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Blended learning in anesthesia education: current state and future model

Jaya Kannan^a and Viji Kurup^b

Purpose of review

Educators in anesthesia residency programs across the country are facing a number of challenges as they attempt to integrate blended learning techniques in their curriculum. Compared with the rest of higher education, which has made advances to varying degrees in the adoption of online learning, anesthesia education has been sporadic in the active integration of blended learning. The purpose of this review is to discuss the challenges in anesthesiology education and relevance of the Universal Design for Learning framework in addressing them.

Recent findings

There is a wide chasm between student demand for online education and the availability of trained faculty to teach. The design of the learning interface is important and will significantly affect the learning experience for the student.

Summary

This review examines recent literature pertaining to this field, both in the realm of higher education in general and medical education in particular, and proposes the application of a comprehensive learning model that is new to anesthesiology education and relevant to its goals of promoting self-directed learning.

Keywords

anesthesia education, blended-learning, millennial learners, Universal Design for Learning

INTRODUCTION

Top Universities have begun offering free online education recently, thereby radically altering the landscape of higher education. As it becomes more mainstream, virtual education is proving to be a game changer in how education is being envisioned and delivered. Like the rest of higher education, medical education has also been steadily integrating online education in the new millennium. While the field of anesthesiology has aimed to keep pace with online learning trends and has demonstrated an eagerness to integrate online learning, this path of transformation has been hindered by legitimate challenges. These include: the inherent nature of the specialty, which requires face-to-face hands-on training; demanding production pressures in hospitals that limit the time available for development of online courses; greater reliance on traditional methods of teaching; and a lack of process and resources for faculty training.

It is becoming increasingly common in US medical education to integrate blended learning via Learning Management Systems and Virtual Learning Environments. Compared with the rest

of higher education, however, which has advanced to varying degrees in adopting online learning, anesthesiology education has been sporadic in the active integration of blended learning, and this integration has been limited to a small minority of institutions.

Higher education today has gone past the point of debating whether online learning is useful. The question of HOW it can be integrated effectively has taken center stage in academic discussion. Studies analyzing the integration of online learning in anesthesiology have called for an e-learning model that uses Open Source solutions aimed at lifelong learning [1].

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KEY POINTS

- Several challenges persist, and struggles in anesthesiology education are similar to higher education's struggles in blended learning implementation.
- While there are studies indicating the positive role of specific online tools, one tool in isolation cannot ensure academic success. The suitability of the tool and how it is used effectively to meet the learning objectives are key variables in the students' learning experiences. An ideal framework will use multiple tools and strategies to maximize learner performance and present the student with an enriching learning environment.
- In building better infrastructure, top priority should be placed on expanding resources, funding, and capabilities for training of faculty.
- In order to raise the quality of online learning implementation, the field of anesthesiology needs to start by assigning as much value to teaching as it does to revenue-generating clinical practice.

Anesthesiology education is facing fresh challenges as a result of important policy changes by the Accreditation Council for Graduate Medical Education (ACGME) and American Board of Anesthesiology (ABA) in the last few years. In describing these challenges, this paper examines learning outcomes when using blended learning in recent national and regional studies. Distilling key concepts from available literature, we arrive at the conclusion that students employ a range of learning methodologies and learn from multiple modalities within the online environment. We propose the application of the Universal Design for Learning (UDL) as a theoretical framework for anesthesiology residency programs aimed at empowering students to develop as self-directed learners.

CURRENT CHALLENGES

Anesthesia residency programs are currently faced with a number of challenges for teaching and learning.

- (1) Medical educators are usually clinicians with a strong interest in teaching, who are trying to balance clinical practice and research with their educational interests. Medical education has been slow to adopt current pedagogical practices, a situation exemplified by Albert *et al.* [2]. Faculty who are content experts are usually not provided with any formal teacher training. Nevertheless, they are expected to magically formulate their own methods through trial and error.
- (2) In many institutions, the time spent teaching residents is neither compensated nor valued as much when compared with the credit given for clinical practice. Hence, this culture does not encourage younger anesthesiology faculty to get actively involved in teaching [3].
- (3) Some faculty who are accustomed to traditional methods of teaching and learning (e.g., textbooks and lecture format for teaching) are resistant to the integration of technology (e.g., lecture podcasts) and practices that foster collaboration among residents. This can be detrimental to a uniform implementation of technological tools across the entire curriculum [4].
- (4) The ACGME initially established duty hour restrictions in 2003, and modified them again in 2011, restricting duty hours to 80 hours per week for residents [5]. This policy is aimed at reducing the rates of stress and fatigue among residents. Many anesthesia departments have had to redesign their education sessions in light of the new recommendations. The fact that American residents across specialties perceive an improvement in their educational environment and an increase in their quality of life after implementation of duty hour restrictions is seen as a positive development [6]. However, a systematic review of the association between shift length and resident education failed to show any consistent change after the implementation of the work hour change [7]. Consequently, faculty is burdened with having to cover the same breadth of curriculum in a limited time.
- (5) The ABA proposal to modify the board examination process to include Basic and Advanced examinations, which should be finished mid-residency as opposed to the end of residency, will change the way in which residents are taught and the way in which they learn during their residency. This may increase the problem of 'teaching to the test' and reduce the focus on understanding basic concepts of physiology and pharmacology during the initial year of training.
- (6) Production pressures in the operating rooms mandate that in order to increase productivity, more rooms must be run with fewer anesthesiologists. Nowadays, academic anesthesiologists find themselves supervising more rooms. This gives them comparatively less time to spend teaching residents. It also makes them exhausted and leaves them with little enthusiasm to spend time with residents.

