Pathology Lectures and Practical Sessions Utilizing Various Digital Educational Materials

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1．Introduction

The COVID-19 pandemic has significantly impacted global society, leading to widespread fatalities and ongoing disruptions in various sectors, including the economy, education, and daily life. Educational institutions, including universities, shifted almost entirely to online instruction during the peak of the pandemic. Subsequently, as the infection rates decreased, in-person classes were reinstated, although the transition to online education presented numerous challenges. At Ehime University School of Medicine, a website was quickly established to provide detailed instructions on general procedures for video production. However, only a limited number of lectures were able to deliver high-quality video content within a short time frame. Student surveys revealed dissatisfaction with some aspects of the online lectures, such as the distribution of lecture handouts solely in digital format, and videos that contained only audio without visible indicators like pointers to show the lecturer's current position on the slides. Many students expressed that the quality of these emergency digital lectures was inferior to that of traditional in-person classes. While some instructors successfully implemented real-time interactive classes, technical difficulties such as limitations in students' equipment, poor internet connectivity, and low video quality often led to interruptions in the live streams. This paper reports on the development of digital educational materials, spanning efforts made before the pandemic, during the fully online lecture period, and the current situation after the resumption of in-person teaching.

2．Projects

2.1 Pre-COVID-19 Projects: Development of Videos for Introducing Students to Pathological Autopsy Procedures and Instructional Videos for Pathology Residents

Prior to the COVID-19 pandemic, efforts were made to create educational videos that introduced medical students to the practice of pathological autopsy, as well as detailed instructional videos for pathology residents regarding autopsy techniques. The autopsy methods can be broadly classified into three main approaches: ⑴ the Virchow method, where individual organs are removed one by one for examination, ⑵ the Rokitansky method, which involves removing all organs as a single block from the body before inspection, and ⑶ the en bloc method*, where organs are removed in systematic units such as the cardiovascular system in the thoracic cavity, and urogenital system in the retroperitoneum, allowing for detailed examination. Each of these methods has its advantages and limitations, and it is important to select the appropriate technique based on the patient's age and the specific pathologic conditions. These three techniques form the basis for various modifications used by pathologists and institutions（Volmar, 2003）.

When I began my pathology residency in 1985 after graduating from medical school, I had the opportunity to participate in approximately 200 autopsies annually. However, one major issue at that time was that the autopsy techniques varied slightly depending on the supervising pathologist, which often caused confusion among pathology trainees. A notable method I encountered was the en bloc technique, which was introduced by Dr. Satoshi Okada of Kobe University Hospital's pathology department. He had learned this method during his studies at a university in southern Germany. The en bloc method allows for systematic and comprehensive examination of organs while preserving their interrelationships. I found it to be the most rational approach, developed by German pathologists.

Although mastering the en bloc method is relatively easy if one understands the rationale behind it, the technique can appear complex and difficult to grasp when approached mechanically without understanding the underlying logic. Therefore, in 1995, when I assumed the role of supervising new pathology residents, I sought ways to effectively convey the rationale behind this technique. Instead of relying solely on text or still images, I decided to create educational videos. At that time, consumer video recording equipment, such as Sony Handycam, had become widely available, and I collaborated with autopsy technicians to film autopsy procedures. Additional footage, including the examination of formalin-fixed organs like the brain and coronary arteries in cases of ischemic heart disease, was recorded over the course of several months.

Given the limitations of digital editing technology at the time, I used linear editing**, a process in which edited video and audio are sequentially transferred to a separate tape from the video camera's magnetic tape (Figure 1). It took a full month to edit the video into a 45-minute instructional tape, complete with narration and chapter headings. Additionally, I created a 20-minute condensed version for medical student education.

Figure 1. Equipment used to photograph dissections and tissue sections after pathological autopsy and tissue fixation

While hands-on participation in actual autopsies is critical for training, repeatedly watching explanatory videos of autopsy procedures greatly enhanced residents' ability to master the techniques. Many graduate students transitioning from clinical to basic research successfully obtained autopsy certification. For student education, I incorporated the condensed version of the autopsy introduction video into the tumor pathology macroscopic exercises for general pathology courses and used it to prepare fourth-year students for basic practical training and sixth-year students for clinical training. After watching the video, students participated in actual autopsy, which increased their motivation to engage in pathology.

Over the course of more than 10 years, this educational material helped standardize autopsy techniques and increased student participation in autopsies. As digital non-linear editing** technology became more accessible, and with the construction of a new autopsy room designed for infection control, I produced updated instructional videos for the new autopsy procedures. Compared to linear editing, digital video editing allowed for a smoother process, enabling the removal of unnecessary scenes, privacy protection, and the addition of explanatory text. These materials were effectively used for the reorganization of the pathology department, the training of pathology residents, and the construction of new autopsy facilities (Figure 2). After transitioning to Ehime University, I continued to use these videos for undergraduate education, clinical training, and resident instruction, as well as for the operation of the newly constructed autopsy room.

