Lessons learned creating microbiology laboratory demonstration videos

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Keywords
Laboratory demonstrations, Microbiology procedures, Pre-laboratory work, Recorded videos

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Case Report

Lessons Learned Creating Microbiology Laboratory Demonstration Videos

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Abstract

Microbiology laboratory classes are designed to allow students to apply knowledge gained during lectures and become proficient in laboratory skills. Students are introduced to procedures for working with and identifying microorganisms. Instructors must prepare students to perform and interpret the necessary testing procedures to be successful. Laboratory demonstration videos provide students with a first-person, unobstructed demonstration on how to perform laboratory techniques. The videos can be used as a visual learning tool to supplement courses with an in-person laboratory session or as a component in online learning. This article describes the creation of instructional microbiology laboratory demonstration videos.

Key Words
Laboratory Demonstrations, Microbiology, Procedures, Pre-Laboratory Work, Recorded Videos, Clinical Laboratory, Curriculum

A critical aspect of developing a deep understanding of clinical microbiology is through active learning that occurs during a hands-on laboratory session. Due to a lack of experience with performing hands-on microbiology laboratory procedures, students must be shown how to perform the tasks. In most laboratory sessions, instructors rely on written procedure instructions and in-class demonstrations of techniques to guide students, which have numerous drawbacks.

In-person demonstrations result in a limited line of sight, the inability to watch the process repeatedly, and the use of valuable laboratory time. If written procedure instructions are the only resource available, the student cannot visualize how to appropriately use the equipment and reagents or correctly interpret a test result. A solution is recording videos demonstrating laboratory techniques that complement the written instructions.

One of the goals of developing demonstration videos was to assign them as pre-laboratory work to save valuable laboratory time. Pre-laboratory work allows students to connect the laboratory activity and theory, leading to a deeper understanding (Agustian & Seery, 2017; Pölloth et al., 2019). Other goals were to provide a way for students to view the procedures close-up without obstruction, clearly hear instructions, and watch the process repeatedly. Pre-recorded demonstration videos help provide students with the confidence to perform the tasks (Agustian & Seery, 2017; Pölloth et al., 2019). When filming the videos, a simulated first-person point of view was used to imitate how a student would see the cultures and tests, thus providing an unobstructed view. The demonstration videos were developed following Brame's recommendations for educational videos: segmenting (chunking), signaling (cuing), weeding, and matching modality to content (Brame, 2017). The

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videos were chunked to 6 minutes or less and used onscreen text to highlight essential concepts when indicated. Weeding removed extraneous information that did not contribute to learning outcomes. Lastly, modality was matched by providing written procedure instructions that matched the video content.

Case Presentation

Pre-recording preparation

Throughout this project, a total of 63 laboratory demonstration videos were recorded over a span of seven days. Additional time was necessary for laboratory preparation and setup. Appendix 1 lists the demonstration videos and how they were incorporated into an online microbiology course for reference.

The initial step in preparing to record the videos was developing a spreadsheet of procedures essential to developing a student’s laboratory skills. After creating the list, we prioritized the videos based on budget and time frame. Supplies were requested with time allotted for ordering or delivery issues. When developing our timeline, we also considered setup and incubation times for bacterial cultures. We found it helpful to create a storyboard for each video before filming, including the narration script, a list of required supplies and equipment, and notes for non-verbal actions needed for the video. The narration script allowed us to eliminate unnecessary information that did not contribute to understanding the demonstrated technique and kept the videos under 6 minutes. Furthermore, using the script ensured we covered all the critical steps in a testing procedure and emphasized key information for students. Within the script, keywords and phrases were identified for inclusion as static images during post-production editing.

Filming

Through grant funding, a professional video producer was hired to record the videos. The video producer supplied the recording equipment, acted as the videographer, and handled all aspects of post-production. The videographer used a Sony® professional PXW-400 video camera with a Canon™ broadcast television and macro lens to record the videos. The videos were shot at 1920x1080i resolution to provide a sharp image of the culture plates and biochemical tests. To ensure that the test components were evenly lit, a Lowel 3-point light kit was utilized. To provide crisp, clear sound quality, the video audio was recorded using a Sony® (ECM-77B) Electret Condenser miniature lapel microphone. Working with a video producer was an invaluable experience. They helped guide the video recording project from conception to completion and provided helpful tips during video production. The video producer and their equipment allowed us to pause filming to adjust equipment, find the best angle, repeat steps within a procedure, tweak the lighting, or re-record the voice script as needed. The footage could then be edited post-production to provide high-quality videos.