- (7) The current group of millennial generation residents expect greater integration of technology as part of effective teaching practices. They appreciate the ways in which technology enables them to multitask, and they have a high expectation of technology's usefulness and availability in all settings [8,9]. It is important to align with these current educational trends.
- (8) Residents' learning preferences vary greatly, with some of them wanting to read from textbooks, while others prefer to get their information from multimedia learning objects that are available electronically. Many go to the Internet as their first source of information and watch YouTube videos for procedures [10]. This makes it difficult to develop a model that fits the learning preferences of all students.

REVIEW OF CURRENT LITERATURE ON BLENDED LEARNING OUTCOME STUDIES

With the aim of sharing recent national perspectives in online learning, we present below brief summaries of three recently published reports.

In the first report, the International Association for K-12 Online Learning [11¹¹] has brought out an updated version of the national standards for quality online courses in October 2011, based upon the original Southern Regional Education Board (SREB) standards. This model adds value to the development, delivery, and assessment of blended courses by providing a diagrammatic representation of 'defining dimensions of blended learning programs'. In particular, it presents the characteristics and range of implementation practices with a focus on the variety of instructional models. It gives the beginner an improved understanding of how various online tools can be implemented, especially in a blended learning context. According to this report, new models are not just improvements over old models, but are moving towards 'personalizing digital learning for each individual student at scale'. This has great significance for the anesthesiology classroom, which consists of a heterogeneous mix of international students bringing a wide range of prior knowledge and varying degrees of learning competencies.

The second report, a 2012 article [12], that presents survey results on the impact of e-learning is based solely on current trends in community colleges. Nevertheless, it seems representative of the challenges in higher education overall today. The observations in the report validate what we know intuitively, namely that there is a wide chasm between student demand for online education and the availability of trained faculty to teach.

Administrators who responded to the survey reported an increase in the number of hours required to train faculty. The top reason for struggles with faculty training included time needed (at least 8 hours) and emotional resistance from some faculty groups.

The third report, a meta-analysis released by the US Department of Education in 2009 describes the presence of more than a thousand papers on online learning between 1996 and 2008, but only 176 of them had a good experimental design and used objective measures for outcome [13¹³]. Although the project was undertaken to shed light on K-12 teaching, most of the articles were related to medicine and healthcare. Blended learning has been used in medical education for a long time [14]. A number of studies have been published on the subject, but rigorous trials comparing methods with similar instructional design are lacking within the domain of medical education, as compared with research being conducted in higher education overall. Given this picture, the high percentage of online learning reports from medicine and healthcare featured in the 2009 meta-analysis might seem unusual. However, this is highly indicative of a strong interest in conducting studies among these groups. The main finding was that courses using online resources showed slightly better learning outcomes compared to courses that were limited to only traditional face-to-face instruction. The nature of curriculum materials and instructional design also proved to be key variables in influencing learner outcomes.

The core principles for application of the science of learning to medical education by Mayer [15] and the pedagogical benefits of e-learning by Griffin *et al.* [16¹⁶] can serve as useful references for anesthesiology research.

From this overall review of blended learning in national conversations, it is clear that an enriching dialogue is taking place on many campuses. The e-learning models available from research can serve as useful guides for best practice implementation and applied to anesthesiology education, without having to reinvent the wheel. Several frameworks such as *Quality Matters* and, most recently, *Inter-regional Guidelines for the Evaluation of Distance Education (Online Learning)* are available to institutions for planning and evaluating online learning. Anesthesiology education is much more focused on the subject areas in curriculum planning and delivery; however, it lacks a systematized approach for learning from current trends and applying pedagogical principles relevant to e-learning within resident education.

This next section looks at research results from recent publications focused on three online tools:

video lessons, podcasts, and online quizzes. Since these tools have been used actively by institutions implementing blended learning methodologies for the anesthesiology program, this will be relevant to anesthesiology faculty and students.

