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REVIEW ARTICLE/BRIEF REVIEW

Review article: Teaching, learning, and the pursuit of excellence in anesthesia education

Article de synthèse: L'enseignement, l'apprentissage et la poursuite de l'excellence dans la formation en anesthésie

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Abstract

Purpose *Excellence in anesthesia education has been advocated to meet the future needs and direction of the specialty. The purpose of this article is twofold: first, to review the current medical education literature and theory in order to inform teaching and learning in anesthesia; and second, to advocate for excellence in anesthesia education.*

Source *This review considers the general education, educational psychology, and medical education literature based on a search of the MEDLINE and ERIC databases, educational Web sites, and library catalogues.*

Principal findings *Excellent teaching is considered that which facilitates and maximizes learning. A conceptual framework of learning as a convergence of teacher, learner, assessment, and context is proposed. The contribution of each component to learning is examined in order to enable anesthesia teachers to choose and adapt the most appropriate educational approaches for their particular contexts. The relationship of excellent teaching, scholarly teaching, and the scholarship of teaching is explored. Strategies for promoting excellence in anesthesia education are suggested.*

Conclusions *The call for excellence in anesthesia has become an important theme, particularly with respect to education. While excellent teaching is a goal to which all anesthesia faculty should aspire, scholarly teaching and scholarship in teaching should also be promoted in order to advance anesthesia education for the benefit of the profession and ultimately for patient care.*

Résumé

Objectif *L'excellence dans la formation en anesthésie a été promue afin de répondre aux besoins et à l'orientation futurs de la spécialité. L'objectif de cet article est double: en premier lieu, de passer en revue la littérature et les théories actuelles sur la formation médicale afin de guider l'enseignement et l'apprentissage en anesthésie et, en second lieu, de promouvoir l'excellence dans la formation en anesthésie.*

Source *Cette synthèse porte sur la littérature traitant de la formation générale, la psychologie pédagogique et la formation médicale. Les articles analysés sont tirés d'une recherche des bases de données MEDLINE et ERIC, des sites Internet pédagogiques et des catalogues des bibliothèques.*

Constatations principales *Pour que l'enseignement soit considéré comme excellent, il doit faciliter et optimiser l'apprentissage. Un cadre conceptuel d'apprentissage qui fait converger l'enseignant, l'apprenant, l'évaluation et le contexte est proposé. La contribution de chaque composante à l'apprentissage est examinée afin de permettre aux enseignants en anesthésie de choisir et d'adapter les approches pédagogiques les plus appropriées à leurs contextes particuliers. La relation entre un enseignement excellent, un enseignement scientifique et l'érudition dans l'enseignement est explorée. Des stratégies pour promouvoir l'excellence dans la formation en anesthésie sont proposées.*

Conclusion *L'appel à l'excellence en anesthésie est devenu un thème important, particulièrement en ce qui touche à la formation. Alors que l'excellence en enseignement est un objectif vers lequel le corps enseignant en anesthésie dans son intégralité devrait aspirer, l'enseignement scientifique et l'érudition dans l'enseignement devraient également être*

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promus afin de faire avancer la formation en anesthésie pour le bienfait de la profession et, en fin de compte, des soins aux patients.

The practice of medicine is changing at a dynamic rate, fuelled by new technologies, drugs, and therapeutic interventions. Medical organizations throughout North America have embarked on major initiatives aimed at revising medical education in order to keep up with this rapid pace of change.[1] In Canada, the Royal College of Physicians and Surgeons of Canada has exemplified this strategy by the adoption of the CanMEDs competency-based curricular framework for residency training programs.[2] In addition, "best evidence medical education" (BEME) has emerged in response to demands for a more robust use of theory and evidence to support practice in medical education.[3,4] Furthermore, there is a growing recognition of the need to value teaching as a scholarly activity in order to advance medical education.[5]

In anesthesiology, concerns about the future needs and direction of the profession have precipitated calls for the pursuit of excellence, particularly in education.[6-8] Pardo[7] advocates for a concerted effort to "organize our teachers to pursue excellence in education", supported by strong organizational recognition and educational academies that prioritize the educational mission and faculty development. To answer the call for excellence in anesthesia education, educators need to go beyond the "see one, do one, teach one" motto, not only to pursue excellent teaching but also to engage in scholarly teaching and the scholarship of teaching.

