



## Mini Review

# Developing Interactive Video to Enhance Clinical Education: How Difficult Can It Be?

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## Abstract

**Introduction:** Providing consistently standardized clinical experiences for medical students rotating within a specialty area is not without challenges. This is especially pertinent to a specialty such as anesthesiology where learning opportunities often depend upon patient factors such as the surgical procedure or underlying co-morbidities, individual faculty teaching efforts, and the degree of student initiative and engagement. Developing innovative educational resources can help ensure consistent exposure to educational content regardless of clinical opportunities. **Intervention:** The authors introduced a novel active learning video activity into the existing medical student anesthesiology curriculum. The videos were created using an interactive platform and placed within the school of medicine's learning management system. The authors hypothesized that the creation of interactive instructional videos of key anesthetic concepts and procedures would (1) be well received by the medical students enrolled in our course, (2) provide a standardized mode of content delivery and skill demonstration to our learners, and (3) be utilized consistently by the students. Three interactive videos were created and covered the following topics: basic anesthesia monitoring, thoracic epidural catheter, and insertion of a peripheral intravenous catheter. These videos were integrated into a 4-week elective clinical anesthesiology course in the undergraduate medical education curriculum. **Outcomes:** Student's level of engagement was markedly lower than what the authors expected. During a 12-month timeframe, 72 students were enrolled in the course. The basic anesthesia monitoring video was viewed by a total of 25 students. In addition, 17 and 12 students viewed the videos describing the placement of a thoracic epidural catheter and insertion of a peripheral intravenous catheter respectively. Focus groups data revealed that medical students (1) liked the interactive video quiz questions, (2) felt the annotations enhanced the content of the video, and (3) perceived the interactive video as a valuable educational tool for teaching clinical procedures. **Lessons Learned:** Successfully integrating innovative activities into an existing medical student curriculum is time consuming and labor intensive. Prior to development and implementation of interactive videos for learner consumption, faculty should conduct a needs assessment and collect specific end user data on preferred modes of learning and motivation for engagement of the learners. The authors assumed the medical students would prefer interactive video technology. However, lack of student engagement with the videos taught us that successful teaching and learning requires buy-in from all stakeholders.

**Keywords:** Interactive video; Multimedia; Undergraduate medical education; Clinical education

## Introduction

Clinical education encompasses the unique complexity of providing quality and safe medical care, maintaining workplace productivity and efficiency, and incorporating meaningful and standardized learning opportunities for learners. This is especially pertinent to the perioperative setting where offering consistent and predictable clinical experiences create an additional challenge to medical student education. During a clinical anesthesiology course, learning opportunities often depend upon patient factors such as the surgical procedure or underlying co-morbidities, individual faculty teaching efforts, and the degree of student initiative and engagement. Finally, formal didactics require dedicated scheduled time for faculty, which often poses a challenge when working in a busy clinical setting. The best approach to ensuring predictable clinical opportunities and consistent exposure to educational content for medical students learning anesthesia remains an ongoing question.

In an effort to address these challenges, the authors hypothesized that the creation of interactive instructional videos of key anesthetic concepts and procedures would (1) be well received by the medical students enrolled in our

clinical anesthesiology course (2), provide standardized mode of content delivery and skill demonstration to our learners, and (3) be utilized consistently by the students. The decision to use this educational format was multifactorial. With the current generation of students, active learning has been validated to increase student performance particularly in science and technology education [1]. Emerging trends in higher education reinforce active and self-directed learning in the form of technology-enhanced approaches, e-learning, and flipped classroom [2-5]. Additionally, interactive and technology-enhanced approaches are effective in engaging students with diverse learning styles [5].

The benefits of video as an instructional method have been reported in the medical education literature. Video can provide students with important learning opportunities that may not present themselves during clinical experiences [6]. Students perceive video as a valuable stimulus for group discussion and enhancing content knowledge during problem-based learning activities [7]. Hansen et al. [8] demonstrated the effect of instructional videos in increasing medical interns' confidence levels and enhancing skill competencies with performance of a clinical procedure such as urinary catheter

insertion. Video instruction has also been shown to be as effective as expert feedback in the instruction of basic suturing and knot-tying skills. The authors of this study concluded that video instruction is a useful pedagogic adjunct for basic clinical skills training while making efficient use of faculty time when appropriately incorporated into a curricula [9].

