teamwork may be better accomplished through integration and practice opportunities.

Exposure

IPE activities in the medical education preclinical curriculum might be initiated by ***exposing*** learners to other professions. This can reinforce to learners that there are a cadre of health professionals with whom they will eventually work, each with unique skill sets; yet, at the same time, while getting exposure to the uniqueness of different professions, it simultaneously becomes apparent to learners that there are many shared bodies of knowledge, skills, and values across the different health professions.

IPE exposure activities can take many forms. For example, one profession (and associated students) can allow early learners from another profession to shadow them. Allowing medical students to shadow a pharmacist (and pharmacy students) is one example. Students from one profession might have the ability to work alongside nurse care managers and social workers (along with nursing students and social work learners) as patient navigators. In addition to developing an understanding of the roles and responsibilities, knowledge base, and skill of these other professions, learners simultaneously see the many shared principles, morals, and ethics that exist across professions put into action (e.g., patient-centeredness, cost-conscious care, social justice, etc.).

Even in the absence of shadowing opportunities, small group discussions can be intentionally created for learners from different professions to discuss topics that are common across professions. Social justice inequalities or ethical dilemmas are perfect opportunities to bring learners from different professions together. Even extracurricular activities such as an outdoor game-day or scavenger hunt that intentionally put learners from different professions together on mixed teams can expose learners to new people, ideas, and ways of thinking.

Immersion

Immersive activities provide opportunities for interprofessional interactions as learners are developing their own professional identities. Students will be most receptive to this when engaged with other professional students around a relevant clinical problem that requires input from multiple professions. Interactions with others at this point in one's individual professional development allow learners to begin to incorporate a world view that also considers the perspectives of other members of the healthcare team.

Common IPE immersion activities include case scenario discussions that require a team approach to develop a plan for optimal patient outcomes. Students from different professions may also engage in joint service-learning or outreach projects. In these situations, interprofessional learners share background information with their team in terms of program-specific education and training (e.g., how many years in school, type of training and/or clinical exposure before graduation), as well as profession-specific knowledge (e.g., their professions' most likely *roles and responsibilities* regarding the patient's needs). Students often become aware of the **role overlap** that exists across professions for the first time (e.g., nutritional education; blood pressure screening; screening for cardiovascular risk factors and/or diabetes; immunizations) during immersive IPE encounters.

Integration

Integrative IPE activities tend to be most appropriate for more advanced learners. These activities force students to apply their knowledge, skills, and judgement while collaborating with other health professional students to make clinical decisions and solve problems (Pinto et al., 2018; Karpa et al., 2019). Such activities may involve simulations or student-led team meetings and are well suited for clinical scenarios that involve chronic disease management. Effective *communication* is a core interprofessional competency often assessed through integrative IPE activities.

Practice

Ideally, through existing partnerships with health systems and other organizations, students will have opportunities to demonstrate mastery in interprofessional **practice** by functioning as an effective *team* member, delivering collaborative care in daily life. Creating learning opportunities that allow students to demonstrate mastery in this area requires a high degree of intentionality. Interprofessional teaching clinics (Zaudke et al., 2016; Karpa, 2021), student-led free clinics (Lawrence et al., 2015), mission trips, and clerkships in specialty areas that require complex care delivered by a team are examples of ways that students can demonstrate they are collaborative-practice ready and able to function successfully as an effective team member.

Taken cumulatively, IPE activities ideally exist as a continuum, across training, via multiple different methods where students have ample opportunities for exposure, immersion, integration, and practice, while simultaneously demonstrating personal accomplishment of the IPE core competencies of shared values and ethics, roles and responsibilities, effective communication, and teamwork.

Identifying Learners

By definition, IPE requires learners from at least two different professions. Keep in mind, just because you *can* include a large number of professions in a single activity, does not mean that you *should*. It is generally advantageous to "start low and go slow," by engaging only a few professions initially. Typically, it makes the most sense to consider the professional students at your own institution before reaching out to other colleges that are geographically localized. Although, as will be discussed in detail later, geographical co-localization is no longer an absolute necessity. Using videoconferencing technology, my institution has held multiple IPE sessions over the past three years mimicking telehealth/telemedicine, in which health professional students, separated by great physical distances, connect with the rest of their IPE team remotely to discuss patient care plans (Karpa et al., 2019).

It is critically important to appropriately match the "level" of learners. For example, it may be perfectly reasonable in a simulation activity with a standardized patient to match a senior (soon-to-graduate) nursing student with a medical student who is just transitioning from pre-clinical to clinical training. In this situation, the medical student likely has had some "doctoring" coursework and has practiced taking a patient history and physical examination but has not directly worked with patients very often. In contrast, the nursing student will have completed hundreds of clinical hours with direct patient care experience and is able to effectively communicate and easily develop rapport with the patient. Together, these students can learn from each other; the medical students may learn from observing nursing students communicating and interacting confidently with the standardized patient, while the nursing students may learn about a particular physical examination skill from the medical student. On the other hand, a mismatched learning situation would quickly be evident if a soon-to-graduate medical student was paired with a first year nursing student who has not had any clinical opportunities. When learners are not appropriately leveled, one profession tends to dominate the encounter; this can inadvertently reinforce negative stereotypes and counteract the desired goal of learning with, from, and about each other.

When selecting student groups to engage in IPE, initial efforts should focus on professions that are most likely to naturally intersect in patient care (e.g., medical and nursing students). Over time, it may be advantageous for learners to be exposed to IPE situations that incorporate other professions that might be otherwise overlooked as members of the healthcare team, such as chaplain residents (e.g., role on "brain attack" teams), dental hygiene (to achieve oral health competencies), or law students (medical legal partnerships). Similarly, it may be worthwhile to create learning opportunities where students see several different aspects of another profession highlighted (e.g., contrasting roles of physical therapy in sports medicine rehabilitation *versus* acute stroke rehabilitation).

Before embarking on novel IPE activities, if possible, aim to garner positive student feedback and buzz around the concept of collaborative care by highlighting areas where students from different professions already work collaboratively (e.g., short-term mission trips, rural underserved populations, service-learning projects, etc.). Positive vibes and momentum from these experiences can be capitalized upon as IPE activities are developed, expanded, and incorporated into formal curricula.

Identifying and Developing Faculty Facilitators

New IPE initiatives require investment in terms of both personnel and time to train faculty. Individuals who recognize the value of teamwork in their own practices, have linkages to an active practice site, have time available to commit, and who are able to influence academic priorities and resources within their own units, are ideal IPE faculty champions (Brashers et al., 2015). Additional considerations might include facilitator knowledge of contemporary teaching and learning methods, prior experience with facilitation, as well as knowledge of team dynamics and conflict resolution.

It is important to note that the majority of today's faculty lack formal training with IPE. Thus, they need systematic education about the principles of IPE, learning activities, desired learning outcomes, effective facilitation skills, debriefing strategies, and assessment expectations to build their own confidence as they take on a new role. Emphasis should focus on their need to create a psychologically safe space for learning and the importance of facilitating positive interactions between learners. Additionally, IPE facilitators should be prepared for being a part of, rather than a leader of, a community of inquiry -- as they, too, will be learners, in their facilitation role (Evans et al., 2020). To the extent possible, recruiting experienced facilitators from university and practice settings that represent the student professions involved in the activity provides advantages; faculty can contribute their own examples and experiences to small group discussions to reinforce learning points. Just like learners prefer small group interactive learning, trainers of IPE facilitators have found that faculty prefer professional development activities that engage them in hands-on learning, too (Hall & Zierler, 2015). Exposing faculty to the same activities that learners will participate in can work especially well during faculty development training.

As you plan each IPE activity, a goal should be for each small group of interprofessional learners to have, at a minimum, one faculty facilitator assigned to the group; however, two co-facilitators, representing different professions, is preferable. When partnering facilitators, a successful strategy often results when partnering individuals from complementary backgrounds; for example, those with educational expertise might be partnered with experienced clinicians to build linkages between education and practice. Alternatively, novice facilitators may be paired with experienced facilitators for mentorship and development purposes (Shrader et al., 2016).

As facilitators receive advanced training, it is imperative to help them understand their role, as it will likely be different than typical uniprofessional activities they may have grown accustomed to facilitating. In this regard, they will need instruction about specific goals and objectives of the IPE event and detailed instruction for how the IPE competencies fit into the learning session. Rarely will faculty's role in an IPE facilitation be to deliver didactic "content." Instead, facilitators will support students' understanding and collaboration of teamwork in healthcare by helping students synthesize the learning/experiences that occur during the IPE encounter, highlighting similarities and differences between professions; correcting misconceptions and resolving miscommunications; and translating struggles into learning opportunities. All IPE activities should have ample time included for debriefing, where facilitators help learners draw connections between their IPE experience and collaborative practice. Additionally, time should be built into the end of IPE encounters for shared reflections where learners can summarize what they did well, indicate what they would like to improve, and share how their learning differed as a result of an IPE activity versus completing the same activity in a uniprofessional environment. Providing facilitators with detailed guides that outline logistics, timing, debriefing questions, assessment expectations, and pearls of wisdom can help to standardize the experience across all groups of learners.

Creating Scenarios

A challenge that exists for all programs involved in IPE activities is identifying curricular, calendar, and physical time and space for events to occur. Solutions to these challenges are institution-dependent; some schools have set aside a specific day/time for IPE; other schools host IPE activities in evenings; still other institutions have resorted to IPE events held on weekends. Some programs utilize remote learning platforms where possible to decrease "drive time" between campuses and universities. Others have added asynchronous learning components that allow team members to contribute when schedules permit.

Once logistical solutions have been addressed, development of the content and activity planning can commence. It is imperative to include all professions on the development team. Creating educational content and delivery should be collaborative, reflect shared-decision making, and highlight unique contributions of each profession. Joint planning builds trust and accountability into the IPE leadership team. On the other hand, activities that have already been ongoing with one profession and are retrofit for the purpose of artificially including another group of learners, may not be well-received by learners or their faculty.

Ideally, IPE activities will align with clinical priorities and will be fully integrated as core curricular components for all professions involved (as opposed to a "volunteer" activity for one or more groups of learners). Some institutions have developed foundational IPE programming that is a universal and a required curricular component for all health professions students at the institution. These experiences can improve knowledge, skills, and attitudes regarding interprofessional collaborative practice.

For sustainability, not only should IPE activities be mapped to objectives for each professions' curricula, but it is also common for session objectives of a specific IPE activity to be mapped to corresponding IPEC sub-competencies. Tracking the IPEC sub-competencies prevents unintentional over-targeting of some competencies while neglecting others and improves accountability when demonstrating compliance with accreditation requirements (Willgerodt et al., 2015).

As IPE activities are developed, content of a particular session can be approached explicitly, in which topics related to interprofessional collaboration are the sole focus, or can be implicit in which another topic appears as the focus (e.g., comprehensive geriatric assessment), while students are simultaneously learning interprofessional competencies.

Common topics that are well suited to IPE are those that represent meaningful clinical problems that are shared across professions. Examples include: ethical dilemmas, geriatric care, and chronic disease management (e.g., Alzheimer's disease) or management of complex situations (e.g., sepsis). Institutional, state, or federal priority areas (e.g., oral health, opioid crisis, intercultural competencies/sensitivity) as well as areas pertaining to quality improvement, patient safety (TeamSTEPPS at https://www.ahrq.gov/teamstepps/index.html), or error disclosure are also commonly selected themes for IPE activities, as these often align with institutional goals. Ultimately, the pedagogical approach that will best accomplish the desired goals and objectives (e.g., case-based learning, team-based learning, problem based learning, simulation, point-of-care experiential learning, etc.) should be selected.

Learners need clear ground rules established in advance. It should be plainly stated that all participants' contributions are valuable, everyone is expected to contribute, and everyone should be treated with respect. Often, instead of having learners meet each other for the first time at an event where they are immediately tasked with working together as a team, it is preferable to provide deliberate opportunities for students to think about session objectives, content, and initiate communication and relationship building *prior* to the IPE event. This can be accomplished using course management systems to share pre-session assignments that encourage introductions and prompt problem-solving or advanced planning for a scenario. Many online resources, often built within course management systems, promote written and/or audiovisual discussion boards to facilitate communication and collaboration between learners remotely and asynchronously prior to in-person events. Faculty facilitators should engage in these online discussion board activities, too, as their participation lends legitimacy to the activity and encourages student buy-in and engagement.

Applicability of IPE activities to clinical practice should be readily apparent to students to garner their engagement. Simulated IPE experiences can build student confidence and lessen anxiety when practicing procedural skills and handling instruments (e.g., surgery, obstetrical deliveries), as well as stimulate interest in collaborating with and learning more about individuals from other professions. Thus, IPE can be used as a mechanism to teach overlapping clinical skills to learners from different professions (Kumar et al., 2018).

Unsurprisingly, students are most responsive to IPE experiences in which they are working collaboratively with other learners at the point of authentic patient care, as opposed to classroom or simulated scenarios. In some circumstances, small teams of interprofessional learners have provided value-added services in hospital or community practice settings – even serving as resources for over-stretched providers. These experiences can take on many different formats but do require *deliberate* planning to facilitate interprofessional learning, as opposed to relying on opportunistic learning that *may* (or may not) take place in a practice environment. Internationally, there are several examples of *team-based interprofessional practice placements* (TIPPs) in which entire training wards have been converted for students to achieve both uniprofessional and interprofessional outcomes, simultaneously strengthening formation of professional identity at the same time as developing collaborative practice skills (Brewer and Barr, 2016). *Intentional co-teaching* with an interprofessional colleague may be a more viable goal than TIPPs for many programs. Co-teaching can be operationalized in clinical settings, where students have "on-the-job" learning about another profession and scope of practice. Having learners "huddle" in advance of seeing patients permits time for information sharing before they speak with and examine the patient and process their individual and collective assessments; post-encounter "huddles" give students opportunities to develop joint care plans. Cooperative note-writing can help learners synthesize and reflect upon their interprofessional experiences (Karpa, 2021).