The purpose of this article is twofold: first, to enable the anesthesia program directors and faculty members who teach to make sense of the current medical education literature in order to facilitate teaching, learning, and program planning in anesthesia; and second, to advocate for excellence in anesthesia education. This article expands on Bould *et al.*'s[9] introductory review of key issues in anesthesia education. It focuses on how anesthesia educators can facilitate learning by considering its different components (i.e., teacher, learner, assessment, and context) as well as by exploring the relationship of excellent teaching with the scholarship of teaching. Additional articles in this special review series will feature further in-depth discussion of educational scholarship as well as other aspects of anesthesia education, including assessment, human factors, simulation, and medical education research methodology.

The focus of much of the literature on teaching and learning concerns the discussion of teaching techniques or tips.[10,11] While this approach has practical appeal, this article adopts a general theoretical perspective with the premise that theory provides the basis for informed practice. Rather than reviewing specific teaching techniques in anesthesia, this paper draws from the general education, educational psychology, and medical education literature to provide the broad educational principles that will then enable anesthesia teachers to choose the most appropriate educational approaches for their particular contexts. This review also takes the position that there is no single model or "best practice" in teaching—the key is the appropriateness of use.

For this review, a MEDLINE search was conducted for relevant articles from 1990 to 2011 using the keywords: "medical education", "teaching and learning", "learning theories", "assessment", "feedback and medical education", "anesthesiology and education". The ERIC database was searched for the keywords: "scholarship of teaching and learning". Specific citations from searched articles were also retrieved. In addition, the McMaster University and the University of Toronto library catalogues were searched for literature on teaching and learning. Finally, specific Web sites, including the BEME Web site and those of the medical education journals, *Medical Education, Medical Teacher*, and *Academic Medicine,* were handsearched to find relevant literature.

This article is divided into several sections. First, a conceptual framework of learning is described as the convergence of teacher, learner, assessment, and context. Second, the contribution of each component to learning is examined in order to enable anesthesia educators to develop a comprehensive and theory-based approach to teaching. Third, an overview is provided regarding the relationship between excellent teaching, scholarly teaching, and the scholarship of teaching. Finally, the article concludes with suggestions for the promotion of excellent and scholarly teaching in anesthesia.

Teaching and learning: a conceptual framework

Anesthesiologists work in a wide variety of settings, including the operating room, intensive care unit, emergency room, diagnostic and interventional radiology suites, obstetrical wards, and clinic settings. In particular, the operating room is a unique, dynamic, and complex environment where there are particularly acute workload demands on anesthesiologists to manage patient, surgeon, equipment, and personnel interactions.[12] Teaching and supervision in this complex interactive environment can be particularly challenging.[12] Using a conceptual model of learning can provide a framework to help anesthesia teachers develop reasoned educational strategies to optimize learning while simultaneously dealing with

competing demands of patient care and operating room management.

Teaching has been defined as "enabling a person to do something by instruction and training".[13] On the other hand, learning is defined as "a process that leads to a change" in knowledge, beliefs, behaviours, and attitudes of the learner.[14] In addition to teaching, assessment and context also play major roles in learning.[15] We can consider the components of an educational activity as encompassing teacher, learner, and assessment within a particular context. As illustrated by the Figure, we can conceptualize learning, the ultimate desired outcome of an educational activity, where all of these different components converge. A holistic approach to facilitate learning with this conceptual framework would be to consider these different components when making decisions about educational strategies. Each is examined in the following section.

Teachers and teaching

The medical education literature pertaining to teaching falls into several categories: defining the characteristics of good teachers, good teaching practices, and professional development. There is also a body of literature which focuses on learning theories. Learning theories guide teaching practices by describing the conditions and factors under which effective learning can be promoted.[16,17]

The characteristics of good teachers from both the learners' and teachers' perspectives have been examined extensively.[18-22] These characteristics generally pertain to aspects of personal qualities (e.g., friendliness, supportiveness, and respectfulness), skillfulness as a clinician (knowledge, clinical competence, compassionate care), and skillfulness as a teacher (commitment to teaching, ability to actively engage the learner, and knowledge of teaching and learning principles).[19-22] Good teachers are also seen as role models.[22-24] In addition to qualities such as interpersonal skills, dedication, commitment, enthusiasm for teaching and the profession, Cleave-Hogg *et al.*[25] found that good anesthesia teachers emphasize the development of higher order thinking skills in residents.