Recent evidence published in higher education literature supports the use of interactive and technology-enhanced approaches to promote active learning and student engagement [10-12]. Interactive features may include pop-up questions, prompts to allow the student to select which information is to be viewed next, or links to websites allowing for further knowledge inquiry. In a study by Guy et al., [13] 96% of the students agreed or strongly agreed that interactive video clips provided useful learning support for lectures during a physiology course. Fingeret et al. [14] described a technology-based tool utilized during a surgery clerkship which included video content of specific procedures containing illustrations and text overlay of indications for the surgical procedure and a review of the pertinent pathophysiology and anatomy, post-operative care, and relevant complications. The authors of this study concluded that the web-based video platform was associated with improved clinical reasoning and fund of knowledge. Interactive video also fosters self-directed and self-paced learning while improving learner satisfaction [15]. However, the authors did not elicit medical student's opinions prior to the creation of the videos in order to gauge their perception of the possible benefits or value of using them. Additionally, the authors assumed that the use of videos would effectually standardize the student's experience, provide a desired method of delivery, and aid in the acquisition of knowledge and skills.

## Intervention

### Learners

Vanderbilt University School of Medicine, located in Nashville, Tennessee, is a 4- year degree program that serves approximately 400 students. The department of Anesthesiology at Vanderbilt University Medical Center hosts third and fourth year medical students in an Advanced Clinical Anesthesiology Elective. Seventy-two students over a one-year period participated in this course.

### Interactive video platform tool

To create our videos, we used HapYak, a web-based video platform that consists of an annotation editor, an annotation player, and a web portal. Videos can be customized with pop-ups, multiple-choice and free-text questions, video chapters, external links, drawing overlays, and images. The annotated video can then be embedded into a web page, placed in learning management system (LMS), or accessed directly from the video's landing page [16]. Our videos were integrated into Vanderbilt University School of Medicine's LMS platform, allowing for asynchronous, unlimited access and flexible student learning. Another important feature of the LMS is the ability to capture user interface and usage data. Comprehensive engagement reports can facilitate analysis of student usage, such as the number of times each video was played, the frequency of interaction with each annotation, and the number of correct and incorrect answers to quiz questions. Specific topics of our interactive instruction videos include basic anesthesia monitoring, insertion of a peripheral intravenous catheter, and placement of a thoracic epidural catheter. Figure 1 demonstrates an example quiz question.

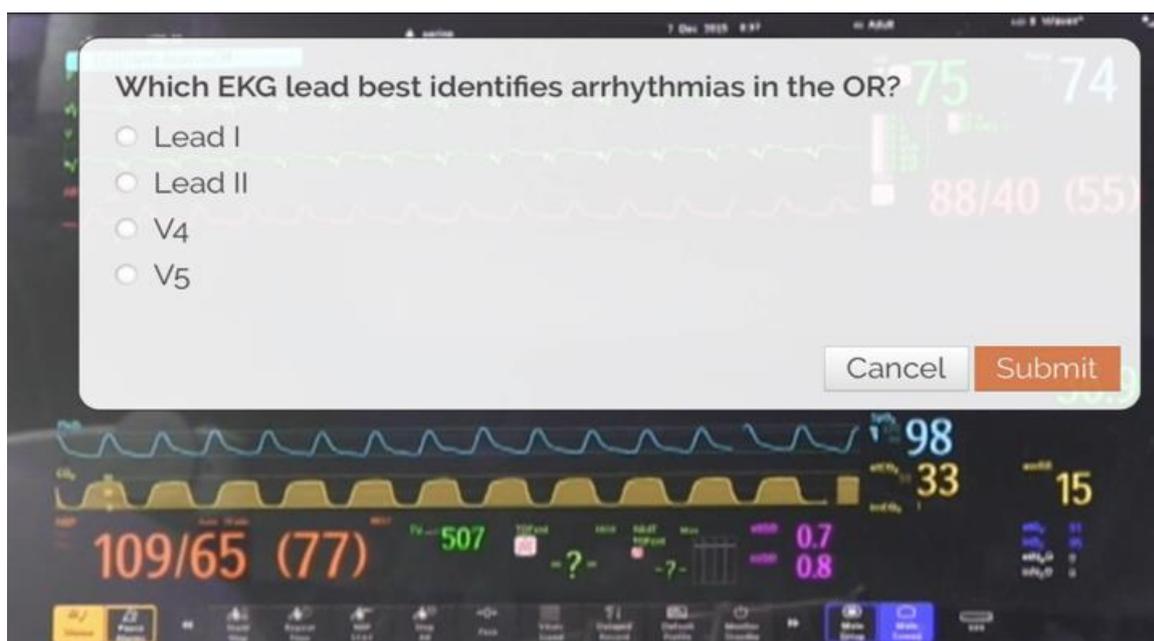
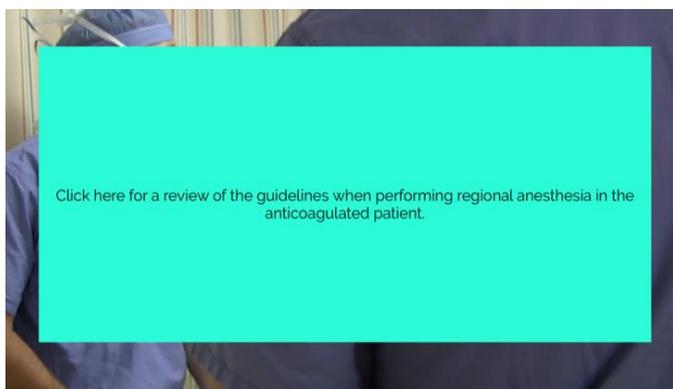