Assessment and Feedback

Assessments and feedback can be individualized to each student on an interprofessional team or can focus on team performance and interactions. Depending upon the IPE activity, rubrics should be developed and implemented that align with the learning goals of the event. Feedback for individual learners can be solicited from multiple sources including facilitators, standardized patients, and peers. Students can also apply the same feedback rubric to themselves, providing a critical opportunity for self-reflection. Cumulatively, these pieces of information can become part of each individual student's professional portfolio and can track students' experiences and interprofessional behaviors across a continuum. When discrepancies exist between students' self-reflection and observations/perceptions by others, personal introspection can be insightful to account for the differences.

Additionally, team-based assessments may be completed by team members, a facilitator, a standardized patient, or authentic patients. Even patient feedback, when received in this manner, is perceived as non-threatening to students, which can increase their confidence, reduce anxiety, and be translated into actionable changes in subsequent patient encounters (Lie et al., 2016).

Evaluation/Utilizing Feedback

End-of-session evaluations that formally appraise the value and worth of an IPE activity provide valuable feedback to local stakeholders and can be used to disseminate information to others. Many validated instruments have been designed to assess students' attitudes or behaviors towards interprofessional practice (Lockeman et al., 2017). Mixed methods, using quantitative and qualitative feedback, are recommended to best understand not only the "what" but also the "why" behind learners' responses. This information tells faculty what worked well, as well as areas that need improvement. Learners should also be given opportunities to provide feedback about the skill and professionalism of facilitators.

Depending upon the details of the educational scenario, knowledge can be assessed to check for learning of specific content. Students' enjoyment of an activity and knowledge gained are often said to be "low hanging fruit" on the Kirkpatrick pyramid (Jamieson et al., 2019) of curriculum evaluation. Behavioral changes and demonstration of positive outcomes for patients or healthcare teams are more difficult to achieve, yet can be accomplished by thoughtful design of activity and evaluation methods (De Jesus et al., 2020). It is generally these higher order learning outcomes that administrators wish to see to prove the value of IPE.

Feedback from IPE sessions should also solicit information from faculty facilitators. At my institution, in addition to real-time feedback submitted immediately following each IPE session from all facilitators, we also have a structured debrief with key stakeholders. This occurs several weeks after IPE events once all the feedback has been compiled and reviewed. These are critical opportunities for considering the strengths and weaknesses of an IPE endeavor and enable modifications and improvements to be planned for future iterations.

Barriers/Opportunities: Sudden Conversion to Online IPE Activities

The spring of 2020 brought both challenges and opportunities to IPE, as COVID-19 spread around the globe. Using video-conferencing technology (ZOOM; http://zoom.us), coupled with our learning management system and Google Docs (https://www.google.com/docs), we were able to continue providing learners with interactive and meaningful IPE experiences designed around developing care plans for de-identified inpatient and outpatient scenarios – despite individuals being scattered across the country and team members lacking geographical proximity.

Case Discussions and Simulations

Briefly, several different activities followed the same format: the learning management system contained student rosters for each team, learning objectives, a journal article for pre-reading, and introductory chart notes. Students were instructed to familiarize themselves with these materials in advance.

At a designated day and time, large numbers of interprofessional students joined a single ZOOM meeting. Administrative assistants had pre-assigned each student to a breakout room, such that students were "dismissed" to their correct small group during the appropriate times, as part of the larger ZOOM meeting. During introductory remarks delivered by a faculty member, administrative assistants worked behind-the-scenes to verify that each student and facilitator was, in fact, in attendance and assigned to their proper breakout room. During the introduction, the large group of students (e.g., n ~ 155) were kept engaged using the features within the ZOOM platform including: the chat function, various non-verbal options within the participants' window, annotation, and polling (Karpa, 2021).

When it was time for small group work, the course management system "released" additional chart notes/patient information on a just-in-time basis, the students and facilitators were "sent" to their breakout rooms (small groups), and each team completed a team-specific Google document template guiding their care plan development.

Depending upon the activity, some sessions had just two breakout group sessions, whereas other IPE activities had as many as five breakout activities. Similarly, depending upon the activity and task to be completed, students were in breakout rooms for as little as 10 minutes or as long as 30 minutes. After each breakout room's activities were completed, all students returned to the large group for debriefing.

Authentic Patient Care

Using secure web-conferencing technology in accordance with HIPAA-compliant standards, we also successfully held interprofessional teaching clinics (IPTC) via virtual visits with authentic patients (Karpa, 2021). Students representing different professions and faculty/staff participated in the calls. We found breakout rooms useful for having pre-brief huddles, as well as mid-session teaching sessions with just students and faculty. During the students' encounter with the patient in the "large" group, we found that having faculty mute microphones and disengage their webcams provided students with autonomy as they engaged with the patient. Based upon information gleaned from the patient, interprofessional teams of students developed ideas for the patient's care (e.g., laboratory tests that need to be ordered or followed-up, medication changes, therapy services recommendations, etc.) and jointly wrote an interprofessional note to the patient's primary care provider highlighting the team's ideas and recommendations for consideration.

Lessons Learned

Breakout room functions inherent to some web-conferencing technology platforms are ideal for mimicking and re-creating small groups for IPE activities, as well as hosting "hallway" conversations between faculty and learners, reminiscent of direct patient care environments.

In IPE, it has historically been challenging to have at least one learner from each profession represented on each team. For example, at a university with 150 medical students but only seven chaplain trainees, it has been our experience that only a few small groups of IPE learners would have a chaplain resident. However, when teaching IPE remotely, the sky is the limit in terms of geographic locations from which trainees can be pulled. No longer are IPE groups limited to learners within a single institution or a confined geographical location. The door is now open to include learners not otherwise able to engage with in-person IPE activities. Virtual learning also opens the possibility of creating balanced teams of learners. In a recent IPE activity conducted remotely, we included learners that were physically located more than 1000 miles apart.

No Need to Reinvent the Wheel

Many resources already exist that can be re-purposed for your specific IPE needs. For example, the Association of American Medical Colleges' *MedEd Portal* is an open-access journal, indexed in Medline, that publishes educational materials that have been successfully implemented with learners (https://www.mededportal.org/). *MedEd Portal* publications are peer-reviewed, stand-alone, complete instructional materials that are made available specifically for other academicians to use. *MedEd Portal* contains many simulations that may be a useful starting point for creating your interactive sessions. Furthermore, many IPE-specific resources already exist within *MedEd Portal* that could be tailored to your specific situation. Other journals such as the *Journal of Interprofessional Care* or the *Journal of Interprofessional Education and Practice* are excellent resources to gauge what others are doing in the realm of IPE and collaborative practice and can provide new ideas for expanding your own initiatives.

Another resource for you to explore when getting started with IPE is the National Center for Interprofessional Practice and Education's website (https://nexusipe.org/). One of the most useful aspects of this site is the wide range of assessment and evaluation measurement tools that are available, most of which have been previously validated for utility in specific situations.

Networking with others is a fantastic way to learn what is already happening in the field of IPE and can help you develop new ideas and possibly even new collaborations. You can leverage what others have done previously and apply it to your specific goals. For example, around the United States there are many regional consortia that you can tap into such as the Yakima Valley Interprofessional Practice and Education Collaborative in the Pacific Northwest (https://www.pnwu.edu/inside-pnwu/academic-partnerships/yvipec) comprised of a steering committee with representatives from five different institutions and health programs, or the Northeast/Central Pennsylvania Interprofessional Education Coalition (NECPA/IPEC) consisting of faculty members from eleven different colleges and universities. Examine the resources that exist in your own location and see how you and your learners can take advantage of existing collaborations.

In addition to local networking, there are also national and international meetings dedicated to advancing interprofessional education and collaborative practice. In North America, the annual Nexus Summit, hosted by the National Center for Interprofessional Practice and Education, is held in Minneapolis, Minnesota. The National Center for Interprofessional Practice and Education is a public-private partnership that is committed to studying and advancing the way stakeholders in healthcare work and learn together. This center was founded with support from organizations that promote interprofessional education and practice such as the Josiah Macy Jr. Foundation, the Robert Wood Johnson Foundation, the Gordon and Betty Moore Foundation, and the United States Health and Human Services Administration. Depending upon alignment between the goals and interests of these organizations and your own interprofessional education and practice endeavors, such organizations could be explored as sources of grant support for your institution's projects.

The Collaborating Across Borders biennial meeting also provides a fantastic venue where educators, clinicians, researchers, policy makers and students from both sides of the United States and Canadian borders explore common issues around interprofessional education and practice. This conference series is held every other year and meetings alternate between the United States and Canada.

Joining a professional organization dedicated to advancing interprofessional education and practice is another way to expand your network of interprofessional colleagues and ideas. The American Interprofessional Health Collaborative (AIHC) is one such organization that offers opportunities to connect with others, share experiences, and drive healthcare changes. New members may benefit from the AIHC mentor-mentee program or get involved by serving on various committees (e.g., membership, communication, scholarship, or programming). Internationally, the Global Confederation for Interprofessional Education and Collaborative Practice (https://interprofessional.global/) is an organization dedicated to advancing IPE and collaborative practice that holds All Together Better Health meetings at different locations around the globe during alternating years.

Summary

Overall, building connections and improving interactions among students, prior to professional licensure, is a mechanism that will positively shape collaborative care among future healthcare professionals. Thus, exposure to interprofessional teammates, early and often during training, may lead to sustained changes in attitudes, behaviors, and outcomes that will improve patient care once students become licensed professionals.

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Further Reading

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CAIPE – Centre for the Advancement of Interprofessional Education – www.caipe.org.uk

CIHC – Canadian Interprofessional Health Collaborative – https://interprofessional.global/canada/

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Chapter 19
Teaching to Develop Scientific Engagement in Medical Students

Belinda W. C. Ommering, Aviad Haramati, and Peter G. M. de Jong

Abstract Scientific engagement refers to an individual's attitude towards science and a specific way of thinking that is characterized by involvement, commitment, dedication, and passion. It is important that we train scientifically-minded students who are capable of understanding, appraising and applying the research of others into their future health care positions as well as conducting research in a clinical environment. This chapter elaborates on the meaning and importance of scientific engagement among medical students, and the role of fostering scientific curiosity in order to stimulate scientific engagement. Additionally, some suggestions for how teachers can stimulate scientific engagement are provided. To conclude, three case studies of approaches that offer research experience to medical students aimed at increasing their scientific engagement are presented.

What Is Scientific Engagement?

Scientific engagement refers to an individual's attitude towards science and a specific way of thinking that is characterized by involvement, commitment, dedication, and passion. Scientific engagement should not be confused with scientific skills. Skills are technical abilities that can be taught, practiced, and assessed to determine if the student has mastered them. Examples are performing statistical analyses or conducting laboratory procedures. Scientific engagement, however, is something different and relies strongly on curiosity about science. A student with excellent technical scientific skills but minimal engagement may lack the passion to become a dedicated research scientist or devoted science educator.

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Scientific engagement is something that can be modeled, internalized, practiced, and developed to a certain extent, depending on the personal characteristics of the individual. The reality is that many incoming medical students have limited or no experience with scientific work, only a vague concept of the world of research, and possibly, significant misperceptions of what constitutes scientific research. Yet, medicine has its foundation in the scientific method and new information is discovered and reported at an astounding rate. Treatments evolve and become refined as more information becomes available. Since the quality of health care is dependent on scientific advances, it is worth the effort to expose students to this way of thinking and working, to offer them the exciting opportunity to not only get acquainted with science, but to get enthused by it, and to stimulate scientific engagement in their future professional practice.

Why Is Scientific Engagement Important for a Medical Student?

Physicians and other health care professionals must confront the increasingly rapid production of new knowledge in the sciences fundamental to medicine (AAMC-HHMI report, 2009). It is difficult to stay abreast of these new advancements in post-graduate education programs; doctors themselves struggle to keep up-to-date in their own field of expertise. Physicians are expected to find, appraise and understand new information from scientific publications. Every physician should practice evidence-informed decision making, by integrating the newly gathered information and best available evidence in their clinical decision making. In this way, physicians also contribute to the process of life-long learning. Furthermore, physicians should be able to identify problems and questions in daily clinical practice to be translated into research (Ommering & Dekker, 2017). While every physician needs to have the ability to *use* research, society also needs physicians that *conduct* research (Richardson et al., 2014) to advance the health of the public. Such clinician-scientists devote a substantial amount of their time to both research and clinical duties (Sklar, 2017). They are needed to connect bench to bedside, thereby bridging the translational gap between scientific research and medical practice (DeLuca et al., 2016; Harding et al., 2017).

Medical education should aim to deliver scientifically engaged graduates with the ability to use research in their future practice, some of whom are motivated to conduct research as well. In line with this, Vandiver & Walsh (2010) propose that medical students need to understand and must learn to conduct scientific research in order to appraise experimental results when they become physicians. Another view has been expressed by Ludmerer (2010), who posited that a medical diagnosis and a researcher's hypothesis are very much similar: both must be critically tested on their value.

Therefore, we need to not only teach scientific knowledge and skills, but also train our students to be curious and critical. Engaging students in conducting research results in academically minded graduates who are capable of understanding and appraising research of others, subsequently integrating scientific discoveries into their future professional practice. Moreover, some of these graduates might even be stimulated to pursue a clinician-scientist career (Lawson McLean et al., 2013; Ommering & Dekker, 2017; Ommering et al., 2019a, b).

What Is It Exactly That We Want to Teach?

When we talk about fostering critical attitude, scientific curiosity and habit of mind, we are sure that many medical educators understand what we mean. However, it turns out to be very difficult to define exactly what it is that students must learn in order to achieve the scientific engagement we are advocating. We can delineate three aspects that should be kept in mind when teaching in this area (Fig. 19.1).

Stimulation of Curiosity and an Inquiring Mind In a research context, curiosity is the basis of scientific research and endeavor. It influences motivation for research and thereby contributes to continued scientific engagement (Amgad et al., 2015; Ommering et al., 2018; Ommering et al., 2019b). In several studies, curiosity scored high among attributes that graduates should possess, as judged not only by experts but also by students and patients (Laidlaw et al., 2012; Rabinowitz et al., 2004). Once students discover, through experience, that actively searching for new knowledge in science can lead to enormous progress in health care, they will become more curious and motivated for research (Ommering et al., 2020).