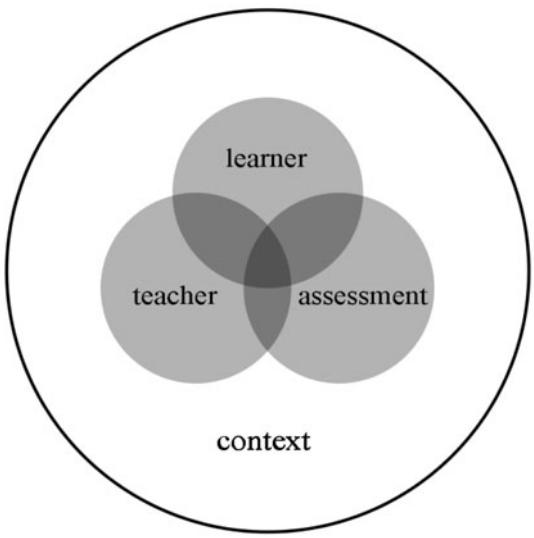

Figure Learning as a convergence of teacher, learner, assessment, and context

There is a body of literature which is aimed at defining good teaching through evaluation standards.[26] Hesketh *et al.*[27] have developed a model to evaluate excellence as a clinical educator which is based on 12 expected competencies, including competence in teaching in a variety of contexts, developing and working with different resources, attitudes and interpersonal skills, knowledge of learning theories, and use of best evidence medical education. Berk[28] describes 12 strategies which can be used to measure teaching effectiveness, including student, peer, and administrator ratings; self evaluation; and use of videos, learning outcome measures, and teaching portfolios. He advocates a multisource approach which allows for triangulation and increased reliability and validity.

There is much educational literature that focuses on what is considered to be good teaching practices. Common themes in this category of literature include a student-centred approach, teaching methods that stimulate active rather than passive learning, problem-based learning, teaching in different clinical settings, use of learning theories (particularly adult learning theory), and feedback.[10,11,29-31] For example, in their edited text, Greaves *et al.*[31] discuss practical approaches to clinical teaching in anesthesia, including the teaching of procedures, decision-making and non-technical skills, and professionalism in the operating room and other settings. This category of literature is considerably valuable and applicable for practicing educators; however, Pratt *et al.*[32] caution against reading this literature as a "one size fits all" notion of good teaching. In addition, Witman *et al.*[33] critique some of the work in this category as being advice that is based largely on personal experience—"This is what I did and everyone liked it" —rather than being based on theory and empirical evidence.

The literature pertaining to effective clinical supervision is related to good teaching practices. In their literature review, Kilminster *et al.*[34] define clinical supervision as "the provision of monitoring, guidance, and feedback on matters of personal, professional, and educational development in the context of the doctor's care of patients". They found that the quality of the supervisor-trainee relationship, rather than supervisory methods, is the most important factor for effective clinical supervision and positive patient outcomes. Characteristics of effective

supervisors include empathy, respectfulness, flexibility, knowledge, and interest in their trainees.[34]

Finally, in the literature on faculty development, there is growing agreement that teaching is a skill that needs to be taught and fostered for excellence rather than an innate ability that comes with clinical expertise.[35] In a systematic review of faculty development initiatives for improving teaching effectiveness, Steinert *et al.*[35] found that the literature supports the efficacy of these programs in fostering changes in attitudes and behaviours, gains in knowledge, and changes in organizational practice and student learning.

Learning theories

Teachers hold implicit theories about teaching related to their beliefs about learning, knowledge, and the teacher-learner relationship.[16,32] However, unless the teacher is able to access her/his tacit knowledge explicitly and relate this knowledge to a larger body of educational theory, the teacher may fail to articulate, justify, or modify her/his teaching strategy to improve teaching effectiveness.[17,32]

There are many theories of learning; however, only a few of the dominant theories are highlighted here to illustrate how they can be used to inform educational decisions and strategies. Learning theories can be broadly categorized into behaviourist, cognitive, constructivist, social learning, and humanist approaches. Each approach has a set of assumptions about what facilitates learning as well the nature of the teacher- learner relationship.