An alternative to a professional filmmaker is using mobile devices such as a GoPro® or smartphone. A challenge encountered when using a mobile device was recording the video in one take due to a lack of video editing software. In addition, it was harder to record from a first-person perspective with a mobile device without assistance from someone else. When recording without assistance, the use of an adjustable tripod is recommended to keep the camera steady and provide a neutral first-person view.

Other considerations for recording videos include laboratory space and necessary equipment. Select a quiet area and avoid people or other distractions in the background. We found that noisy
and distracting environments shifted students' focus away from the demonstration. Additionally, block out ample time to record. We learned it took longer to record videos than initially thought, especially with complicated procedures.

Whether using a professional company or filming videos with a mobile device, consider having more than one person help. One person to read the script, one person to record the video, and one person to perform the testing. Having extra people saves time and effort.

One lesson we learned was to practice completing the procedures in front of a camera to adjust arm movements that may obstruct the camera view. It can be awkward and not usually how you hold your hands and arms. We also learned to plan for the unexpected and create backups of cultures and tests. Bacterial cultures may not grow, or biochemical tests may not react properly. In addition, to save time, we set up multiple test stages which eliminated waiting for reactions to develop and minimized incubation times. Due to lighting, camera resolution, and other factors, tests may not show up well on video, and you may need to enhance a reaction or supplement a test to create a better image during filming. Another lesson learned was to break up long, multi-step procedures into separate videos if possible. This allows students to view each part of the procedure separately as they are learning, or while performing the test in lab. It also allowed us to use the videos for multiple procedures that shared some of the same procedural steps. For example, we separated how to set up and interpret a disk diffusion antimicrobial susceptibility test into four videos: 1) preparation of a McFarland turbidity suspension, 2) agar media inoculation, 3) dropping of antibiotic disks onto the agar media, and 4) interpreting the growth patterns to determine susceptibility result(s).

Lastly, we chose not to show our faces on camera for several reasons. First, this simulated the first-person, unobstructed point of view. Second, it increased the longevity of the videos; students notice changing hairstyles and clothing. Furthermore, we found by not showing our faces, students focused on the demonstration and not on us.

**Editing and Post-production**

We advise making a copy of the raw footage before editing the video to have a backup if needed. Use video editing software when possible. It gives you flexibility during filming and post-production. Editing software lets you delete errors, stitch together scenes, use the most appropriate voice recording, and add written cues to specific sections. The files were provided to us as an MP4 file. The MP4 was used because it is one of the most common formats used for video files and works on most devices.

Following editing, the MP4 files of the edited videos were uploaded into a video learning platform for transcription and closed captioning. The video learning platform generated a transcript using automated speech recognition (ASR) software. The ASR transcript was reviewed and edited for accuracy using the pre-written scripts as a reference before the videos were posted for student use. The videos were published in the learning management system (LMS) using either an embed widget or learning tools interoperability (LTI) links. We chose to post the video using the embed widget or LTI link because it allowed us to track student analytics. The analytics allowed us to determine if each student watched the video and what proportion of the video was viewed.

**Discussion**

Laboratory demonstration videos provide essential information for students and can be used in a variety of class formats including online, in-person, and hybrid courses. They can be used as a supplement for courses with an in-person laboratory session or as a component in online learning.
The videos complement the written procedure acting as a visual learning tool that can be key to student learning. An example of a finished video can be viewed on the University of Nebraska Medical Center’s YouTube® channel at https://go.unmc.edu/microbiology-vids.

There are many benefits to using recorded demonstration videos. For in-person classes the videos can save valuable laboratory time by allowing students to watch the videos before class. In addition, students do not have to fight for a good view. Their view is not blocked by other students, and they can clearly hear instructions in the video when compared to in-class demonstrations. Depending on the technology in the classroom, students can refer to the videos while performing the tests in in-person classes. For example, we have tablets students use during in-person labs; they can rewatch the videos, pause, etc., while performing the tests. In courses without an in-person laboratory class the laboratory demonstration videos provide students with the ability to see laboratory testing procedures with a real-life perspective. Furthermore, if you have laboratory reports that are due after class or other assignments based on the laboratory testing, students can reference the videos while completing those assignments as necessary outside of the classroom setting (Donner & Imhoff, 2022). Additionally, the videos can be used for multiple years and in several different courses which saves valuable time and expense.

Conclusion

Laboratory demonstration videos may improve students’ microbiology laboratory skills necessary to succeed in the laboratory setting. We recommend instructors create a library of laboratory demonstration videos to enhance student learning. In summary, when creating laboratory demonstration videos key considerations include to create storyboards with written scripts, schedule more time than anticipated, set up multiple stages of testing ready for recording, schedule multiple people to facilitate recording, procure appropriate recording equipment and editing software, and be adaptable for the unexpected.

Conflict of Interest

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Supplemental Materials

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References