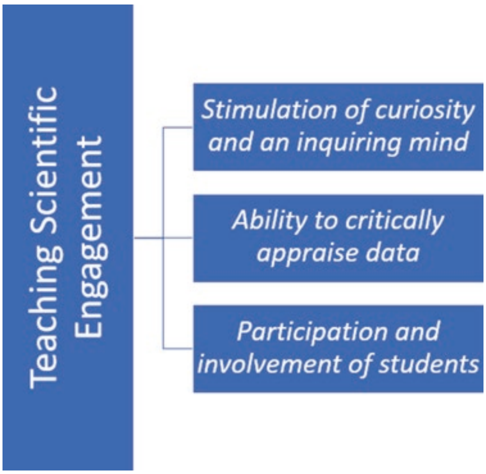


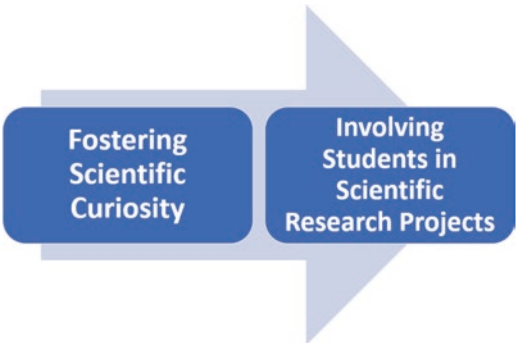
Fig. 19.1 Three aspects in teaching scientific engagement

Ability to Critically Appraise Data This competency is generally recognized as essential for medical students and physicians (Laidlaw et al., 2012; Ommering & Dekker, 2017; Richardson et al., 2014). It is extremely important that a physician can analyze and critically evaluate data that are presented by others in the literature, or received in the form of laboratory results. This is especially relevant when students discover that the data presented sometimes differ from presented conclusions, it will stimulate them to become more critical. As students enter the academic world with a tendency to accept as fact everything they read, it is beneficial to make students aware of exemplars involving academic uncertainty or multiple probable perspectives, as this contributes to a critical mindset and the ability to critically appraise scientific literature and data (Ommering et al., 2019a, b).

Participation and Involvement of Students As soon as students get involved, whether in pursuing answers to questions that they raise in class, or by participating in an actual research project, they will become more engaged in science. Engaging students in science is not something to talk about in curricular committees, but rather something that should occur every day in the classroom or lecture hall. It is something that must be experienced, even in early phases of medical education. Experiencing what research entails, what it is to actually conduct research, and becoming aware of the possible impact and importance of research for health care, may stimulate students to become motivated, curious, and critical individuals (Ommering et al., 2020), thereby benefiting future medical practice by their scientific engagement as physicians.

In summary, developing scientific engagement in students can be divided into two important steps as shown in Fig. 19.2 *Fostering Scientific Curiosity* and *Involving Students in Scientific Research Projects*. In the following sections, we wish to elaborate on these steps in more detail.

Fig. 19.2 Steps in student engagement



The First Step in Student Engagement: Fostering Scientific Curiosity

Many of our students have come to expect that in most learning settings in medical school, especially in the biomedical science courses, faculty transmit information to the students. Though in the recent years many active learning formats emerged, students still have the expectation to receive complete, annotated handouts, distributed sets of PowerPoint™ slides, audio and video capture of the sessions, all in the hope that the pertinent "facts" have appeared somewhere for the student to internalize and prepare to regurgitate on the examination. Quite a few of our faculty actually believe that is their role, as well. And yet, does the amassing of facts constitute "education"? What about understanding and application?

Lambert et al. (2010) very clearly articulated the goals of science education in medical school: "*…to provide students with a broad, solid foundation applicable to medicine, a deep understanding of the scientific method, and the attitudes and skills needed to apply new knowledge to patient care throughout their careers.*" How do the students get a "solid foundation" and what constitutes "deep understanding?" To answer these questions, it is helpful to consider what Regehr and Norman (1996) wrote, *"True understanding […] is defined not simply by the quantity of information a person possesses, but by the extent to which this information is organized into a coherent, mutually supportive network of concepts and examples."* In other words, the ability to use scientific information and apply scientific reasoning and principles reflects true understanding of science, ultimately leading to evidence-informed decision making in future medical practice.

To that end, in many institutions the teaching of science has moved to incorporating case-based teaching in the form of, among others, problem-based learning (Chap. 9) or team-based learning (Chap. 6). However, the essence here is not the method itself, but the approach. In each instance, students are asked to work with their peers and develop questions and learning issues after reviewing a particular case or considering a set of laboratory values. In other words, they are faced with getting beyond facts to the key questions and gaps in their knowledge, stimulating inquiry. This we believe fosters scientific curiosity: the recognition that there is a puzzle to be solved, information to be searched, and not simply delivered to them. The student has the opportunity to solve the problem by seeking the answer, as opposed to having the facts before the question has appeared.

The importance of scientific curiosity was underscored by Dyche and Epstein: *"Medical educators should balance the teaching of facts, techniques and protocols with approaches that help students cultivate and sustain curiosity and wonder in the context-rich often ambiguous world of clinical medicine"* (Dyche & Epstein, 2011). A second aspect, that Dyche and Epstein allude to, is the notion that biomedical science is not always clear and exact; it can be ambiguous and uncertain. There are limitations to our current knowledge, which sets the stage for student engagement in pursuing new knowledge. But the first step is to be curious, something that requires some planning and patience on the part of the teacher.

Curiosity can be stimulated among medical students by using relevant clinical examples involving patients (Ommering et al., 2019a, b). Here, uncovering real-world problems and eliciting emotion are key as this especially triggers curiosity (Prober & Heath, 2012). Furthermore, curiosity can be fostered by challenging students to ask questions and be critical. However, to be successful, the environment must be psychologically safe, and optimally conducive to learning and exploring. Typically, in a large lecture hall, students are reluctant to answer a question in front of hundreds of students for fear of being wrong or even humiliated. However, the instructor can ensure that the class setting is psychologically safe by creating an atmosphere that welcomes diverse views and encourages students to voice them. By emphasizing that the answers students provide are in fact "hypothesis testing," which may merit further exploration, the teacher can create an inviting and respectful learning environment. Further, instead of stating that an answer is "correct" or "incorrect", the teacher might follow on the student's response by asking "what made you think that"? This way the discussion centers on the line of thought more than being right or wrong.

The Second Step in Student Engagement: How to Involve Students in Scientific Research Projects?

Once their curiosity has been stimulated, students will be motivated to seek answers, sometimes by engaging in new scientific research projects. This leads to the second step of student engagement: the independent research project. To be successful in completing an independent research project, students need to learn fundamental research competencies and we need to train them in the process of scientific, critical, inquisitive, and analytical thinking. The way this scientific training is incorporated in the curriculum differs from country to country and from institution to institution (Jenkins et al., 2003). In some medical schools, scientific research is a mandatory part of the core undergraduate curriculum, while in many schools training in this field is offered as an elective (Chang & Ramnanan, 2015; Wolfson et al., 2017). However, when taking the reasons for scientifically engaging medical students into account, it seems imperative to offer integrated research programs, provided to all students. This not only complies to current higher education policies striving for inclusiveness, but is also needed in order to deliver graduates with an academic mindset and the ability to perform evidence-based medicine and possibly conduct research. Therefore, every student could benefit from opportunities to practice research skills by performing real research projects and to be challenged by scientifically exploring medicine. This reflects a learning-by-doing approach, which is in line with the emerging notion that we must strive towards a transition from research-informed education, characterized by viewing students as passive consumers of research knowledge, to research-based education, where actively involving students in conducting research is a key component (Ommering et al., 2019a, b).

It is known that active and authentic learning approaches are more effective in mastering skills than passive ways (Vandiver & Walsh, 2010; Lazonder & Harmsen, 2016). In fact, passive learning approaches are related to a decrease in curiosity among students (Walkington et al., 2011). After a curriculum change, implementing a course in which every first-year student conducts a research project individually, Vereijken et al. (2018) compared cohorts before and after the curriculum change on student learning outcomes, perceptions, and motivation. Their findings implied that the course had a positive effect on student learning outcomes regarding, for instance, writing research reports. Furthermore, positive effects were found regarding students' perceptions of research integration and motivation. Ommering et al. (2020) reported that engaging students in research during early phases of medical training results in a broader perspective of research and its connection to patient care. Another study suggested that authentic aspects within a course in which students actually conduct research are key, as the findings imply that it is the experience of and grade for presenting own research that is most strongly related to increasing intrinsic motivation for research and research self-efficacy beliefs (Ommering et al., 2021). In turn, intrinsic motivation is related to students pursuing further research involvement (Ommering et al., 2019b).

We believe that innovative ways of teaching, in which students take on the roles of researchers, are valuable and ought to be adopted to foster scientific engagement in our students. Creating opportunities for all students to pursue scientific research in the undergraduate medical curriculum promotes enthusiasm for scientific research and scientific engagement of the students. A possible parameter to measure this effect is the number of publications after graduation. Several studies show that students do publish their work, and that those who experienced active and authentic scientific research in an early stage of the curriculum tend to have a higher publication rate after graduation (van Eyk et al., 2010; Havnaer et al., 2017; Waaijer et al., 2019).

Tips for Involving Students in Scientific Research

As a result of the pronounced call to engage students in research in early phases of medical education, many medical schools implemented courses within the core curriculum to scientifically educate undergraduate medical students. However, as most medical schools educate many students at the same time, it is challenging to engage every student in authentic research. Ommering et al. (2019b) published 12 tips to offer a short authentic and experiential individual research opportunity to a large group of undergraduate students. These tips are intended to provide insights into how every single student, in early phases of medical training, could be offered the experience to conduct research individually. These 12 recommendations are based on theory, a review of the literature and on the author's own personal experiences. In this section, we wish to reflect on those suggestions and we encourage you to adapt one or more in your own teaching.

We already thoroughly elaborated on the importance of viewing students as active producers of research instead of passive consumers. The recommendations are in line with that philosophy, emphasizing the importance to stimulate students to conduct research and involve them in every stage of the scientific process. This not only contributes to a broader perspective of research, but it also reveals how research is valuable for patient care (Ommering et al., 2020). Often, students are asked to contribute to a small component of an ongoing project; which is convenient, but makes them miss the opportunity to experience the entirety of the project. That overall perspective is vitally important in order to enhance engagement in research (Lawson Mclean et al., 2013). Within the provided research experience, it is important to engage students in real-world tasks. This could be done by stimulating students to come up with a relevant clinical research question to be answered, followed by gathering real patient data. In order to make this feasible within a large scale education course, gathering of data could be distributed among all the students. Consequently, every student would have the responsibility to collect a small amount of data, after which all the gathered data will be combined into one bigger dataset. In this way, every student could experience collecting real-world data, and each student would have access to a larger dataset to answer their clinical research question, without the entire process being too time-consuming.

Teachers can support students on an individual basis and effective mentoring is key. Mentorship can provide students with an inspirational role model for a medical researcher. By passionately describing their own research, these mentors can make their own enthusiasm contagious. Furthermore, serving as an inspiring role model is related to enhanced positive perceptions of and motivation for research among students (Ommering et al., 2020). As a mentor, providing students some autonomy within their research project can elicit feelings of ownership. However, mentors should also scaffold the research process. In practice, this means that students should be stimulated to take a leading role in carrying out their research, while the more experienced mentor closely monitors progress and provides help where necessary.

As students should be involved within every stage of the scientific process, dissemination of findings should be an important element within the course as well. Students should express their knowledge in authentic ways, relating to the real research world. Therefore, it is argued that students should disseminate their work by writing a professional academic piece and orally present their results. Awareness of the avenues to communicate scientific knowledge helps to create a sense of what it means to be a researcher (Shanahan et al., 2015), while at the same time practicing academic writing and presenting. Teachers and mentors should encourage students to present the results of their research project at conferences or publish their work in a peer-reviewed journal. Previous studies showed that students who publish during medical training, publish more articles after graduation than the students who did not (Waaijer et al., 2019).

As academic research and teaching is very closely connected, students also develop an academic mindset from teaching or reviewing the work of others.

Mentors should also develop opportunities for students to teach or lead peer discussions and reviews within their courses. Several medical schools offer elective courses in medical teaching to prepare the students for that future role. We strongly believe that being involved in scientific research and academic teaching can reinforce each other resulting in better critical thinking and higher motivation (Harland, 2016). It also raises students' awareness about possible future academic career opportunities in research and education.

Fostering Scientific Engagement in Students: Case Studies

Following below are examples from our own institutions of approaches that offer research experience to medical students aimed at increasing their scientific engagement.

Example 1: 'Bedside to bench': individual clinical research arising from patient bedside experiences (Leiden University Medical School).

Leiden University Medical School has a modern curriculum defined by competency-based educational outcomes. Besides teaching the sciences fundamental to medicine, special attention is paid to the personal development of competencies in longitudinal programs along the entire 6-year curriculum, integrated in the regular courses. One of these programs focuses on the academic and scientific development of students by engaging students in scientific research and academic scholarship.

Within the first year of medical school, a research course is offered in which every student within a class of about 350 students individually conducts a small research project from start to end. Students gather and process data of real patients in a nursing home, formulate an individual research question inspired by patient bedside experiences, analyze data, write a research report (i.e. extended abstract) and present their research outcomes in a simulated conference setting. The research experience within this course mirrors how actual clinician-scientists perform research, as students are involved in every step of the research process and engage in authentic and real-world settings by really connecting bedside to bench. Students are free to formulate their own research questions and have a leading role in carrying out their research, while being mentored by a clinician-scientist or PhD candidate.

Example 2: Writing and Critiquing a Scientific Mini-Review: A Lesson in Peer-Review (Georgetown University).