The behaviourist approach to learning focuses on behaviour as a learned response to stimulus and the environment. This approach tends to emphasize the role of the teacher in directing learners towards specified objectives or outcomes. Positive (or negative) reinforcement, such the use of feedback and assessments, are used to bring about desired learning outcomes. Competency-based curriculum draws from this approach.[36] An example of a behaviourist approach is a highly structured curriculum which uses airway simulators to teach fibreoptic airway skills and in which expected competencies to be acquired are clearly defined. The expected competencies are reinforced by positive or negative feedback either directly from the instructor or indirectly through simulator-generated feedback.

The cognitive approach to learning takes the view of learning as residing within the individual's memory and internal cognitive processes, such as perception, information processing, storage, and retrieval. Research in cognitive psychology has shown that memory processes are enhanced by elaborative rehearsal (connecting the meaning of information to other concepts already in memory) and deep processing of information (thinking about the information in terms of their underlying meaning rather than their superficial characteristics).[37] For example, the retention of a new concept, such as negative pressure pulmonary edema, is less likely if it is taught in isolation than if it is presented within a clinical context or problem which the learner has previously encountered. Connecting the concept to known pre-existing physiologic mechanisms and treatments should also improve retention. Furthermore, it has been found that the ease of information retrieval from long-term memory increases with its frequency of retrieval, thus supporting the use of repeated practice.[37] Therefore, the cognitive approach would promote active learning processes through the use of many illustrative examples, discussions, problem-based cases, and repeated practice. Other concepts in cognitive psychology include encoding and context specificity, which is discussed later in the article.[37]

The constructivist approach to learning, such as Kolb's theory of experiential learning, views learning as an active development of meaning brought about by the learner's experiences.[16,38] Kolb's learning cycle consists of a concrete experience followed by reflective observation which results in abstract conceptualizations about the experience.[16,38] These conceptualizations or theories are then tested by active experimentation which results in another concrete experience and a new learning cycle.[16,38] A related approach is reflective practice, proposed by Schon[39] as an important part of dealing with indeterminacy in professional practice. Deviations from expected outcomes cause practitioners to engage in "reflection-in-action", to critically re-assess the presenting problem, and to find solutions. "Reflection-on-action" follows after the event to develop a more refined representation of the problem which can then be validated or disproved.[39]

As it promotes "learning by doing", experiential learning theory lends itself to performance and technical specialties such as anesthesia and surgery. To promote the Kolb cycle of learning rather than follow a prescribed set of learning objectives, Tweed *et al.*[40] proposed an experiential curriculum for anesthesia residency training which focuses on maximizing exposure to clinical experiences. Use of simulation to allow learners to experience unexpected clinical situations is consistent with an experiential learning approach[41]; for example, a simulated experience of intraoperative laryngospasm could serve as a stimulus for reflection and could generate causal theories. During a repeated similar scenario, residents can actively act on these theories in order to test their assumptions and, in so doing, learn from their experience.

The humanist approach views learning as being an integral part of human growth and autonomy. The focus is learner-centred, and the role of the teacher is to enable learners to recognize and reach their potential. Knowles'

Adult Learning Theory is an exemplar of this approach.[42] It assumes that adult learners are naturally self-directed and internally motivated to learn and that learning needs to be relevant to their past and present experiences. A humanistic approach would adopt a learner-centred focus, negotiate individualized learning objectives, and make use of self-directed learning strategies and self assessment. Problem-based learning curricula in medical schools (e.g. McMaster University) are an example of this approach. Another example of taking the humanist approach is allowing residents, with assistance from faculty, to construct their own academic curriculum and modes of instruction and assessment.

Social learning theories view learners as learning by means of interacting and observing others within a social and community context.[16,17] This approach focuses on learning by observation, role modelling, and apprenticeship. The teacher acts a mentor and maintains a close supportive relationship with the learner. Sociocultural theories, situated learning, and communities of practice derive from social learning theories with their focus on learning as a shared and social activity.[43] These theories may be particularly relevant for acquiring professionalism, communication skills, or "non-technical skills" in anesthesia, such as task management, team work, and situation awareness.[44,45]

These different categories of learning theories are not mutually exclusive, and it is not uncommon to make use of the tenets of more than one school depending on the context. Laidley *et al.*[46] view a threefold role for the use of learning theories: to help predict which current approaches should be effective, to create a framework for evaluating current practices, and to create a framework for new untested strategies.