Figure 1: Example quiz question.

Figure 2 illustrates an annotation with an external link that we incorporated into our videos with the intent to promote active learning. We believed these videos would be an innovative and effective educational tool for our medical students.



**Figure 2:** Annotation with an external link.

Theme	Example Comments
Students like the quiz questions	<ul style="list-style-type: none"> <li>• “The types of questions were good, not too complicated.”</li> <li>• “It would have been nice to have questions at the end to summarize what you had just seen.”</li> </ul>
Annotations enhanced the content of the video	<ul style="list-style-type: none"> <li>• “Overlay of anatomy pictures made it more educational.”</li> <li>• “Integrated text provided more detailed information. I wouldn’t have learned as much by just watching the video.”</li> </ul>
Interactive video is a valuable educational tool for teaching procedures	<ul style="list-style-type: none"> <li>• “It was clear and nice to watch the steps from the start to finish.”</li> <li>• “Hearing what you’d actually say to a patient was helpful.”</li> <li>• “Most helpful part is going over the epidural kit.”</li> </ul>
Allow for more time to read annotations	<ul style="list-style-type: none"> <li>• “It would have been nice to have more time to read and a little control of when to progress through the presentation.”</li> <li>• “If you wanted to take notes, there is no time.”</li> </ul>

**Table 1:** Themes from focus groups.

### Lack of student engagement

Despite what appeared to be positive feedback from the focus group, we ultimately discovered an overall lack of student engagement. The videos were available on Vanderbilt’s LMS platform to all students taking our 4-week clinical anesthesia elective. At the beginning of each course, curricular content located on the learning platform was explained in detail to the students. The videos were uploaded to the category of “educational videos.” Students were told about the interactive aspect of the videos along with an overview of the focus group feedback. During a 12-month timeframe, we tracked student engagement. A total of 72 students were enrolled in the clinical anesthesia elective. The basic anesthesia monitoring video, viewed by 25 students, seemed to be the most popular. In addition, 17 and 12 students viewed the videos describing the placement of a thoracic epidural catheter and insertion of a peripheral intravenous catheter, respectively (Table 2). We expected student engagement to be much greater. The lack of student engagement poses questions pertaining to student motivational factors and the quality of the videos as an educational tool. Did we incorrectly assume that millennial

## Outcomes

### Focus group data

We initially held a focus group with eight students enrolled in our anesthesia course. Prior to the focus group, the students were given an opportunity to view the newly created interactive videos. Primary objectives of the focus group were to assess student satisfaction and perception of their learning experience and determine specific areas of improvement. Major themes from the focus groups included (1) students liked the quiz questions, (2) students felt the annotations enhanced the content of the video, (3) interactive video was perceived as a valuable educational tool for teaching procedures, and (4) more time should be allowed for students to read the annotations. Specific comments for each theme are included in Table 1.

learners would prefer technology rather than more traditional resources? Did students perceive that the content of the video was not relevant to the course? Are there alternative learning resources that students are seeking out to learn the same content? Did students have sufficient time available to view the videos? Were there technical issues with viewing the videos of which we were unaware?

Title of video	Number of views
Basic Anesthesia Monitoring	25
Placement of Thoracic Epidural Catheter	17
Insertion of Peripheral Intravenous Catheter	12

**Table 2:** Total number of views for each video.

### Lessons Learned

We consider several possible reasons for the lack of student engagement. From the onset of the project we omitted an important detail, specifically the performance of a needs assessment. This is a well-recognized initial step prior to

undertaking any educational endeavour [17]. We made the assumption that inconsistent learning opportunities in the clinical setting resulted in variable knowledge acquisition of pertinent course content. We, therefore, concluded that an approach to consistently provide learning content was needed. Yet we had no data to support that an educational problem existed and that students were failing to gain the knowledge of basic anesthetic concepts. As an example, even if students in our course were not involved with caring for a patient with chronic obstructive pulmonary disease, they likely experienced a patient who developed bronchospasm on emergence from general anesthesia and thus had an opportunity to learn the typical end-tidal carbon dioxide (ETCO<sub>2</sub>) waveform pattern in this scenario. However, we felt obligated to include ETCO<sub>2</sub> waveform patterns in the basic anesthetic monitoring video as we neglected to assess if students routinely learn this concept in the clinical setting.