Another shining example of an innovative activity that fosters scientific thinking and curiosity occurs in a first-year module at Georgetown University School of Medicine: *Sexual Development and Reproduction (SDR)*. One of the requirements for this module is that students in groups of 4 must write a scientific mini-review on a topic they select from a list of possibilities. On the first day of class, the purpose of writing this paper is explained to the students and the format is detailed and assignments are made. The team of students must work together on this activity using a clear rubric and completing the task in 12 days. The papers are submitted electronically by group number to the module director, who then assigns them to other groups to conduct a peer-review much like any review of a journal article. Anonymity is maintained as only the course director knows which students are in which groups. The critiquing group has 5 days to complete the peer-review following a defined rubric and evaluation form, and the original writing group can rebut the elements of the critique to the module director. Sixty percent of the points are awarded for writing the paper and forty percent for the critique including an assessment of individual author contributions. The highest scoring papers (about 7 per year) are bound and held in the Medical School's library and several are submitted for publication. In the 11 years that this activity has been part of the module, over 30 papers have been published in a peer-reviewed journal. Moreover, to date, the published papers have received over 200 citations in Google Scholar. While this task has been challenging for the students, it has also been very rewarding. Most of the students report that it increased their interest and enthusiasm for science, in general, and the subject matter, in particular.

Example 3: Critically appraising Drug Advertisements (Leiden University Medical School)

Following the first-year research course, a 3-week collaborative research course is offered in the second year with a full class size of approximately 300 students. The goal of the course is to foster a scientific mindset and to encourage participation in science by offering some theory regarding research study design, critical reading, statistics, data analysis, and presentation of outcomes, all related to one central research question posed: *"What percentage of the clinical trials referred to in drug advertisements accurately support the claims made in the advertisement?"*. To answer this question, all students together rate 150 preselected randomized controlled trials (RCT) and the pharmaceutical advertisements in which they were referenced. Every student works on only two of these RCT's, and every RCT is reviewed by four different students. The students enter the data in an online database on which statistical analyses are performed. As a result of this course layout, the full class rates 150 RCT's as if they were one virtual researcher. The results of the analysis are discussed in the full class. In this case, the conclusion of the study is that a solid RCT reference does not automatically support the claim made in the advertisement. From this exercise the students learn that critical appraisal of the literature is a necessary skill for medical doctors, with clear implications for treatment. And by working together as a full class working on a single research question, engagement for scientific research increases.

Using Scientific Engagement to Promote Diversity, Equity and Inclusion

There are concerns about the lack of diversity of the healthcare and scientific workforce, with the current inadequate representation of individuals based on gender, racial and ethnic demographics. While improvements have been made in increasing the number of women and unrepresented minorities in recent medical classes, the percentages of those who opt to enter research careers and pursue scientific discovery are still lower than their respective proportions in the general population. The various strategies described above to foster scientific engagement can also be leveraged to simultaneously address diversity, equity and inclusion objectives. For example, giving students the opportunities to explore health outcomes in ethnic or racial group other than their own might expose them to the reality of health disparities and implicit bias. On the other hand, inviting diverse faculty to participate in these activities can further stimulate learners, who perhaps for the first time see someone like them serve as a role model. Imagine how this might motivate a curious student to pursue their own scientific questions and research projects. Medical science education can provide a much-needed spark and opportunity to broaden the scientific engagement of all students.

Summary

In this chapter we emphasize the importance of scientific engagement among medical students and provided some suggestions for how you, the teacher, can stimulate that engagement. It is important that we train scientifically minded students who are capable of using and conducting research in a clinical environment. We hope that this discussion and the examples are helpful for you as a teacher in the exciting environment of medical science education.

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Chapter 20
Advancing the Field: The Scholarship of Medical Education

Bonny L. Dickinson

Abstract Scholarship drives the practice of medical education forward by providing evidence-based approaches to teaching and learning, curriculum development, learner assessment, advising, mentoring, and coaching, and educational leadership and administration. Contributing to the medical education knowledge base through scholarship is highly rewarding, and this chapter seeks to support medical education scholars in this endeavor. Herein, the various forms of scholarship are described, including the scholarship of discovery, integration, application, and teaching and learning. A particular focus of the chapter is to differentiate *scholarly approaches* to educational activities from the *scholarship* of medical education. The importance of embracing conceptual frameworks to guide medical education scholarship is emphasized, as is employing research paradigms to make clear philosophical assumptions that underpin the design and interpretation of medical education research. The chapter concludes with a call for medical education scholars to address issues of diversity, equity, and inclusion in medical education.

Introduction

Medical education scholarship advances the field by building upon existing the collective knowledge to contribute new knowledge that in turn can be built upon. In a nutshell, medical education scholarship refers to peer-reviewed and publicly disseminated materials, products, or resources created to meet specific educational objectives (Simpson et al., 2007). I begin this chapter by describing the process by which medical educators engage in a systematic, intellectually rigorous approach to their work to produce high-quality medical education scholarship. Next, I focus on the four domains of scholarship delineated by Boyer: discovery, integration,

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application, and teaching and learning (Boyer, 1990). This is followed by the importance of using conceptual frameworks and research paradigms to guide scholarship. The chapter closes with a call to educators to bring issues of diversity, equity, and inclusion to the forefront of medical education scholarship.

A Scholarly Approach: A Prerequisite to Scholarship

To understand what it means to produce medical education scholarship it is first necessary to differentiate a *scholarly approach* from *scholarship*. A *scholarly approach* refers to taking a systematic approach to one's work as a medical educator by intentionally addressing six specific criteria defined by Glassick and colleagues: clear goals, adequate preparation, appropriate methods, significant results, effective presentation, and reflective critique (Glassick, 2000). When scholarly work is peer-reviewed, publicly disseminated, and contributes new knowledge to the field of medical education, it becomes *scholarship* (Colbert-Getz et al., 2020; Simpson et al., 2007). Next, Glassick's six criteria for producing high-quality scholarship are described in detail.

Clear Goals

High-quality scholarship begins with clearly stating the purpose of the work and defining achievable objectives, realistic goals, and measurable outcomes (Simpson et al., 2007). A number of frameworks are available to guide this process, including the FINER criteria, which articulate five key questions: Is the inquiry **f**easible (i.e., answerable with available resources)? Is it **i**nteresting to others (i.e., important or interesting to you as the researcher as well as to the general medical education community)? Is it **n**ovel (i.e., does it add to the current body of knowledge)? Is it **e**thical (i.e., can the question be answered with minimal or no risk to others)? Is it **r**elevant (i.e., does the answer to the question matter to those outside of your own institution)? A more direct approach to thinking about a scholarly project's goals is to address the "so what" question to ensure that the work is meaningful to a broader audience and that the results impactful (Chan et al., 2017). Additional questions to ask include: Are the project goals research-oriented or experiential? What types of outcome measures are needed to determine whether the goals have been achieved? What is the potential future of the project? And, what makes the project interesting to others? (Darden & DeLeon, 2017).

Adequate Preparation

In addition to articulating clear goals, taking a scholarly approach to medical education scholarship requires learning the medical education landscape. This is accomplished by reading the literature, identifying mentors and networks, and engaging with the larger community of educators to learn from the existing body of knowledge in the field (Simpson et al., 2007; Wang et al., 2019). Relevant literature, best practices, best evidence, and artifacts in the field can be identified using widely accessible resources such as the National Library of Medicine's PubMed database, which includes citations from MEDLINE and PubMed Central. High-quality medical education literature can also be found using indices such as ERIC, Web of Science, Scopus, Google Scholar, PsycInfo, CINAHL, Embase, ProQuest, and EBSCO.

To engage with the broader community, medical educators should explore the numerous organizations and associations that exist to promote, advance, and support educators. Seek out international organizations such as the International Association of Medical Science Educators and the Association for Medical Education in Europe, as well as discipline-based organization such as the Association of Biochemistry Educators, the Association of Medical School Microbiology and Immunology Chairs, and the Society of Teachers of Family Medicine. As discussed later in this chapter, understanding and applying conceptual frameworks, relevant theory, and research paradigms to one's work are also part of adequate preparation to inform a scholarly approach. In addition to demonstrating an understanding of the existing literature, adequate preparation requires that medical educators acquire the skills and necessary expertise to advance the field (Simpson et al., 2007). Medical educators have a variety of venues to expand their skills and expertise in medical education, including medical education conferences and workshops, research certificate courses and programs, and formal training in master's and PhD programs in medical education.

Appropriate Methods

To answer a scholarly question, medical educators must select and apply methods that are feasible, practical, and ethical (Simpson et al., 2007). As discussed later in this chapter, articulating an appropriate research plan requires that one's philosophical assumptions are made clear, and that those assumptions align with the research design and specific methods used for data collection and analysis (Creswell, 2014) (Fig. 20.1).

Medical education questions can be addressed using qualitative, quantitative, and mixed methods approaches (Fig. 20.1). Qualitative research in medical education uses experiments and surveys to collect data, and statistics are applied to analyze the data. Various experimental designs are available to test the impact of an

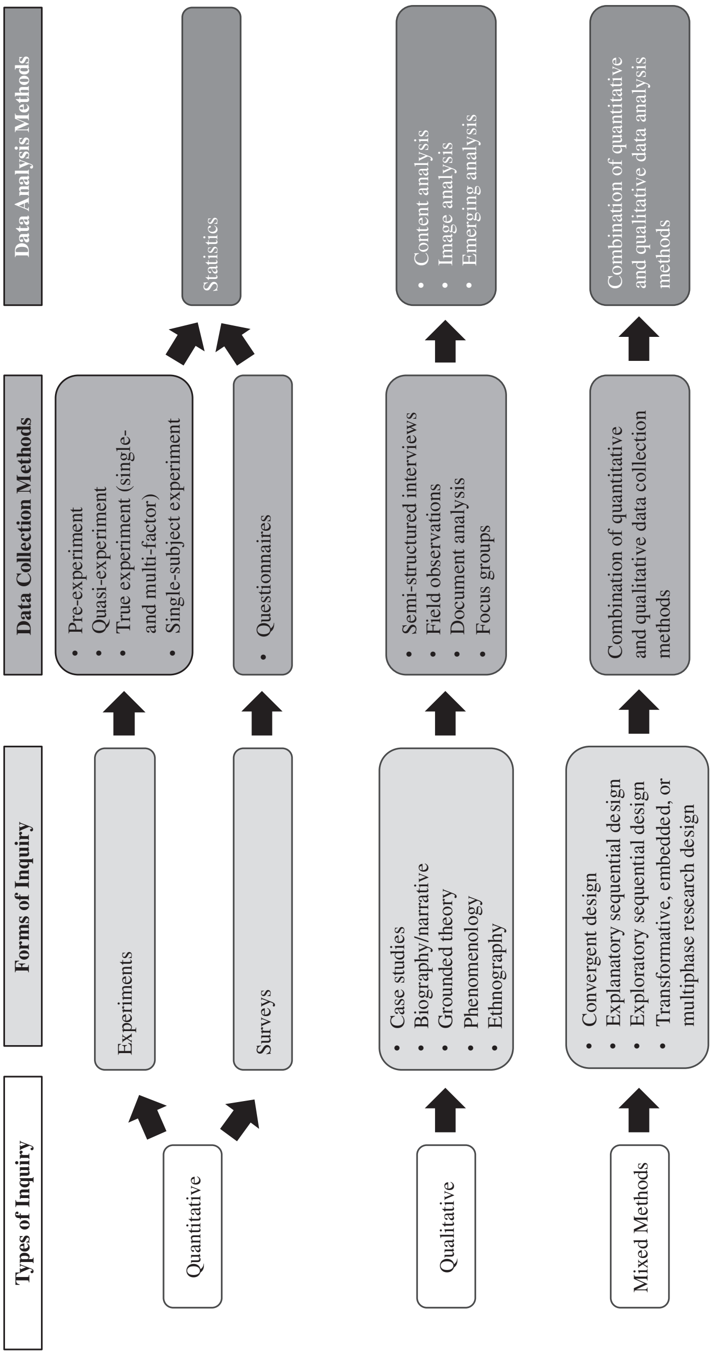

Fig. 20.1 Research approaches

intervention on an outcome, including pre-experimental, quasi-experimental, true experiments (single- and multi-factor), and single-subject designs (Creswell, 2014). Surveys are non-experimental research methods that use questionnaires to collect numeric descriptions of trends, attitudes, perceptions, or opinions of a population under study.

Qualitative research has its own distinct forms of inquiry including case study, biography/narrative, grounded theory, phenomenology, and ethnography. Methods to collect qualitative data include interviews, field observations, document analysis, and focus groups. Methods to analyze qualitative data include content analysis, image analysis, and emerging analysis to name a few (Creswell, 2014). Mixed methods research, as the name suggests, uses a combination of quantitative and qualitative methods to address a research question. Forms of mixed methods include convergent, explanatory sequential, exploratory sequential, and transformative, embedded, or multiphase research designs (Creswell, 2014). As mentioned earlier, identifying one's philosophical assumptions and selecting conceptual frameworks and research paradigms are central to selecting an appropriate research method, as will become clear later in the chapter.

Significant Results

This criterion addresses whether the desired goals of the study were achieved and if so, whether they contribute to the field in a manner that invites further exploration (Simpson et al., 2007). The quality, impact, and significance of the results can be evaluated by considering whether: additional areas for further research have been opened as a result of the work, the work challenges an established educational belief/theory or if it addressed these in a novel way, the work describes or shares an educational product others can adopt, or the work expands the field of medical education by impacting learner knowledge, skills, attitudes, or behaviors (Darden & DeLeon, 2017).

The significance of study results in medical education research also can be evaluated using various models. Kirkpatrick's learning evaluation model is a classic model used for assessing outcomes of an educational intervention according to four levels: reaction, learning, behavioral change, and organizational change (Kirkpatrick, 1998). Level 1, reaction, captures learners' views on the learning experience, its organization, and quality of instruction. Level 2, learning, reflects modification of learner attitudes, perceptions, knowledge, or skills in response to an intervention. Level 3, behavioral change, documents the transfer of learning to the workplace or willingness of learners to apply new knowledge and skills. And level 4, organizational change, reflects change in organizational practice. Other evaluation frameworks include Moore's expanded outcomes framework and Hakkenes' domains of evaluation (Moore et al., 2009; Hakkennes & Green, 2006).