Learner style and motivation

Learners bring their own experiences, emotions, personal and cultural characteristics, and motivations which affect how they receive, perceive, process, and act on information. Learning style is a learner characteristic which has been a topic of research. North American researchers have classified learning styles based on differences in cognitive processes of perception, thinking, and judgement or personality traits.[47] An example is the Kolb's Learning Style Inventory[38] which classifies learners into Divergers (view concrete situations from many points of view), Assimilators (create theoretical models from a wide range of disparate information), Convergers (find practical solutions for ideas), and Accommodators (learn from direct practical experience). Baker *et al.*[48] studied learning styles in 205 anesthesiologists and found them distributed across all four learning styles, with a slightly higher proportion falling into the Accommodator category (31% *vs* 21-24% in the others). Their follow-up study of four residency training programs showed a predominance of the Accommodator and Converger learning styles in both faculty and residents, although they did qualify their findings by stating that every training program has its own unique learning style profile.[48] Baker *et al.* concluded that the practice of anesthesia requires the flexibility of adapting to many different learning styles.[48]

On the other hand, European researchers, such as Newble and Entwistle,[49] have taken a different perspective by characterizing three distinct approaches to learning used by students. Their research has also provided empirical evidence of the relationship of motivation and assessment to learning. The deep approach to learning is characterized by acquiring an in-depth understanding of the material and is associated with an intrinsic motivation to incorporate the information into pre-existing knowledge. The surface approach to learning is characterized by identifying and memorizing the facts and ideas that are perceived to be important for testing, and it is associated with extrinsic motivation to pass the exam. The strategic approach to learning is characterized by use of either the deep or the surface approach depending on what is required for the exam, and it is associated with extrinsic motivation for academic achievement. From this research, it is suggested that deeper approaches to learning could be elicited by changing the type of assessment (e.g., essay questions instead of multiple choice questions), which in turn may improve understanding and retention.

It has also been suggested that learners will be more motivated and learn better if teaching styles were adjusted to fit their preferred learning styles, but this hypothesis has been empirically inconsistent.[30] Furthermore, learning styles are fluid rather than fixed, and the ability to adapt learning styles to different situations is important for professional success.[47,48] However, consideration of different learning styles is useful to help students understand their preferences and to capitalize on different strategies to promote learning.[30]

Assessment

Assessment of learners serves several purposes: it is used to gather information about the efficacy of the educational intervention, to measure competency of the individual for certification, to demonstrate accountability to stakeholders and regulatory bodies, and to stimulate learning.[50] Summative assessment serves the purposes of certification and accountability by ascertaining whether a certain standard has been met. Formative assessment serves the purpose of informing learners about their progress in order to improve and stimulate further learning.[50] The boundary between the

two types of assessment may be blurred, and ideally, summative assessment should also include elements of formative assessment.[30] With summative high-stakes assessment, psychometric criteria of validity, reliability, and equivalence are emphasized, while with formative assessment, the educational criteria are emphasized.[50]

As learners typically study the subject matter to be tested, assessment, particularly summative, has been described as the engine that "drives learning".[15] Indeed, assessment has been described as a form of instructional design.[51] Assessment may have both positive and negative effects on learning. Used as feedback, it may stimulate and improve learning; however, depending on the format, summative assessments may have a trivializing effect, resulting in superficial rather than deep learning.[52] As well, it is recognized that factors other than assessment influence learning—learners may be intrinsically rather than extrinsically motivated, and they may learn through other means, such as role modelling, observation, and social interaction.[52]

"Miller's pyramid" has been commonly used as a framework for assessing clinical competence.[53] The pyramid illustrates a hierarchy of increasing level of clinical competence from "knows" (knowledge) at the base, "knows how" (knowledge application), "shows how" (demonstration of skills), to the apex of "does" (actual practice in clinical setting). While assessment of the lower levels (knows and knows how) is relatively established, reliable and valid assessment of the higher levels (shows how and does) are still being developed.[15,50] Some of these assessment methods include the use of simulation and forms of workplace assessments.[50]

Formative assessment in the form of feedback has been shown to be integral to learning and developing expert performance.[54-57] Ericsson[57] showed that expert performance is attained through deliberate practice, which involves repeated targeted practice and immediate detailed feedback on performance. As anesthesia is a highly technical and performance-oriented specialty, the importance of feedback to enhance learning and performance (in the simulated and clinical setting) is particularly relevant. McGaghie *et al.*[58] have identified feedback as being the most important feature of the use of simulation-based medical education.