Acquiring a better understanding of the pedagogical approach for effectively using educational video before incorporating it into a curriculum may have enhanced the success of this project. Due to the novelty of the modality, best practices for designing interactive video have not yet been established [16]. However, we should have considered key principles for maximizing student learning from video content, specifically cognitive load, student engagement, and active learning [18]. We deliberately addressed the active learning principle with the integration of questions. Yet we failed to consider strategies pertaining to cognitive load and student engagement. For example, the thoracic epidural video is 20 minutes in duration, which may have negatively impacted student engagement. Segmenting or dividing the video into “chapters” of 6-7 minutes duration is an effective strategy to avoid cognitive load and is described as one of Mayer’s principles for designing effective instructional multimedia materials to enhance medical education [19,20]. Student engagement could also have been improved by emphasizing relevance of the video content to the course. For example, creating an interactive video of how to successfully perform an endotracheal intubation with the intent of viewing it prior to a simulation session could potentially enhance student engagement. Instead, we designed and utilized the videos primarily as an educational resource rather than incorporating them as pertinent course content.

We significantly underestimated the amount of planning, effort, and assistance required. This project proved to be more time consuming than expected. We aimed to create high quality videos and therefore needed to seek out the assistance of a videographer. In addition, video production in the clinical setting involves deliberate and planned coordination along with obtaining patient and clinician consent. Recording of the thoracic epidural placement video required a specific procedure room that would allow for sufficient space for the videographer while safely performing the procedure. Creating and adding annotations and interactive features further contribute to the complexity of this process. Finally, integrating the videos into our LMS necessitated the technical assistance of our learning platform administrators. Each of the steps mandated more time than anticipated with approximately two months required for creating of each video.

Finally, we did not take the time to evaluate the value and

potential challenges of interactive video. Successful development and implementation of an innovative approach such as interactive video requires assessment of the short- and long-term educational impact of the proposed technology for all stakeholders including students, course director, and administration [21]. We neglected to consider if the interactive videos would make learning better and not just different. The decision to use a technology-focused educational method should occur only after establishing clear learning outcomes and determining that it is the best modality [6]. In addition to knowledge and skill acquisition, ideally we should have developed a plan for assessing retention and how students apply their knowledge and skills in the clinical setting.

## Future Directions

This project taught us the importance of performing a needs assessment prior to launching a time-intensive educational endeavour. If an alternative educational modality is deemed necessary to address a gap in the curriculum, it is imperative to research potential options, which may already exist. When considering technology-related interventions, it is necessary to develop an understanding of the advantages and possible challenges. Finally, we learned the valuable lesson of the importance of ascertaining how best to incorporate new educational modalities into the existing curriculum while also addressing student engagement. We now have an appreciation for emphasizing the relevance of the new education modality and directly linking it to specific course content rather than using it solely as a resource.

Despite the initial lack of student engagement, our efforts are not wasted. Basic anesthesia monitoring is now taught as a flipped classroom model. Students are required to watch the video prior to an introductory session in the operating room in which they demonstrate specific aspects of monitoring such as the proper placement of a 5-lead EKG. With improved student engagement, we also plan to do further data analysis in order to gain a deeper understanding of interactive video as an educational tool. Since it is integrated into our LMS, we can track learner patterns such as completion time and rate, how many times a video is viewed by each student, and what content students spend more time on. Finally, we are currently developing a plan to assess knowledge retention and application to the clinical setting in order to determine the effectiveness of this interactive video.

## Conclusion

The authors developed and implemented a new method of providing educational content to medical students participating in the clinical anesthesiology course. We sought to not only provide a robust clinical experience for our medical students but to augment this experience with novel and engaging resources. Although, the expectation was that students would wholly engage with our innovative approach, this was not the case. We conclude that we underestimated (1) our time commitment to the project’s development, (2) the level of student’s interest in technology based content distribution, and (3) the essential nature for a structured and

data driven needs assessment based on learner's preferences. Our project is not completely unsuccessful because we have learned many valuable lessons. We understand the need to allow more time to adequately prepare as well as to ask more questions of our learner groups. Additionally, the videos are still being utilized as a flipped classroom exercise, which provides us the opportunity to improve and build upon our course development.

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