Effective Presentation

Effective presentation addresses the selection of a suitable style and organization in which to present one's work, the identification of appropriate forums to reach an intended audience, and whether the work has been peer-reviewed and publicly disseminated (Simpson et al., 2007). There are clear benefits to disseminating scholarship, including improving learning environments, patient care, teaching techniques, and educational systems to name a few (Chan et al., 2017). Today, there are many ways to disseminate scholarship beyond peer-reviewed medical education journals, viewed as the most widely recognized platform (Chan et al., 2017). Additional venues for dissemination of scholarship are addressed in Chap. 21.

Reflective Critique

The final criterium, reflective critique, refers to thoughtful assessment and self-critique of the work, and use of reviews and critiques from others to refine, enhance, or expand the original concept (Simpson et al., 2007). Reflection requires addressing the work's limitations, significance, applicability, generalizability, and providing key recommendations to guide practice and future action (Darden & DeLeon, 2017). Engaging in reflective critique may prompt the medical educator to ask: How does the work add to what is known? How can it be used by others? What are the work's strengths and limitations? How does it impact future practices?

In addition to addressing Glassick's criteria, it is important for medical education researchers to position their work as compelling. Lingard proposes a useful heuristic for doing so, referred to as the problem, gap, and hook heuristic (Lingard, 2015). Begin by determining whether your proposed scholarship idea addresses a timely problem in the field that scholars are talking about by asking whether your research question is truly novel, currently being worked on, or one that some readers might see as passé or already solved. Second, identify a gap in the current knowledge or thinking by asking whether readers are likely to agree upon the work or whether there is debate. While a good research question must be grounded within a base of knowledge, it must also identify a gap that requires exploring or propose a different interpretation that would illuminate new knowledge (O'Brien et al., 2019). In the final step of Lingard's heuristic, a hook must be articulated to convince readers that the identified gap is of consequence by asking whether answering the research question will have significant, enduring implications for the field of medical education. Identifying the purpose of the scholarly question is also important. As discussed later, questions may be exploratory, explanatory, descriptive, or emancipatory in nature. Finally, addressed in more depth later in this chapter, it is also critical to situate your scholarly question within a theoretical or conceptual framework.

Scholarship and the Three P's

Having addressed Glassick's six criteria as the foundation for high-quality scholarship, let's now address scholarship itself. According to Beattie, scholarship is "incomplete unless communication to peers and other scholars occurs in addition to presentation to the usual audience of students, colleagues, or the public." (Beattie, 2000). Thus, to produce scholarship, scholarly work must be peer-reviewed, publicly disseminated for others to critique and build upon, and must advance the field of medical education by contributing new knowledge (Colbert-Getz et al., 2020; Simpson et al., 2007) (Fig. 20.2). This model is referred to as the 3P's of scholarship: **p**eer-reviewed, **p**ublicly disseminated, and provides a **p**latform that others can build upon (Simpson et al., 2007).

To put these concepts into practice, reflect on the differences between teaching, scholarly teaching, and the scholarship of teaching by considering the Q^{2}E conceptual framework. The Q^{2}E framework articulates measures of **q**uantity, **q**uality, and **e**ngagement with the broader medical education community (Simpson et al., 2007). *Teaching* can be measured both quantitatively and qualitatively. Quantitative measures include descriptive information on the scope, types, and frequencies of education activities and educator roles, and the number of learners, sessions, hours of effort, contact hours, or other countable factors (Gusic et al., 2013). Qualitative indicators include assessing effectiveness and excellence using learner evaluations, peer reviews, and subsequent performance of learners. By contrast, *scholarly teaching* requires engagement with the broader medical education community to understand current principles of teaching and learning and to apply these principles to one's teaching. Although a continuum, *teaching* and *scholarly teaching* directly impact learners, while the *scholarship of teaching* goes beyond the learner and impacts the field. The *scholarship of teaching* can also be measured quantitatively (e.g., impact factors, number of downloads/views, number of peer-reviewed products generated, etc.) and qualitatively (e.g., dissemination to settings beyond the classroom, expert reviews, assessment by educational consultants, etc.) (Gusic et al., 2013). As you can see, documenting quantity, quality, and engagement alone, though important, does not constitute scholarship (Simpson et al., 2007). Thus, what distinguishes the *scholarship of teaching* from *teaching* and *scholarly teaching* is peer-review to ensure quality, and public dissemination to create a platform upon which others can build to advance the field (Simpson et al., 2007).

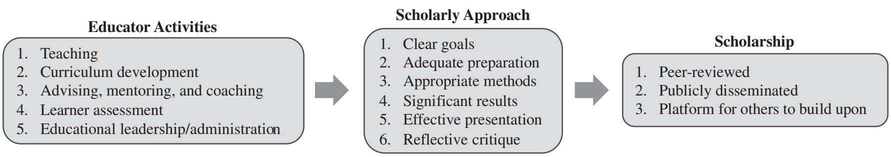

Fig. 20.2 The continuum of educator activities, a scholarly approach, and scholarship in medical education

Domains of Medical Education Scholarship

Now that we've established what scholarship is, let's consider the various forms of medical education scholarship. Boyer defined four domains of scholarship: discovery (e.g., original research), integration (e.g., synthesis of ideas and data), application (e.g., application of skill and knowledge to solve problems), and teaching and learning (e.g., creation of new knowledge about teaching and learning in the presence of learners) (Boyer, 1990).

The Scholarship of Discovery

The scholarship of discovery is perhaps the most widely recognized form of scholarship and refers to use of the scientific method to discover new knowledge. As such, discovery research addresses core problems, basic principles, and foundational questions related to education or related phenomena (O'Brien et al., 2019). This form of scholarship is empirical, hypothesis driven, deductive in nature, and typically documented in peer-reviewed journals, scholarly presentations, and grants. As described below, a useful way of thinking about the scholarship of discovery is to consider the work's primary purpose as to describe (description studies), justify (justification studies), or clarify (clarification studies) phenomena (Cook et al., 2008).

Description studies in medical education focus on observation to describe what was done or to present a new conceptual model, conceptual framework, theory, or hypothesis that can then be used for justification or clarification studies (Cook et al., 2008). The aim of description studies is to establish the current or past state of an educational phenomenon by defining it, organizing it, and measuring its variables (Ringsted et al., 2011). Thus, description studies in medical education tend to describe attitudes, perceptions, or relationships with implications for educational practice (Elnicki & Papp, 2015). The value of description studies is that they lay the groundwork for future innovation and research by communicating truly innovative ideas and interventions in medical education.

Justification studies seek to compare methods to identify which is superior by determining why or how an intervention worked. In medical education, justification studies often compare one educational intervention with another to address the question of whether the new intervention worked, or whether one intervention was better than (or as good as) another. Justification studies that address higher-order outcomes such as behavioral and patient- or practice-oriented outcomes are particularly important to the field of medical education because they provide a stimulus for empowerment and transformation.

Clarification studies start with observations, make predictions from the observations, and test the predictions in order to clarify or elaborate the processes that underlie the observed effects (Cook et al., 2008). Clarification studies use classic experiments, correlation research, comparisons between naturally occurring groups, and qualitative research to answer questions. A hallmark of clarification studies is that a conceptual framework or theory can be validated or falsified by the results of the study (Cook et al., 2008).

The Scholarship of Integration

Having addressed the first domain of scholarship, discovery, let's now turn our attention to the scholarship of integration. This form of scholarship aims to give meaning to isolated facts by putting them in perspective, making connections across disciplines by placing them in a larger context, and illuminating data in revealing ways (Boyer, 1990). Examples include narrative, systematic, scoping, critical-realist, and open peer commentary reviews as well as research synthesis as meta-analysis (i.e., statistical integration of quantitative research results) *(*Simpson et al., 2007; McGaghie, 2015). In medical education, integration studies often combine the field of higher education with sociology, psychology, or the humanities (Dauphinee & Martin, 2000). Integration scholarship requires "stepping back from a narrow area of research to search for connections between discoveries obtained by different approaches or even from varied disciplines." (Beattie, 2000). Thus, the scholarship of integration generates novel insights by synthesizing knowledge within and/or across disciplines and by bringing diverse fields together to shed new perspectives and insights on research findings (Beattie, 2000). To do this, medical educators must move beyond discipline boundaries to engage in interdisciplinary work with the aim of placing their work within a larger context. Examples of the scholarship of integration in medical education include collaboration across fields or expertise to address educational questions, and knowledge syntheses and literature reviews (O'Brien et al., 2019).

The Scholarship of Application

The third form of scholarship, the scholarship of application, occurs when "knowledge is responsibly applied to consequential problems" (Boyer, 1990). This research involves "building bridges between theory and practice and encompasses the service functions of academics." (Beattie, 2000). Medical educators conducting application scholarship ask how findings from the literature and knowledge from other disciplines can be used to solve practical real-world problems of individuals and society (Beattie, 2000). In this way, application scholarship demonstrates the interaction between research and practice wherein one informs the other (Simpson et al., 2007; Shapiro & Coleman, 2000). Examples of the scholarship of application include "applied work" such as consultation, evaluation, and analysis (Hofmeyer, et al., 2007). In the setting of medical education, this might also include "applied products" to improve the work of educators. Examples of the scholarship of application in medical education include consultation to encourage or support the use of sound principles of educational practice, innovations grounded in theory and evidence, and exploration of problems or questions applied to a specific institutional context (O'Brien et al., 2019).

The Scholarship of Teaching and Learning

Finally, the scholarship of teaching and learning refers to the systematic study of teaching and learning, and involves asking a question, gathering evidence to answer the question, and disseminating the evidence so that others may benefit from the new knowledge. Examples include peer-reviewed manuscripts and presentations describing advising, mentoring, or coaching programs, teaching and learning resources, faculty development offerings that share knowledge of educational research, learner assessment tools, a novel curriculum model that has been adopted by others, etc. (Colbert-Getz et al., 2020; O'Brien et al., 2019). For practical examples of applying a scholarly approach to produce educational scholarship in each scholarship domain, I recommend the excellent resource offered by Colbert-Getz et al. (2020).

Evaluating Medical Education Scholarship

Traditional metrics for evaluating medical education scholarship include article- and journal-level metrics such as citation counts and journal impact factors. Beyond these, a growing number of tools are being developed to measure impact, including the Science of Science (Sci2) Network Visualization Tool, Gephi, D3.js, VOSviewer, Rimpact, Rapid Science's "C-Score", and Publons. The emergence of social media has ushered in a variety of alternative metrics of influence (Sherbino et al., 2015a). Altmetric (alternative metrics), for example, provides metrics and qualitative data sourced from different platforms across the Web (Priem et al., 2012). Examples of social web data sources include mentions on Facebook, Twitter, ResearchGate, comments in publisher-hosted websites, mentions in the mainstream media, social bookmarks on sites such as CiteULike, or exports to citation management programs. Other alternative metrics include Plum Analytics, which collects impact metrics in five categories: captures, usage, citations, mentions, and social media. Plum Analytics covers different types of artifacts including journal articles, books, videos, presentations, datasets, source code, and others. Impactstory is another tool that provides metrics from a variety of sources and normalizes those metrics based on comparison sets. Impactstory provides metrics for journal articles, data sets, slides, and other research products. Others tools for measuring the impact of social media-based scholarship include Google Analytics, Symplur Analytics, and YouTube Analytics (Sherbino et al., 2015a, b). It is important to be aware that not all social media activities meet the standard of scholarship defined in this chapter. For example, not all products on social media are original, advance the field of education by building on theory, research, or best practice. In addition, they may be shared in a way that prevents the education community from providing feedback to inform wider discussion (Sherbino et al., 2015b).

Using Conceptual Frameworks to Guide Medical Education Scholarship

"Conceptual frameworks represent ways of thinking about a problem or a study, or ways of representing how complex things work the way they do" (Bordage, 2009). Using conceptual frameworks, also referred to as theoretical frameworks, in the design and interpretation of a study advances the rigor of medical education scholarship. There are many conceptual frameworks, each offering a perspective or lens through which to view a problem or question. As discussed earlier, a research question should be situated within a theoretical or conceptual framework. Conceptual frameworks guide multiple aspects of scholarship, including the development of a research question by helping to identify the content of the study, selection of appropriate research methodologies and methods, selection of relevant data, and interpretation of study outcomes (Bordage et al., 2016). Conceptual frameworks may be used to challenge theories, resulting in their revision or abandonment if found to be obsolete. They may also be used to generate *new* theories. Many of the conceptual frameworks used in medical education come from the social sciences and the humanities, most notably from the fields of psychology, sociology, philosophy, and anthropology. And, many originate from within the general education setting (K-12).

Conceptual frameworks are derived from theories. Reeves and colleagues define theory as "an organized, coherent, and systematic articulation of a set of issues that are communicated as a meaningful whole" (Reeves et al., 2008). Because different conceptual frameworks can be used to explore various aspects of a problem or question, each framework only presents a partial view of reality. Thus, considering a variety of frameworks before selecting one or more to guide your scholarship is an important step when conducting medical education scholarship. Selecting an appropriate framework(s) depends on the overarching goal of the work. Conceptual frameworks used to frame teaching interventions, for example, include Bandura's Social Cognitive Theory, Ericsson's Theory of Deliberate Practice, and Kolb's Experiential Learning Theory (Abramson et al., 2018). Other conceptual frameworks applicable to medical education scholarship include: self-regulation theory, adult learning theory, self-determination theory, cognitive load theory, situated learning theory, and staged theory of learning.

Research Paradigms in Medical Education

Research paradigms refer to "the set of common beliefs and agreements shared between scientists about how problems should be understood and addressed" (Lincoln et al., 2011). In other words, research paradigms are sets of *assumptions* about the nature of reality (ontology) and the nature of knowledge (epistemology). Other terms used to denote a research paradigm include philosophical paradigm, worldview, theoretical perspective, philosophy of science, or philosophical stance. Because research paradigms make transparent one's assumptions about reality and the nature of knowledge, they are essential to scholarship. Ontology refers to theories on the nature of physical and social reality, while epistemology refers to theories on the origin, nature, and limitations of knowledge. Articulating one's ontological and epistemological stance is important, because they influence how and why a specific research approach is selected to study a scholarly problem as well as how the study outcomes are interpreted.