Properly managed feedback is effective in changing behaviour, improving performance, stimulating motivation, and improving self-reflection (i.e., the ability to self-assess and regulate learning processes).[55,56,59,60] However, poorly managed feedback can have damaging effects on motivation and performance.[55] Providing effective feedback is often one of an educator's most challenging tasks. Certain issues contribute to this difficulty, including inadequate training in giving feedback, avoidance of conflict, and concern over undermining a learner's self-confidence or the teacher-learner relationship.[55,59]

General principles of effective feedback derived from educational theory and empirical research[54-56] include:

1. Establishing a culture of feedback that is integrated as an expected part of a teacher-learner relationship which includes mutual respect and dialogue;
2. Establishing well-defined criteria against which the learner's performance can be compared;
3. Delivering feedback in descriptive non-judgemental language based on specific observable and remediable behaviours;
4. Eliciting the learner's self-understanding of his/her performance and checking for the learner's understanding of the feedback;
5. Timing feedback at or close to the event;
6. Limiting feedback to the amount that can be processed at one time and focusing on what can be changed;
7. Articulating a plan on how best to narrow the gap between actual and desired performance.

A classic approach to delivering feedback is the Pendleton model. It begins by first asking the learner to self-assess on positive aspects of his/her performance and is followed by the instructors' comments on positive aspects of the learner's performance.[61] The learner and teacher, respectively, then comment on the aspects of the performance that could improve.[55,61] Another common feedback technique is dubbed the "sandwich model" in which negative feedback is "sandwiched" between opening and closing positive feedback. These classic approaches have been criticized as being formulaic and potentially obscuring the essential feedback message by not candidly getting to the "heart of the matter".[55,61]

Cantillon *et al.*[55] suggests an alternative approach called the "reflective feedback conversation" which allows the learner to reflect on the difficulties he/she encountered and to problem solve about how to improve before the teacher elaborates on the learner's response, offers feedback and suggestions, and checks for understanding and agreement. This is believed to be a more learner-centred approach which encourages the development of self-assessment and reflection skills. However, this approach is contingent on the ability to self-assess, which can be highly variable and limited.[62]

The complexities in giving feedback have been highlighted by Kluger *et al.*[63] Contrary to the conventional wisdom, they found that negative feedback and positive feedback may not differ in their effects on motivation and performance. Specifically, both positive and negative feedback may have either positive or negative effects on motivation and performance depending on the context and the "self-regulation system" of the recipients. According to

Kluger *et al*.,[63] Higgin's theory of self-regulation proposes that two self-regulation systems operate within people, i.e., the prevention system (which is associated with avoiding pain) and the promotion system (which is associated with attaining pleasure).[56] It would be expected that negative feedback for prevention-focused tasks (such as those requiring vigilance or monitoring to avoid an accident) would improve motivation and performance as it would result in heightened arousal and awareness of the need to avoid further pain. On the other hand, it would be expected that positive feedback in this scenario would maintain the status quo, elicit little arousal, and result in lowered motivation and potentially lowered performance. In a promotion-focused task, such as initiating an educational innovation, positive feedback would positively influence motivation and performance by eliciting high arousal of this system, while negative feedback would have the opposite effect. Kluger *et al*. confirmed these predictions empirically and with two meta-analyses. They concluded that both positive and negative feedback can have unpredictable and unintended effects on motivation and performance.

Their work demonstrates the inherent complexity of feedback and highlights that its outcome is influenced not only by how it is delivered but also by its context and how it is received. Their work also supports Bing-You's[59] call for a renewed and expanded program on the subject of feedback, which is supplemented with rigorous research and faculty development to improve understanding and practice in this "crucial educational and social interaction".