Video Lessons: In two examples of studies examining the role of video in medical education, results from a well conducted study by Evans *et al.* [17] showed higher student scores and less discontentment when students were exposed to virtual lecture, while a 2009 study that looked for a correlation between the use of streaming video and program outcomes in medical education (year 1–2 basic science curriculum) demonstrated a neutral to positive effect [18].

Podcasts: An evaluation of the effectiveness of video podcasts showed that, although video podcasts served a useful purpose for reviewing information, they didn't play a significant role for answering multiple-choice questions immediately after the session [19]. Students from this study attributed lesser engagement to learning from video podcasts, and expressed a clear preference for the live lecture format. Hence, this study concluded that, although this online tool was useful for reinforcing learning, it was not yet suitable for replacing face-to-face interaction. Results from other studies showed that podcast viewers did considerably better than those who attended the lecture in person. Concluding observations from this research study emphasize that the tool itself cannot ensure a superior learning experience, but instead much depends on the students' approach to learning [20].

Online Quizzes: Anesthesiology programs have been using online quizzes as an academic support tool that students can use asynchronously to review concepts and strengthen self-assessment. We are summarizing two studies that have evaluated the effectiveness of online quizzes in medical education. One research case study evaluated the role of online quizzes with PGY1 and PGY2 surgical residents in in-training exam performance. There was no significant relationship between total time spent on the program, the use of the tool, and total tutorials completed with the in-training exam scores [21]. As a surprising aside in the study, the individual who had the greatest total time spent (58.5 hours) and highest number of completed tutorials (100) had the greatest decrease in score! In a different research project, Kibble [22] conducted a series of experiments to assess the impact of online quizzes on student performance. He found that scores on unsupervised online quizzes were predictive of outcomes on summative examinations. When no credit was assigned to the practice quizzes, however, the student participation rate fell.

Students attributed lower performance on the final summative examination to a lack of engagement when studying through these online quizzes. Learner motivation was connected to credits, and the author sees greater benefit in making the exercise voluntary in order to promote self-directedness. While it is clear that online quizzes have a role to play in the review of material and self-assessment, they have not made a tremendous impact on improving learning.

Similar results were found when researchers compared web versus print media in internal medicine settings. In the first example, this comparison was made in an internal and family medicine program. There was no significant difference in student performance between the print users and the web users. Even though the web-based learners spent less time studying, they concluded that they had greater learning efficiency and were more satisfied with their experience. The knowledge decrease was similar in both the web and print groups after 6 months of this experiment. Interestingly, the web-based group did not use all the resources provided to them through the hyperlinks, and they stopped working significantly sooner than the print group [23]. In the second example, Cook *et al.* [24] compared learning preferences and learning gains with 75 internal medicine residents through a randomized controlled crossover study. They were randomized to web-based modules or paper practice guidelines. The results showed that 78% preferred the web-based format. Test scores improved in both formats, although without significant difference between them, and learning efficiency was better with web-based modules [24].

The summary of studies presented above has a clear pattern. Every online tool does seem to have a somewhat positive impact on learning. However, many studies seem to emphasize that the student experience is dependent not just on the tool, but rather on how that specific online tool was used to meet a given learning objective, combined with the nature of the student learning approach. Following is a summary of general observations:

- (1) As educators, we are intrinsically keen to enthusiastically embrace online learning and stay abreast of current trends. As a result, there is a danger in placing too much significance on using the online tool without paying equal attention to teaching and learning goals.
- (2) There is a greater need to focus on the suitability of a tool to enhance teaching and achieve specific learning objectives.
- (3) The authors' conclusion that the design of the learning interface will significantly affect the

learning experience of the student [17] seems applicable to all the learning tools being discussed here.

- (4) Survey results from the community college study have led to the conclusion that there is a lack of systems, personnel, data tools, time, and funding to effectively implement and evaluate the online resources as part of the self-assessment and continuous improvement initiatives.

This seems in line with the challenges that are also experienced by anesthesiology programs.

PROPOSAL FOR AN EDUCATIONAL FRAMEWORK

Although different technological tools are being used sporadically in anesthesiology education, no uniform framework exists for implementing these tools in a residency program. In addition, the variability in learner preferences and learner styles among residents necessitates the creation of an effective teaching and curriculum design. This section proposes addressing this challenge by applying the UDL model [25^o].

The principles of UDL divide the ability to learn into three broad and interconnected categories: ‘the multiple means of representation, multiple means of action and expression, and multiple means of engagement’ [25^o].

Since it provides guidelines for instructional practices by acknowledging the complexities of learning differences among individual learners, it can be a powerful model for curriculum planning in the field of anesthesiology.