The most commonly used research paradigms in medical education scholarship are positivism, post-positivism, constructivism, and critical theory. Although defined in general terms in this section, it is important to note that there are significant differences between positivism and post-positivism as well as constructivism and critical theory. In general, medical educators adopting positivist or post-positivist paradigms believe that there is a single universal truth, while those adopting constructivist or critical theory paradigms believe that multiple truths exist and that they are socially constructed within human consciousness through experience. These core beliefs are reflected in the ontological and epistemological stances of these paradigms: The ontological stance of positivism and post-positivism is that a single objective reality exists, while the ontological stances of constructivism and critical theory is that there are multiple subjective realities. Similarly, the epistemological stance of positivism and post-positivism states that knowledge is observable and independent of the human knower (i.e., knowledge exists outside of human consciousness), while the epistemological stance of constructivism and critical theory states that knowledge is subjective and constructed by and between individuals.

As mentioned above, the underlying assumptions or beliefs of a research paradigm are salient because they influence the selection of a specific research approach. Positivist and post-positivists answer questions by testing hypotheses using deductive approaches, while constructivists and critical theorists study phenomena using inductive approaches. Finally, research paradigms also influence the interpretation of study results. For positivists, a hypothesis is proven or disproven, while post-positivists believe that hypotheses can only be falsified, as outcomes are never totally objective. By engaging in dialogue, constructivists gain a better understanding of complex phenomena, while critical theorists gain knowledge by raising study participants to a different level of consciousness with the aim of empowerment and social change. As is true for theories and conceptual frameworks, there are many different research paradigms worth exploring as you think about your research question.

Tips for Engaging in Scholarship

In this section, practical tips for engaging in scholarship curated from the literature are presented. As discussed earlier in the chapter, learning the medical education landscape is an essential first step. To do this, read the literature. Read for content, methodology, methods, and manuscript organization and format (Sullivan, 2018). Read a variety of article types including monographs, perspectives, reviews, personal essays, commentaries, conference reviews, systematic and scoping reviews, and original research (Sullivan, 2018). Now that you are familiar with conceptual frameworks, theory, and research paradigms, look for how these are applied to various works. Setting up automatic system alerts to receive journal table of contents or PubMed topic alerts via e-mail will encourage the habit of reading. Importantly, read with others! Find or start a medical education journal club. Reading with others improves learning and is one way to build a community of practice at your institution. As you read, begin to identify an area that interests you and that aligns with your future goals. Think about your everyday work as a medical educator, including the service activities you engage in at your institution and professional organizations, as these activities may form the basis of scholarship. For example, has a committee you serve on contributed to policy development to meet accreditation needs? Has the committee contributed to a continuous quality improvement study? Has it developed resources that others can use or adapt? Service activities present overlooked but ripe opportunities for scholarship (Tewksbury et al., 2009).

Once familiar with the medical education landscape, identify areas in which you may require additional training or resources to engage in scholarship. This might include a certificate course or program, negotiating for protected time, and identifying colleagues with expertise to guide you in strategically planning a project (Sullivan, 2018). Identifying mentors with expertise to help you plan projects prospectively rather than retrospectively will help you avoid retrofitting your work to meet the requirements for scholarship. Using Glassick's scholarship criteria when planning scholarly work can help you plan prospectively (Sullivan, 2018). It is also important to develop a network of collaborators and mentors, as scholarship is much more fun and impactful when working with other scholars. Seek collaborators at your institution but also connect with faculty from other institutions. Meet others with shared interests by participating in regional, national, and international medical education conferences, and join collaboration and networking platforms such as Twitter, LinkedIn, ResearchGate, Academia.edu, and Mendeley to facilitate collaboration.

In general, it is best to start small and build from there. After learning the medical education landscape, seek opportunities to engage in presentation-based scholarly growth. For example, present a poster, oral presentation, or workshop at a medical education conference. From there, look for an opportunity to write a letter to the editor, a monograph, a review article, or a research manuscript (Wang et al., 2019). Take time to reflect frequently on innovations you are currently developing, such as novel curricula, assessment tools, or accreditation strategies to solve existing

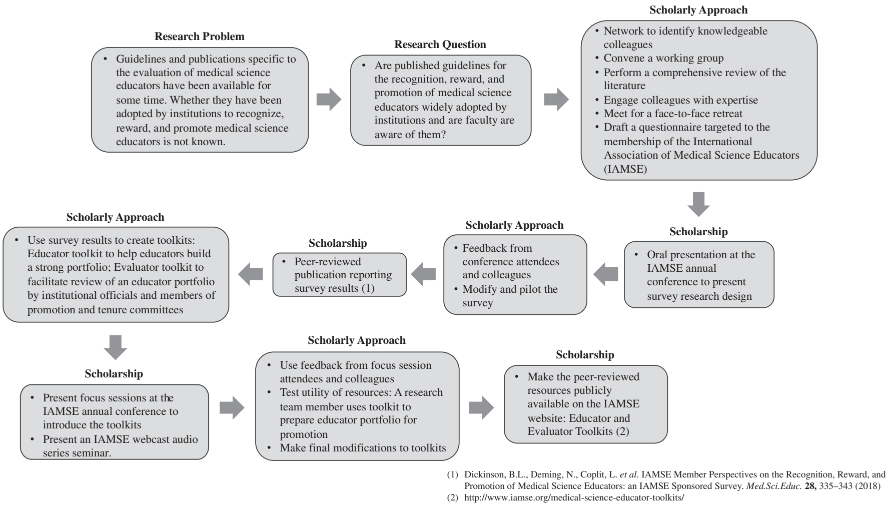

Fig. 20.3 The Scholarship of Medical Education continuum

problems or to improve education at your institution. Many of these innovations can be turned into scholarship. Ryan et al. provide a succinct five step approach to propel educational innovations to publication: preparation, problem, solution, implementation, and reflection (2020). Their model couples best practices for describing educational innovations to guide authors in writing and publishing (Ryan et al., 2020). Finally, seek to develop a community of education scholars at your institution and nearby institutions. Engage your office of faculty affairs or your medical education department to facilitate this process. The key is to jump in and get involved! Figure 20.3 provides a practical example of the continuum of medical education scholarship.

The Future of Medical Education Scholarship: A Call to Action

While there are many reasons to engage in medical education scholarship, perhaps one of the most exigent is to address issues of diversity, equity, and inclusion. A greater scholarly focus on ways to improve the diversity of our medical school learners, faculty, and administration, and our healthcare workforce is clearly needed. According to the Association of American Medical Colleges, “In 2019, an estimated 68.2% of physicians were white, 23.3% were Asian, 2.6% were Black or African American, 0.4% were American Indian or Alaska Native, 0.4% were Native

Hawaiian or Other Pacific Islander, 3.8% were Hispanic, Latino, or of Spanish origin, 3.3% were other races, and 1.9% were multiple race/ethnicities (2020). During the 2019-2020 academic year, the demographics of medical school enrollment consisted of 49.8% non-Hispanic white, 22.5% Asian, 7.3% Black, 6.5% Hispanic, and the remainder, other or multiple race/ethnicities (12.9%) or unknown race/ethnicity (1%). These findings highlight that some minorities (Black and African American, Hispanic/Latino, Native American and American Indian, and Native Hawaiian and Pacific Islander) are underrepresented among physicians relative to both U.S. and patient demographics. Furthermore, based on national demographic trends, demand for physician services is projected to grow proportionately faster for minority populations."

To address issues of diversity, equity, and inclusion, the medical education community must commit to applying contemporary theories of race, bias, and racism to the development, implementation, and evaluation of interventions in the areas of curriculum and assessment, faculty development, and medical education research (Karani et al., 2017). Models and theories from the fields of improvement science (e.g., Rogers' theory of the diffusion of innovations), business and management (e.g., change management theories), and law (e.g., critical race theory and theories of agency) offer unique opportunities to transfer successful approaches in these fields to the practice of medical education. Critical race theory, in particular, provides an approach to help educational scholars incorporate racial and cultural awareness, consciousness, and positionality into research processes to pursue "deeper racial and cultural knowledge about themselves and the community or people under study" (Milner, 2007). This framework, advanced by Milner, addresses the racial and cultural positionality of the researcher. Specifically, the framework guides researchers through a four-step process of racial and cultural consciousness: researching the self, researching the self in relation to others, engaging in reflection and representation, and shifting from self to system.

Summary

Scholarship in medical education is the fundamental mechanism by which the community of medical education scholars contributes new ideas and methods to the field, with the ultimate goal of improving teaching, learning, and the practice of medicine. As there are numerous stakeholders in medical education including learners, educators, institutions, faculty, professional organizations, patients, and society, it is vital that educators engage in a rigorous approach to generating high-quality scholarship. I hope that this chapter has provided medical educators with a useful framework for contributing scholarship to the field of medical education.

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Chapter 21
Documenting Educator Work: The Educator Portfolio

Maria Sheakley

Abstract The educator portfolio is a collection of documents illustrating the excellence (quantity and quality) and engagement (scholarly work and scholarship) of an educator's teaching activities. It goes beyond the teaching activity section of a curriculum vitae (CV), documenting activities across all domains of educator activities, from teaching to curriculum development, learner assessment, advising and mentoring, and leadership and administration. The educator portfolio can be structured as a developmental portfolio to broadly track educator activities over time or be selectively focused for use in a promotional portfolio to highlight the educator's most significant contributions in each domain. The educator portfolio is arguably the most important tool in the educator's toolbox for recognition, reward, and career advancement.

Introduction

The previous chapter discussed the broader definition of scholarship proposed by Boyer in 1980. This definition of scholarship highlights teaching and service as viable areas for scholarly work and scholarship, and includes four levels of scholarship. Discovery scholarship is finding novel knowledge, Integration scholarship involves synthesizing knowledge and demonstrating the relationships, Application scholarship is harnessing knowledge for meaningful use, and Teaching scholarship is any activity that fosters learning (Boyer, 1990).

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Boyer's definition of scholarship was expanded 10 years later by Glassick (2000) to include six standards for assessing excellence in scholarship: clear goals, adequate preparation, appropriate methods, effective communication, reflective critique, and outstanding results. Whether building a curriculum, writing a literature review, designing and implementing an assessment tool, or conducting original research, Glassick's standards are the benchmark used to measure educational scholarship quality.

Since Glassick, numerous authors have contributed to the conversation about educational scholarship. Most notably, a group of medical education leaders at the 2006 Association of American Medical Colleges (AAMC) Group on Educational Affairs (GEA) Consensus Conference on Educational Scholarship reaffirmed and further elucidated the five domains of educator activity that previously emerged from the literature. Participants at the Consensus Conference developed the Q^2Engage model described by Simpson in 2007 for documenting the excellence and engagement of medical education activity. The five domains of educator activity include teaching, curriculum development, learner assessment, advising/mentoring, and educational leadership/administration and these will be discussed in detail later in this chapter. The Q^2Engage model describes how to document the excellence (quantity and quality) and engagement (scholarly approach and scholarship) of educational activities in the five domains (Simpson et al., 2007). This model can be used to document and evaluate educational activities in an educator portfolio, and it provides a foundation for academic recognition and reward for medical educators.

The Educator Portfolio

The educator portfolio is a collection of documents illustrating the quantity and quality of the faculty member's educational activities and engagement in scholarly work and scholarship (Baldwin et al., 2010; Niebuhr et al., 2013). When used for developmental purposes, the portfolio should be scoping and comprehensive, including a broad and inclusive range of educational activities. When used for academic promotion, the portfolio should be honed into a concise collection of documents that includes only selected works that illustrate the depth, breadth, and impact of the educators' most significant accomplishments in the five educator domains (Niebuhr et al., 2013). The educator portfolio is arguably the most important tool in the educator's toolbox. It is similar to an artist's portfolio in that it allows educators to select the work that best illustrates the scope and impact of their work and accomplishments across the five educator domains.

The Importance and Utility of an Educator Portfolio

Traditional standards for recognition of scholarship do not translate well to the evaluation of medical educators with a primary appointment in classroom and/or clinical teaching (Hammer et al., 2010). Factors such as the quality of peer-reviewed publications and reputation in one's field are important, but using measures such as grant support, journal impact factors, and primary/senior authorship on manuscripts as benchmarks is not equitable. Hence, a modified process for documenting and evaluating the scholarly work and scholarship of medical educators is necessary for the purposes of recognition and career advancement.

The educator portfolio goes beyond the teaching activity section of the curriculum vitae (CV). It is used to collate a diverse collection of examples of teaching activities, including lectures delivered, assessments performed, feedback received, professional development completed, meetings attended, students/peers mentored, curricula organized, and articles published, to name a few (Dalton et al., 2018). It is a dynamic document in which content is developed continuously, reflected on, enhanced, refined, and reused (Baldwin et al., 2010; Niebuhr et al., 2013; Baume, 2003). These processes occur over and over again, honing and refining with each iteration. Thus, the educator portfolio broadly illustrates an educator's areas of interest, continuous quality improvement, growth and development, and trajectory.

Tools for Documenting Educator Activity and Accomplishments

Career development and advancement involves documentation of educator activities and accomplishments; several types of documents are commonly used for this purpose, including the curriculum vitae (CV) and the educator portfolio.

The CV serves as a concise summary of one's educational and career experiences, and includes items such as education, teaching activities, awards, service, grant activity, and evidence of scholarship (Dougherty et al., 2019). An annotated CV is an extended version of the traditional CV. It provides additional details and short narratives about key activities and accomplishments for clarification and contextualization (Dougherty et al., 2019). The educator portfolio can be organized differently for distinct purposes. The developmental educator portfolio is scoping and comprehensive, including a broad and inclusive range of educational activities. The promotional educator portfolio is focused to highlight selected works that illustrate the depth, breadth, and impact of the educator's most significant accomplishments in the five educator domains (Baldwin et al., 2010; Niebuhr et al., 2013). Table 21.1 illustrates the similarities and differences in scope, timing, and purpose of the CV, annotated CV, promotional educator portfolio, and the developmental educator portfolio.