Context

The context in which the educational activity takes place has an important influence on learning. Context is a broad term which may be taken to mean the actual physical setting (e.g., ward, operating room, intensive care unit, simulation lab), educational format of delivery (e.g., lecture, small group learning, practical workshop), the immediate teaching environment (e.g., accepting, safe, threatening, stressful), or the larger social and cultural environment.

The importance of context is highlighted by research in cognitive psychology.[37,64] An example is the phenomenon of "encoding specificity" where the successfulness of retrieval of information from memory depends on the similarity of the conditions during initial processing and during retrieval. This is demonstrated by the classic Godden and Baddeley experiment which compares recall of wordlists that were learned on land or underwater.[37,65] In their experiment, recall of wordlists was significantly improved if the testing environment matched that of learning. Recently, Finn *et al*.[66] found similar results in testing students who learned the anatomy of the kidney while wearing either their street clothes or their hospital scrub suits. The students' recall was significantly improved if they were tested in the same clothing they wore originally during the teaching. Therefore, if trainees learned about managing malignant hyperthermia in a classroom lecture and then were asked to retrieve the information by demonstrating the protocol in a simulation lab, their ability to do so would be impaired due to two contextual differences. First, the trainees were asked to retrieve the information in a different format from how it was encoded, and second, they were in a different setting for retrieval than they were for information processing. If the goal is to ensure that learners are able to retrieve and use the information when called upon in actual real-life situations, it is important to ensure that the context in which they learn the information approximates the authentic setting as closely as possible.

The phenomenon of "context specificity", wherein an individual's performance in a particular problem or situation is correlated poorly with performance in another, is another well established phenomenon in educational psychology.[37,64] This phenomenon further highlights that skills and performance are not necessarily generalizable across settings, but rather, they are highly context-sensitive.

The setting in which the educational activity occurs can affect the way the material is processed, and it can also have implications on how it is taught. For example, lectures have the advantage of being efficient in conveying large amounts of information to many learners under controlled and structured settings, but they have a disadvantage with respect to being a passive form of conveying knowledge. Small group problem-based learning, while showing no improvement in knowledge acquisition (and possibly showing a negative effect) compared with non-problem-based learning, has been shown to be associated with better knowledge application and performance in certain competencies such as communication skills.[67] However, it requires advanced teaching skills, and it is time-consuming and less efficient in conveying large amounts of information. Newer technologies have become prevalent, e.g., Web-based medical education learning formats such as online journals, educational sites, online discussion forums, podcasts, and Web-based interactive resources.[68] Despite their potential, the degree to which anesthesia teachers formally use these resources as part of their teaching or curricula is unclear.

Anesthesiologists have led the use of simulation, particularly high-fidelity simulation, for teaching, learning, and assessment.[69] Byrick *et al*.[69] argue for its use in the full spectrum of educational programs as well as for

enhancement of patient safety. Simulation-based medical education can be used to promote effective learning in several ways: simulators can replicate the clinical environment or situation, and they allow active learning, experimentation, and repeated deliberate practice without the concomitant disadvantages of time pressure, unpredictability and opportunistic clinical exposure, and patient risk.[69,70] Building on their previous reviews, McGaghie *et al.*[58] conducted a critical review of simulation-based medical education research from 2003 to 2009 with the goal to distil the 12 best features and educational practices of simulation-based education. They identified seven other uses of simulation-based medical education for effective learning in addition to the five uses (feedback, deliberate practice, curriculum integration, outcome measurement, and simulation fidelity) previously identified: skill acquisition and maintenance, mastery learning, transfer to practice, team training, high-stakes testing, instructor training, and authenticity with the educational and professional context.[58]

The affective aspects of the environment (e.g., the degree to which learners feel "safe" in expressing their views or in making mistakes) can potentially have enhancing or inhibiting effects on learning. It is important for the teacher to be aware of these potential effects in order to mitigate them or take them into consideration. Studies of stress have shown conflicting and variable effects on memory and performance.[71] Stress associated with elevated cortisol levels has been shown to be associated with improved memory consolidation but also associated with decrements in working memory and memory retrieval.[71] During Advanced Cardiac Life support (ACLS) learning in a high fidelity simulation lab, DeMaria *et al.*[72] were able to show improved ACLS skill retention in a group of medical students exposed to emotional stressors when compared with a matched group without the stressors. However, without sufficient evidence and research in this area, the deliberate use of stress to enhance learning can be fraught with ethical and methodological issues.