Figure 2. The instructional video for the autopsy was distributed to pathology residents on Blu-ray, along with a manual

2. 2 Efforts Toward Remote Pathology Education During the COVID-19 Pandemic

During the COVID-19 pandemic, traditional in-person pathology lectures and histopathology microscope exercises, where students would gather in a single laboratory, were no longer possible. In our department, we had maintained a traditional teaching style in which all faculty members participated in every lecture and lab session, engaging with students and answering questions face-to-face. When instructed by the university to halt in-person lectures due to the pandemic, we faced the challenge of maintaining educational quality and student motivation, while also addressing the anxieties of students who were isolated in their dorms. For the past ten years, we have conducted detailed surveys at the end of each lecture, including a free comment section, to assess students' understanding.

One key concern was ensuring that students received regular and timely updates. Without consistent communication, students might struggle to differentiate between the absence of new information and a failure in information transmission, leading to unnecessary anxiety. Drawing from the pathology practice of reporting negative findings (e.g., "no malignant findings"), we recognized that even the absence of updates was important information. Consequently, we decided to provide direct daily updates to the relevant student year, even if the message was simply that there were no new developments. Leveraging social media and communication platforms, we worked with student representatives to disseminate information, and we established a dedicated site where daily updates were posted. When no new instructions were available, we continued to provide messages such as "No new information today" in order to reassure students.

Initially, for remote lectures, we followed the university's recommendation to deliver synchronous video sessions during the originally scheduled class times, with the videos available for a limited period, out of concern for disrupting students' daily routines. However, we realized that one of the major advantages of digital content is its flexibility—students can access it "anytime and as often as they need." Recognizing this, we shifted our approach to archive all lecture videos, allowing students to watch and rewatch them at their own pace for review and study.

Ultimately, this strategy proved effective, as reflected in the improved academic performance of students in the pathology exams, with results surpassing those of previous years. This suggests that the flexibility provided by the archived video lectures contributed positively to their learning experience (Kitazawa, 2021). During the COVID-19 pandemic, there was a noticeable trend of inflated grades, leading to what could be termed as "grade inflation." The authors observed that even after in-person lectures resumed, all classes continued to incorporate digital components, allowing them to confirm that students' comprehension had improved over the past two years, independent of the pandemic. However, a certain number of students merely glanced passively at the digital materials during lectures, failing to fully grasp the content. While overall academic performance seems to have improved, there also appears to be a growing polarization in student achievement.

2. 3 Efforts Following the Resumption of In-Person Lectures

Even after the easing of COVID-19 restrictions, we have continued to leverage the experiences gained during the pandemic, combining in-person lectures and practical sessions with archiving all materials for remote access. This allows not only absent students but all students to review lectures and practical sessions repeatedly online. To reduce the burden, we record lecture screens using the same computer equipment used during the lecture. For example, on a Macintosh, QuickTime Movie can be used to capture the entire screen along with audio. Since the presenter's image cannot be captured in this method, we separately record the presenter using an iPhone or iPad. By connecting a lavalier microphone directly to the iPhone, we can also achieve high-quality audio recording. After the lecture, we combine the two recordings to create a video where the lecturer is seen pointing to the slides, making the presentation more engaging. While combining separately recorded data may seem time-consuming, using Final Cut Pro, a paid video editing software for Mac, allows us to complete the video editing

Figure 3. Record the screen of the computer and the teacher's appearance, then combine both images into a single video based on the audio recording

within approximately 30 minutes. Specifically, we import the QuickTime Movie recording and the iPhone video of the presenter, compare the audio data to align the timing visually, and adjust the images to synchronize the audio. Then, we shift the QuickTime video slightly to the left and place the presenter's video in the remaining space, as shown in Figure 3. By detaching the audio from the QuickTime video and deleting the unnecessary audio, the final product is complete.

For practical sessions, all pathology specimens have now been digitized, allowing students to explore them interactively, similar to Google Earth, via web browsers. Access links to these files are provided on the university's Moodle site to ensure that students are well-informed.

3. Approach for Publishing Educational Videos to Students

Once the videos were completed, the question arose of how best to distribute them to students. Ideally, if the university has a secure server system that students can access remotely, it would be the safest and most efficient method for disseminating content. However, at Ehime University, Moodle had limited storage capacity, making it impossible to host videos. Initially, following recommendations from the medical school, we used Microsoft OneDrive to provide students with video content. Given that many students accessed the videos via smartphones, we had to keep file sizes as small as possible. Additionally, technical issues arose when large numbers of students accessed the university's network simultaneously, causing congestion, particularly during peak times in the morning.