Table 21.1 Description of common tools used to document educator activity and accomplishments (Baume, 2003; Simpson et al., 2007)

	Curriculum vitae	Annotated curriculum vitae	Promotional portfolio	Developmental portfolio
Scope	Very focused	Focused	Focused	Comprehensive
Timing	Updated annually	Created/updated when eligible for promotion or advancement	Created/updated when eligible for promotion	Update annually
Purpose	High-level overview of education, work experience, teaching, service, and scholarship Good for documenting duration and quantity of activity	Extended version of the traditional CV Additional annotation within each section to clarify and highlight key activities and accomplishments Good for documenting duration and quantity of activities with some contextualization	Highlights and summarizes key educational activities and achievements Improves visibility of accomplishments among academic peers, leaders, and administrators Good for documenting quality and excellence of activities	Includes all educational activities and achievements Helps to identify and set goals Aids in reflection and improvement Serves as a communication tool with mentor or advisor

For academic promotion and tenure, the annotated CV and promotional educator portfolio are the recommended combination of documents. However, each of these documents have utility beyond promotion. They can be refined for use in a number of important career advancement scenarios, including seeking a new position or job, annual performance reviews, applying to a teaching academy, meeting with a mentor, and writing a biographical sketch (Baldwin et al., 2010). Detailed discussion of these documents follows in the next section.

What to Include in an Educator Portfolio

Annotated Curriculum Vitae The curriculum vitae (CV) is not technically included within the educator portfolio, but rather, an important accompanying document. As a reminder, it is listed here as a component of the promotional package. Any item within the CV can be annotated to provide additional detail and context. Annotation of individual scholarship items, in particular, is immensely helpful for articulating the scope and unique contribution of the author to each published work and can serve the broader goal of connecting one's scholarship to both the teaching philosophy and institutional values (Dougherty et al., 2019). Annotations should be brief (2–3 sentences) and include information about the scope and importance of the work, description of the authors contribution to the project, notes about author order (if not first/senior author), and other relevant information to contextualize the work. If the work is outside the scope of a typical peer-reviewed journal publication, a description of the importance and relevance of the work should be included as well.

Educational Philosophy Statement An educational (or teaching) philosophy statement is a “systematic and critical rationale that focuses on the important components defining effective teaching and learning in a particular discipline and/or institutional context” (Schönwetter et al., 2002). It should be brief (1–2 pages), reflective, written in the first person, and include a narrative about educational theory and one’s beliefs for teaching and learning (Dalton et al., 2018). Importantly, it should provide concrete examples of the ways in which the beliefs are transformed into practice in the classroom (Dalton et al., 2018). One’s educational philosophy will naturally evolve over time as experience as an educator progresses.

Most educational philosophy statements contain a discussion of some combination of the following six notions, which were adapted from a paper by Kearns and Sullivan in 2011:

1. Conceptualization of Teaching (What teaching means or looks like to you)
2. Conceptualization of Learning (What learning means or looks like to you)
3. Goals for Students (What knowledge, attitudes, and/or skills you help your students attain)
4. Implementation of Teaching Philosophy (How you operationalize your beliefs about teaching and learning in the course)
5. Evaluation or Assessment of Goals (How you measure your effectiveness and your students’ learning and attainment of your goals)
6. Inclusive Learning (How you foster an environment where all students find a place where they can learn and develop)

The educational philosophy statement is traditionally included at the beginning of the educator portfolio. However, writing the statement last will allow for reflection and a cohesive discussion of one’s educational focus in the philosophy statement and portfolio as a whole (Richlin, 1995). Reviewers are likely to read your educational philosophy first, then look for relevant examples throughout the portfolio, so having a philosophy statement that is congruent with your portfolio is important.

Long-Term Goals Describe 3–5 goals for your development as a medical educator over the next 5 years. Keep this section brief; a numbered list is acceptable. These goals should outline the trajectory of your educational activities and be accompanied by strategies to achieve them.

Evidence of Excellence in the Domains of Educator Activity The five educator domains are the broad categories into which most educator activities fall. These domains emerged from the literature and were reaffirmed and refined by working groups at the AAMC GEA Consensus Conference on Educational Scholarship in 2006 (Simpson et al., 2007). Activities for each of these domains are likely to be incorporated into the portfolio of an experienced educator, but early career faculty may have representation from only a few. Complete only those parts that are relevant to your work and level of experience. Descriptions of the five domains below were taken from the Medical Science Educator Portfolio Toolkits on the IAMSE website (Dickinson et al., 2020) and were originally adapted from the 2006 AAMC GEA consensus conference proceeding (Simpson et al., 2007).

1. Teaching – Teaching is any activity that fosters learning. Educators may engage in teaching by giving lectures, facilitating small group discussions or lab groups, teaching on clinical rounds, etc. In this category, educators should document the quantity and quality of their teaching, a scholarly approach to the process of teaching, and any dissemination of work in the domain of teaching.
2. Curriculum Development – Curriculum development refers to the creation of a longitudinal set of educational activities and is distinct from the creation of a single educational event. Examples may include a basic science lecture series, a set of clinical reasoning cases, a series of clinical skill workshops, faculty development workshops, etc. A curriculum must have goals, teaching methods appropriate for those goals, an informed approach to the design, a means of evaluation of its effectiveness, and ongoing improvement based upon the evaluation results. In this category, the educator should describe each of these aspects of the curriculum they have developed, and any dissemination of work in the domain of curriculum development.
3. Learner Assessment – Defined as all activities related to measuring learners' knowledge, skills, attitudes, and behaviors. To assess excellence in this category, educators should describe how they developed, implemented, and analyzed an assessment project, including any dissemination of work in the domain of learner assessment.
4. Advising, Mentoring, and Coaching – An advisor helps an advisee in a focused capacity surrounding a decision or course of conduct, or provides suggestions for a specific project. A mentor helps a mentee to achieve personal and professional success by providing guidance, support, and creating opportunities for the mentee. This requires an ongoing, committed relationship with a clear objective to help the mentee achieve their own definition of success. A coach facilitates a short-term process that helps individual learners identify goals and the skills to achieve those goals through individual feedback and guidance. Assessing the quality of an educator's contribution in this category means determining whether the advisor, mentor, or coach has helped the colleague or learner meet defined goals. In this category, the educator should describe their role in facilitating colleague or learner success. The educator should provide evidence of a scholarly approach to this important means of teaching, and any dissemination of work in the domain of advising, mentoring, and coaching.
5. Educational leadership and administration - Effective leaders in education transform educational programs and advance the field. They should seek ongoing excellence, evaluate outcomes, disseminate results, and maximize resources. To assess excellence in this category, educators should describe the initiatives they have led in their roles, the impacts and improvements their changes have made, and any dissemination of work in the domain of educational leadership and administration.

Documenting Educational Activities

There are a number of published guides for documenting educator activities for use in an educator portfolio and references for several of these appear in the Further Reading section at the end of this chapter. In general, documentation for an activity should include three components. First, briefly describe the activity, including details about the learners, the program, when and how often the activity occurred, and how much time was devoted to the activity. Second, discuss the quality and effectiveness of the activity based on outcomes. Finally, provide evidence of engagement by documenting how the existing literature informed the work and how the work now contributes to the field through dissemination (Simpson et al., 2004).

In early 2020, the Committee for the Advancement of Medical Science Educators (CAMSE), a subcommittee of the International Association of Medical Science Educators (IAMSE) Professional Development Committee, made available a novel medical educator portfolio toolkit developed to document the excellence (quantity and quality) and engagement (scholarly approach and scholarship) of medical educators in the five domains of educator activity using principles of the Q^{2}Engage model described previously (Simpson et al., 2004; Dickinson et al., 2020). The toolkit consists of a collection of worksheets developed to guide educators through a series of prompts to record the quantity, quality, and engagement for an educational activity or group of activities. Distinct worksheets for each educator domain prompt reflection based on the type of activity. Completion of the worksheets requires one to reflect on their roles, goals, scholarly approach, and outcomes for the activity. These worksheets can be used in a developmental portfolio to broadly track educator activities over time or be selectively focused for use in the promotional portfolio to highlight the educators' most significant contributions in each domain. Figure 21.1 shows a sample of a completed worksheet for an activity in the learner assessment domain (Dickinson et al., 2020). The sample worksheet illustrates how to document excellence and engagement using the worksheet. The complete toolkit for all domains is available on the IAMSE website and the URL appears in the Further Reading section at the end of this chapter. There is also a companion evaluator's guide to assist in the evaluation of educator portfolios for recognition and advancement.

Getting Started

The following five steps are a guide to begin the compilation, organization, and development of an educator portfolio.

1. Learn the rules of your institution: Each institution has different policies and guidelines for appointment, promotion, and tenure. Understanding the rules that govern career progression at your own institution is key. Expectations about faculty advancement vary by country as well. Many colleges, universities, and med-

EXCELLENCE IN LEARNER ASSESSMENT

DESCRIPTION OF THE ACTIVITY

ASSESSMENT TYPE, SETTING, and TARGET LEARNERS
Summative assessment for the cardiovascular course in the second year (M2) of medical school

MY ROLE IN ASSESSMENT
As the cardiovascular course director, I wrote 20% of the summative exam questions and edited 20% of the remaining questions to elevate them from recall to higher-order questions on Bloom's taxonomy.

MY GOAL(S)
My goal was to build an exam consisting of at least 60% clinical vignettes, 20% data analysis, and less than 20% recall questions. I created and reviewed questions to ensure that clear, concise, clinically relevant MCQs with good discrimination were used to assess the course content.

SCHOLARLY APPROACH

INFORMED PREPARATION
I read the National Board of Medical Examiners (NBME)-style question writing manual and used it as a guide for writing and revising NBME style questions for the course summative exam. I also attended a NBME item writing session at the IAMSE annual meeting last year, and I intentionally increased the number of higher order exam items on the course summative exam to better align with the course objectives.

DEVELOPMENT OF ASSESSMENT ITEMS OR TOOLS
I created a spreadsheet of all assessment items to review the difficulty, discrimination index, and point biserial of the items (data from ExamSoft©) used on the previous exam. In addition, I reviewed student challenges for these items to target modifications towards improving question clarity. I also worked with clinical colleagues to revise the basic science exam questions to include clinical vignettes, when possible.

OUTCOMES AND EVALUATIONS
I have included a table showing the item analysis of the exam questions and the items have improved over the course of three years. In addition, the correlation of the cardiovascular course performances to the national board examination has increased from 0.45 to 0.61 over the past three years.

MY REFLECTIVE CRITIQUE
I regularly use student feedback to improve exam items in the test bank. Additionally, feedback from clinical faculty and review of external assessment items indicates a need to increase the difficulty of exam questions around interpretation of ECGs. This will be the focus of revision for the upcoming course.

SCHOLARSHIP/DISSEMINATION

DISSEMINATION
I co-authored a paper titled "Improving High-Stakes Assessments in Medical Education", which was published in a high quality peer-reviewed journal.

- Doe J., Smith S. (2019) Improving High-Stakes Assessments in Medical Education. *Med. Ed.*, 14;263–269.

Fig. 21.1 Completed sample worksheet from the IAMSE Toolkits for the Evaluation, Advancement, and Promotion of Medical Science Educators illustrating how to document excellence (quantity and quality) and engagement (scholarly approach and scholarship) of an educator activity in the 'learner assessment' domain (Dickinson et al., 2020)

ical institutions publish guidelines for career advancement in a Faculty Handbook or Policy Manual. These rules can vary widely in terms of expectations for time spent in teaching, clinical practice (if relevant), scholarship, service, administration and leadership, professional development, mentoring, community service, and other roles. Some institutions have templates for CVs and educator portfolios, while others do not. Some institutions have appointments to distinct clinical, educational, or research tracks, with unique criteria for advancement for each, while others do not. Even when unique guidelines for recognition and advancement of medical educators exist, interpretation of those guidelines is not always clear. For this reason, individual faculty members must find ways to ascertain how they will be recognized and evaluated professionally. This may include discussions with mentors, others who successfully navigated the promotions process, and leadership such as one's department head, dean of faculty, or members of the promotion committee.

2. Collect and organize your documents: Collecting documentation for your educator portfolio is an important early step in portfolio creation. For early career faculty, beginning to collect and systematically organize evidence of excellence in teaching activities from the start is advantageous (Dalton et al., 2018). Following this advice is essential to reach academic promotion milestones for timely career advancement. To start, collect a broad assortment of documents to archive educational activities and scholarly products in the five educator domains. Scholarly products to include in an educator portfolio vary widely. Consider including educational activities with different group sizes (small and large), different learners (students, peers, leadership), different learning environments (lectures, simulations, clinics, lab), different teaching styles (didactic, TBL, PBL), different curricular innovations (web-based tutorials, podcasts, educational videos), and different types of professional development (conferences, seminars, certificate courses). You might also include other related activities such as assessment development, teaching improvements, mentoring activity, publications, book chapters, editorial activity, conference presentations, etc. (McGaghie, 2009; Windish et al., 2019). Each time an educational activity is concluded, the details should be added to the portfolio. The medical educator toolkits from IAMSE (Fig. 21.1) are great tools to document and reflect on activities as they are completed. Consider organizing the documents in a binder containing all relevant documents organized with tabs, or in a folder system on a computer, or anything in between (Simpson et al., 2007). Include brief notes and reflections as the documents are collected and filed; the deeper reflection and refinement comes later.
3. Structure your portfolio: If your institution provides a template or guidelines for an educator portfolio, use that to organize and structure your portfolio. If not, there are many published educator portfolio templates available in the literature (see the Further Reading section at the end of this chapter for a few specific references). Starting with a comprehensive developmental portfolio that covers all of the educator domains that are relevant to you is a good way to document a broad array of activities and achievements. The developmental portfolio can be honed and focused for specific uses such as promotion and job interviews as needed.
4. Reflect on your work: Reflective practice is a way of intentionally studying your own experiences to improve the way you work (Aronson, 2011). Ask yourself how an activity went and how you could improve it. Be intentional about dedi-

cating time to reflect on educational activities in your portfolio; adding an appointment to your calendar 2–3 times a year is effective. Critically evaluate the activity, identify the key lessons learned, and develop a plan for future iterations of the activity – this is the crux of scholarly work. These reflection periods are also a great time to work on writing or refining your educational philosophy statement and long-term goals.