Excellent teaching, scholarly teaching, and the scholarship of teaching

In 1990, Ernest Boyer's seminal publication[73,74] introduced the idea of teaching as a form of scholarship in its own right. By identifying teaching as a scholarly activity, Boyer stressed that teaching must be valued as a specific skill and considered as important as research for the academic mission of universities. His publication catalyzed a paradigm shift in the recognition and promotion of the scholarship of teaching in medical education.[5,73]

Hutchings and Shulman[75] clarified the relationships between excellent teaching, scholarly teaching, and the scholarship of teaching. Ideally, the product of teaching is student learning, and therefore excellent teaching can be considered that which engages learners, communicates information effectively, and maximizes learning.[75,76] While excellent teaching itself provides sufficient benefit, scholarly teaching goes beyond by being informed by current educational literature and research in order to apply the most appropriate educational intervention, analyse outcomes, and conduct peer review to improve the teaching[5,75,76] Three additional criteria are needed for scholarship in teaching: it must be in a tangible form that is publically disseminated, it must be open to review and critique, and others must be allowed to use it or build on it to advance the field.[75,76] While excellent teaching is a goal to which all anesthesiologists should aspire, scholarly teaching and scholarship in teaching elevate excellent teaching beyond individual learners to advance education in the field for the benefit of others in the wider community and ultimately for the benefit of patient care.

Summary: Towards excellence in anesthesia education

The call for excellence in anesthesia has become a recurrent theme in the recent anesthesia literature. In exploring the meaning of excellence, Smith *et al.*[8] observe, "If competence is defined as an observable minimum standard, is excellence simply an extension of competence…or does it imply something else…something qualitatively different?" For Miller,[6] excellence in anesthesia has been conceptualized as the use of creativity, vision, and leadership in going beyond preconceived boundaries. Excellence has also been associated with professionalism.[8] While all of these definitions capture an aspect of excellence in anesthesia, for it to be realized, Pardo[7] argues that there must be investment in excellence in anesthesia education.

The promotion of excellence in anesthesia education occurs at the institutional, departmental, and individual level. There must be departmental and institutional recognition and support of teaching as a form of scholarship. Institutional recognition of excellence in education involves academic promotion and funding criteria that value educators and researchers equally. Pardo[7] suggests the creation of "Academies", strong formal organizations of educators that are dedicated to the educational mission of the institution and facilitate networking and collaboration at the departmental, faculty, national, and international levels. At the departmental level, excellent and scholarly teaching should be promoted through faculty development and mentoring programs that allow senior faculty educators to: mentor junior faculty on their teaching and related educational activities, conduct peer assessment of their teaching, give feedback and advice, help establish

networks, assist/collaborate in educational research, and facilitate self-reflection, professional growth, and career development.[77]

An excellent and scholarly approach to teaching and learning draws from broad educational principles and a multidisciplinary literature base. It is theory-based and evidence-informed. This approach includes a holistic conceptualization of learning that includes considerations of teacher, learner, assessment, and context. It reflects critically on its assumptions, philosophies, and practices. This approach is combined with the experiences and knowledge of the particular context to determine the most appropriate educational strategies. It then applies these strategies, monitors their effects and outcomes, and modifies them accordingly. This approach obtains peer input and communicates the findings in order to improve the educational practices of the organization or institution.

This article proposes a conceptual framework of learning as the convergence of learner, teacher, assessment, and context in order to enable anesthesia educators to develop a comprehensive approach to teaching. It is hoped that this review of the current medical education literature and theory not only helps to inform teaching and learning in anesthesia but also adds to the call for the pursuit of excellence and scholarship in teaching in order to advance anesthesia education and practice.

Key points

- Learning is conceptualized as the intersection of teacher, learner, assessment and context. A comprehensive approach to teaching considers all of these elements in order to determine the most appropriate strategies.
- Learning theories provide a basis for teaching by explicating a set of assumptions about what facilitates learning as well the nature of the teacher- learner relationship.
- Qualities of good teachers, the teacher-learner relationship, teaching approaches, learner characteristics, learning styles, assessment techniques, and the educational context are important influences on how learners process and integrate information.
- Excellence in anesthesia education encompasses not only excellent teaching but also scholarly teaching and scholarship in teaching.

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