Five good reasons to consider this UDL model for strengthening anesthesiology education:

- (1) Under the new ACGME regulations, anesthesiology faculty has fewer hours available to cover the same breadth of content. An efficient application of the UDL framework can assist in enhancing course development, delivery, and assessment practices, and can provide an enriching learning environment.
- (2) The Yale anesthesiology program (in which author Kurup is teaching) provides several online learning resources [e.g., online quizzes, videos, discussion forums] as academic support tools to help students develop their strategies and continue to learn outside the classroom through asynchronous means (Table 1, Fig. 1). By synthesizing concrete online tools that employ multiple means of representation, expression, and engagement into the main course delivery, it is hoped that the program can enable every student to arrive at a customized learning approach.
- (3) The results of multiple studies in the field show a lack of clear correlation between any one teaching method and outcome measure. This

Table 1. An outline for how Universal Design for Learning was applied in the Yale anesthesiology program

UDL principle	Examples of concrete UDL application (Yale anesthesiology, program of author Kurup)	Emerging traits of self-directedness (student takes CHARGE of his/her learning)
Multiple means of representation	Airway skills Didactic face to face session, Case-based discussions, Video on the topic Workshop with mannequins Didactic sessions Conducted live and Podcasted and available to residents either for review or because they could not attend the live session	Retention of concepts through self-regulation
Multiple means of action and expression	Resident involvement in planning of teaching sessions. One resident assigned to each didactic session. They work with faculty to prepare the case stem for discussion and come up with potential questions. Faculty then moderates the discussion with their peers. Anesthesia Jeopardy, incorporating game technology for learning	Inquiry-based learning through engaged questioning
Multiple means of engagement	Regional anesthesiology Basic topics covered in lecture, Ultrasound guided clinical block rotation, Workshop integrated with anatomy lab for cadaver dissection and identification of nerve bundles.	Developing self-efficacy based on individual learning preference

UDL, Universal Design for Learning. For additional insights into how the anesthesiology program at Yale is already beginning to apply the UDL principles, refer to Figure 1.

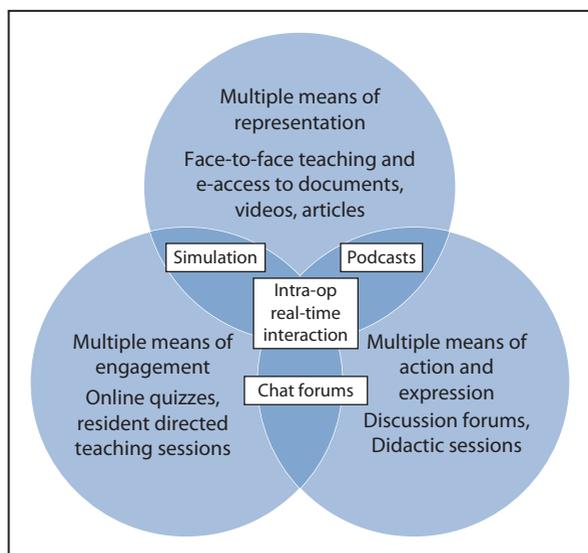


FIGURE 1. How anesthesia programs might already be using Universal Design for Learning (UDL) guidelines. [Note: This is a visual representation of the already well developed UDL framework. This figure provides specific examples of online tools used to synthesize multiple means of representation, engagement and action and expression into a holistic learning experience for the student (<http://www.udlcenter.org>).]

reveals that students have a variety of learning preferences. Clearly, teaching methodology is not a 'one size fits all' situation. This alone is a clarion call for adopting newer methods of educational approaches such as UDL.

- (4) In addition to the stated learning objectives, the anesthesiology curriculum implicitly focuses on preparing residents to develop skills for lifelong learning. Although self-directedness is seen as a necessary virtue to build the continuum of learning, recent literature has chronicled the struggles that residents face in developing as self-directed learners. Providing a variety of learning approaches through a combination of didactic teaching, hands-on training through face-to-face means, and online resources to be used both in the classroom and for independent study can enable the promotion of self-directed learning as an explicit goal.
- (5) Because it is aligned with the trends of millennial education to build inclusive classrooms for diverse learners, the UDL model is also relevant to Yale's international and heterogeneous classrooms, where adult learners come with varying degrees of prior knowledge and an array of learning preferences (Table 1).

Although UDL began with the need to create equal opportunities for students and historically was

focused mainly on students with disability issues, today, its relevance has spread throughout education, from primary to postsecondary and from specialized disabilities contexts to all classrooms.

CONCLUSION

This paper makes a useful contribution to the academic discussion by proposing the application of a comprehensive learning model that is new to anesthesiology education and relevant to its goals of promoting self-directed learning. In fact, the universality of the model can efficiently address the wide variability among learning preferences and facilitate a path for the student to customize and take charge of his/her learning.

As a next step, we will be designing a research plan for the development and delivery of online courses using the UDL framework in anesthesiology residency programs.

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Conflicts of interest

There are no conflicts of interests.

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Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 746).

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