5. Review and update annually: A comprehensive, annual (at least) review of your developmental portfolio is essential to keep your portfolio current and complete. This allows you to have an updated version ready for your annual performance review and facilitates the efficient creation of a well-developed promotional portfolio when needed.

Venues for Dissemination of Educational Scholarship

Traditional venues for disseminating research, such as journals and professional meetings, are important for educational scholarship. However, these venues are not adequate to meet the needs of diverse educational activities that can be scholarly in medical education (McGaghie, 2009). Table 21.2 lists the common types of works for dissemination in medical education, the diverse venues for dissemination of educational activities, and some examples of activities for each venue.

Challenges in the Promotion of Medical Educators

Despite the substantial efforts to advance the recognition and reward of medical educators and the scholarship of teaching over the past 30 years, the scholarship of discovery continues to garner higher value and greater reward than other types of scholarship (Irby & O'Sullivan, 2018). Faculty with primary appointments as medical educators face a number of unique challenges for advancement, including a lack of time and resources for scholarship (Hatch, 2006). Further, there is tension over the validity of educational scholarship and the disparity of institutional recognition and reward between medical education faculty and biomedical research faculty (Hatch, 2006; McKinney, 2007; Thammasitboon et al., 2017). At the institutional level, the guidelines and quality metrics for the recognition and reward of medical educators are highly variable and often vague, unclear, or non-existent (Dickinson et al., 2018). Lack of fiscal support for medical education scholarship is also a challenge, as grants are typically small and limited (compared to biomedical research). These financial constraints can lead to a lack of protected time for educational work (Van Melle et al., 2014). Finally, evidence for career advancement still tends to focus on traditional metrics. Differences in how educational journals are ranked, how author order differs, and how scholarly work outside of peer-reviewed journals is disseminated and assessed can foster bias towards education as a scholarly and

Table 21.2 List of common types of works for dissemination in medical education, venues in which the works can be disseminated, and examples of works for each venue (Simpson et al., 2004; Aronson, 2011)

Types of work	Dissemination venues	Examples of works
Textual works	Peer-reviewed journals	Original research, curricular innovations, commentaries, monographs, short communications, case reports, evaluation methods, multi-institutional research, etc.
	Books and book chapters (author or editor)	Textbooks, examination prep books, medical books, etc.
	Reference works, reports, and gray literature (author or editor)	Handbooks, guides, policy manuals, newsletters, proceedings, dissertations, theses, online resources such as Wikipedia, WebMD, UpToDate, etc.
	Conference presentations and proceedings	Abstracts, posters, oral presentations, plenary talks, focus sessions, workshops, etc.
Curricular materials	Online repositories (i.e., MedEDPORTAL)	Syllabi, e-leaning materials, lecture materials, concept maps, case-based learning resources (TBL, PBL), simulations, OSCE tools, assessment tools, narrated-animated videos, tutorials, etc.
	Case banks	Case-based learning resources (TBL, PBL, etc.)
	Toolboxes or toolkits	Collection of expert resources (often digital) that target a specific issue or audience and help translate theory into practice
	Online course or massive open online course (MOOC)	Complete course materials, syllabi, assessments, PowerPoint presentations, lecture notes, videos, narrations, etc.
Online media	Social media platforms (Facebook, Twitter, Instagram, YouTube, etc.)	Curricular materials, tutorials, formative assessments, TED Talks, Q&As, mentoring, content sharing, etc.
	Webpages and websites	Curricular materials, videos, tutorials, images, assessments, etc.
	Free open access meducation (FOAM)	Blogs, podcasts, webpages or websites (Khan Academy, Life in the Fast Lane, etc.)

promotable activity and make it difficult to evaluate the impact of educational scholarship (Van Melle et al., 2014).

In addition to the challenges faced by all, there is persistent inequity in the promotion of women to senior leadership positions, promotion of underrepresented racial and ethnic groups, and appointment and promotion of lesbian, gay, bisexual, transgender, and queer (LGBTQ) individuals. This results in added struggle for educators within these groups (Callahan et al., 2017; Sánchez et al., 2013; Carr et al., 2017; Sánchez et al., 2015). A shortage of role models and mentors, unclear promotion criteria, and unsupportive institutional culture further impair the recruitment, promotion, and retention of women, underrepresented minorities, and LGBTQ individuals in medicine (Sánchez et al., 2013, 2015).

To combat these challenges, institutions must provide mechanisms to support the professional development of a diverse body of medical educators, create a promotions process that fosters equality and inclusion, and reward the scholarly creation and dissemination of work in medical educational. Department heads play a vital role in mentoring faculty and promoting educational scholarship as a possible career path. Local institutions and national organizations must provide more opportunities for funding and platforms for peer review and dissemination of non-traditional forms of educational scholarship. The creation of teaching academies can also be instrumental in providing recognition, support, and development of medical educators (Van Melle et al., 2014). A great deal has been accomplished in the recognition and reward of medical educators, but there is still much work to do.

Summary

The educator portfolio is a crucial tool for medical educators. Regardless of the organization and structure, the portfolio should be a dynamic collection of evidence that illustrates growth and development in the educator domains, promotes self-assessment and reflection, and supports the appraisal and advancement of medical educators.

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Further Reading

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Appendix

Additional Information About Medical Education

As your journey into medical education unfolds, you may want to refer to advanced resources in the field. Below we have compiled a list of medical education resources that should help your teaching career.

Medical Education Publications

Academic Medicine This is the official journal of the Association of American Medical Colleges (AAMC). This journal publishes articles pertaining to the organization and operation of academic medical centers, emerging themes and contemporary issues and medical education research findings. http://journals.lww.com/academicmedicine

Advances in Health Sciences Education This journal is a forum for scholarly and state-of-the art research into all aspects of health sciences education. https://www.springer.com/journal/10459/

British Medical Journal The British Medical Journal publishes many article types on a range of topics including medical education. The widely renown series of articles entitled "ABC of Teaching and Learning in Medicine" was compiled into a single volume, now in its third edition. The series covers various practical aspects of medical education. https://www.wiley.com/en-us/ABC+of+Learning+and+Teaching+in+Medicine,+3rd+Edition-p-9781118892176

K. N. Huggett et al. (eds.), *An Introduction to Medical Teaching*, Innovation and Change in Professional Education 20, https://doi.org/10.1007/978-3-030-85524-6

The Clinical Teacher This is a publication of the Association for the Study of Medical Education. Designed for clinicians who teach, this journal aims to provide "easy access to the latest research, practice and thinking in medical education presented in a readable, stimulating and practical style." http://www.theclinicalteacher.com

Focus on Health Professional Education This is a refereed journal sponsored by the Association for Health Professional Education. It is primarily directed at educators and students in the Western Pacific Region of Australia, New Zealand, and South-East Asia. www.anzahpe.org

Journal of the American Medical Association This journal publishes an annual issue devoted to articles on medical education. http://jama.ama-assn.org

Medical Science Educator This journal is the successor of the journal *JIAMSE* and is a peer-reviewed publication of the International Association of Medical Science Educators (IAMSE). This electronic journal publishes original research, reviews, editorials, and opinion papers on medical education. http://www.medicalscience-educator.org/

Journal of Interprofessional Care This journal publishes original, peer-reviewed papers of interest to those working on collaboration in education, practice and research between medicine, nursing, allied health, veterinary science, and other health related fields. http://informahealthcare.com/journal/jic

Journal of Interprofessional Education and Practice This journal publishes peer-reviewed articles and reports of innovations in interprofessional education and practice, with particular emphasis on "current issues and trends in interprofessional healthcare topics." https://www.journals.elsevier.com/journal-of-interprofessional-education-and-practice

Medical Education This journal is published by the Association for the Study of Medical Education (ASME). Medical Education is a prominent journal in the field of education for health care professionals, and primarily publishes research related to undergraduate education, postgraduate training, continuing professional development and interprofessional education. http://www.mededuc.com

Medical Education Online This journal publishes peer-reviewed investigations in medical education. www.tandfonline.com/toc/zmeo20/current

Medical Teacher This journal is published by the Association for Medical Education in Europe (AMEE). Medical Teacher offers descriptions of new teaching methods, guidance on structuring courses and assessing achievement, and is a "forum for communication between medical teachers and those involved in general education." https://www.tandfonline.com/toc/imte20/current

New England Journal of Medicine This top clinical journal also publishes occasional articles devoted to the topic of medical education. http://www.nejm.org/

Teaching and Learning in Medicine This is an international forum for scholarly research on medical teaching and assessment. The journal addresses practical issues and provides the analysis and empirical research needed to facilitate decision making about medical education. https://www.tandfonline.com/toc/htlm20/current

Curriculum Resources and Repositories

Best Evidence in Medical Education (BEME) BEME is an international group devoted to the dissemination of information about the best practices in medical education. They produce useful systematic reviews that reflect the best evidence available for various topics. http://www.bemecollaboration.org

Multimedia Educational Resource for Learning and Online Teaching (MERLOT) MERLOT is a free searchable collection of peer-reviewed and selected online learning materials. This collection contains materials from all fields but does feature a large repository of health sciences content. Resources are available for use under the terms described by the author, and users may also contribute content to the repository as well. http://www.merlot.org

MedEdPORTAL MedEdPORTAL is a free publishing venue and dissemination portal sponsored by the Association of American Medical Colleges. It features peer reviewed online teaching and learning resources in medical and health professions education including tutorials, virtual patients, cases, lab manuals, assessment instruments, and faculty development materials. MedEdPORTAL covers undergraduate, graduate, and continuing medical education. Users can also contribute materials for peer review and publication. http://www.aamc.org/mededportal

Health Education Assets Library (HEAL) HEAL is a digital library of peer reviewed multimedia teaching resources for the health sciences. HEAL provides access to tens of thousands of images, videoclips, animations, presentations, and audio files that support healthcare education. Users can contribute media files for inclusion into the library. http://library.med.utah.edu/heal/

Organizations

In addition to publishing scholarly journals, medical education organizations offer many other benefits, especially the opportunity to interact and network with medical teachers and scholars. The following organizations offer a variety of venues for faculty development and scholarship of teaching such as annual meetings, special conferences, online faculty development opportunities, etc.

American Interprofessional Health Collaborative This is the professional community for the National Center for Interprofessional Practice and Education. AIHC contributes to better health and improved outcomes by redesigning how the health care workforce is prepared and how care is organized and delivered. https://aihc-us.org/

Association for Medical Education in Europe (AMEE) The Association for Medical Education in Europe is a worldwide organization including teachers, researchers, administrators, curriculum developers, assessors and students in medicine and the healthcare professions. AMEE hosts an annual meeting and offers courses on teaching, assessment and research skills for teachers in healthcare professions. http://www.amee.org

Association for the Study of Medical Education (ASME) ASME "seeks to improve the quality of medical education by bringing together individuals and organizations with interests and responsibilities in medical and healthcare education." www.asme.org.uk

American Association of Osteopathic College of Medicine (AACOM) AACOM "was founded in 1898 to lend support and assistance to the nation's osteopathic medical schools, and to serve as a unifying voice for osteopathic medical education." AACOM hosts meetings to foster collaboration and innovation; provides centralized data services for member institutions; and develops initiatives to increase awareness of osteopathic medical education and osteopathic medicine. www.aacom.org

Association of American Medical Colleges (AAMC) The AAMC is an organization of allopathic medical schools in the United States and Canada. The AAMC hosts meetings that deal with topics of interest to all aspects of medical education: organizational issues, research and best practices in medical education, student affairs and postgraduate training. The Group on Educational Affairs of the AAMC also hosts regional conferences devoted to curriculum and medical education research. www.aamc.org

Australian and New Zealand Association for Health Professional Educators (ANZAHPE) ANZAHPE is an organization that promotes education in the health professions and fosters research, continuing education, and communication between educators in the health professions. AZAME's scope includes undergraduate and postgraduate training and continuing education. www.anzahpe.org

Foundation for Advancement of International Medical Education and Research (FAIMER) FAIMER focuses on faculty development, research on workforce policy and practice, and advancing educational quality improvement. FAIMER offers fellowships and advanced degrees in health sciences education. www.faimer.org

International Association of Medical Science Educators (IAMSE) IAMSE follows the guiding principle that "all who teach the sciences fundamental to medical practice should have access to the most current information and skills needed to excel as educators." IAMSE sponsors an annual meeting as well as other conferences and faculty development activities and publishes a journal. http://iamse.org/

International Ottawa Conferences on Medical Education This biennial conference is held alternately in North America and elsewhere in the world. This conference focuses on development of education in the healthcare professions by providing a forum for the discussion, debate and the reporting of innovations in the field of assessment. http://www.ottawaconference.org

Panamerican Federation of Associations of Medical Schools (PAFAMS) PAFAMS is a private, non-profit, non-governmental organization whose mission is the promotion and advancement of medical education and the biomedical sciences in the American Continent. http://www.fepafempafams.org/

Society for Simulation in Healthcare (SSIH) This organization "fosters the improvement and application of simulation–based modalities such as human patient simulators, virtual reality, standardized patients and task trainers." The membership of SSIH includes "physicians, nurses, allied health and paramedical personnel, researchers, educators and developers from around the globe." https://www.ssih.org/

Team-Based Learning Collaborative (TBLC) This is an international organization of educators who "encourage and support the use of Team-Based Learning in all levels of education." The TBLC offers an annual conference, faculty development events, and a Knowledge of the Fundamentals of TBL Certificate program. http://www.teambasedlearning.org/

World Federation for Medical Education (WFME) The WFME is a global organization representing six regional associations for medical education. It is primarily concerned with enhancement of the quality of medical education worldwide through establishment of standards. http://www.wfme.org/