In our department, we were able to borrow a video distribution system from NTT, free of charge, for six months. Thus, we used both OneDrive and the NTT system to deliver the videos. However, this required a significant amount of effort to manage and upload each lecture video. While we continued this process for the benefit of the students, it would have been more efficient if the university had implemented a centralized system for distributing video content uniformly to all students. Unfortunately, the responsibility for video distribution was left to individual departments, leading to varied approaches.

We considered YouTube as an option for distributing high-quality video content, but initially, we hesitated due to preconceived notions about the platform. I had the (unfounded) perception that YouTube was associated with frivolous content creators, and there were concerns about video leaks and potential scandals. However, my perspective changed when I had the opportunity to participate in the video streaming of the Japanese Society of Histochemistry and Cytochemistry workshop on YouTube in August 2020. This experience highlighted YouTube's ease of use and effectiveness.

As a result, starting in late 2020, we transitioned to using YouTube for distributing lecture videos. The platform's seamless upload process—where videos are automatically adjusted for size and quality based on the user's environment—proved highly convenient. The video quality, especially for macroscopic and histological images, remained excellent. By using the unlisted video setting, we shared the video links only with the intended students, minimizing the risk of accidental leaks. Given the academic nature of the content, we have not encountered any security issues thus far (Figure 4.).

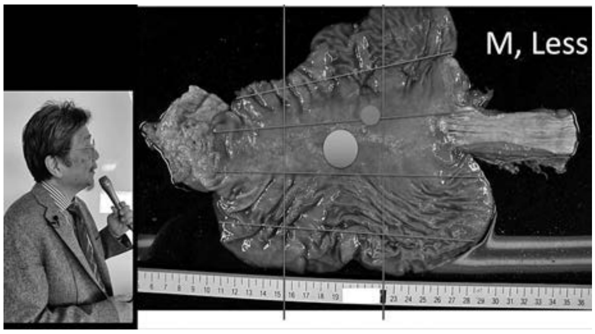

Figure 4. The lecture videos uploaded to YouTube are edited to make it appear as if the instructor is actually delivering the lecture

Although YouTube does not allow detailed monitoring of individual student engagement or attendance, we can track overall view counts, and we assess attendance based on the submission of assignments. All lecture videos, including recordings from in-person sessions, are archived to allow students to review them at any time.

4. Future Challenges and Initiatives

One of the challenges in pathology education is the macro-organ practical session in tumor pathology, where students work with actual organs. For students who miss these sessions, it has been difficult to provide equivalent experiences. However, with the support of Ehime University's budget, we are developing a curriculum using VR180*** technology to offer virtual reality alternatives for these practicals. While past efforts towards complete virtual reality have been made (Kitazawa, 2023), the extensive resources required for software development made independent efforts challenging. On the other hand, VR180 allows us to film and edit videos ourselves, enabling the rapid development of educational materials (Figure 5). In pathology training, we are also recording and archiving the dissection of fixed surgical specimens.

Figure 5. Video filming equipment for VR180 (above) and a student making up for an absence of essential practical session with a VR180 (below)

5. Conclusion

With the rise of 5G technology and the increasing adoption of online medical services, prompted by the COVID-19 pandemic, both education and clinical practice are undergoing significant changes. While individuals may find it difficult to directly influence national-level transformations, it is crucial to make continuous efforts to improve and refine the lectures and practices within our own scope.

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Annotations

＊"En bloc" is a French term used in English to mean "all together" or "as a whole." It refers to a group of items, people, or actions being considered, moved, or treated collectively rather than individually. In a medical context, a group of tissues might be removed "en bloc," meaning the entire set is handled as a single unit.

＊＊Linear and Non-Linear Editing
Linear Editing refers to the process of editing video or audio in a sequential manner, typically from start to finish. In this method, clips are arranged in a fixed order, and to make any changes, an editor must work through the sequence linearly, often re-editing parts of the content in the order they appear. This approach was common in analog editing, such as with videotapes, where edits were made by recording directly onto the tape in a strict sequence. Non-Linear Editing (NLE), on the other hand, allows editors to access and arrange any part of the video or audio at any time without following a set order. Using digital software, editors can make changes, move clips, and apply effects freely, making it easy to experiment with different edits and rearrange the timeline without affecting the rest of the sequence. This approach is standard in modern digital editing software, such as Adobe Premiere, Final Cut Pro, and DaVinci Resolve.

＊＊＊VR180 is a format for virtual reality content that captures a 180-degree field of view, allowing viewers to look around in front of them but not behind. Unlike full 360-degree VR, VR180 focuses on the area directly in front of the viewer, capturing immersive, stereoscopic 3D visuals in high resolution. This format is optimized for VR headsets, giving a sense of depth and realism, and works well for storytelling and action happening within the viewer's immediate field of vision. VR180 is often easier to produce and watch than 360-degree content, as it requires less processing power and focuses attention on the primary subject or scene.