ARTICLE

Making an Effective Flipped Neuroscience Lab by Approaching Students from Their Emoticons

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During the pandemic, we filmed our neuroscience labs, and now the videos provide a great resource to flip the lab. Our lab, however, covers a wide range of complicated topics, ranging from gross anatomy, immunohistochemistry (IHC) staining, and fluorescence imaging to cockroach microscopic surgery and measuring nerve conduction velocity on worms and human subjects, and it is challenging to get students to finish watching these complicated experiments. The biggest challenge that students face while watching these experiment demonstrations is their own emotions.

When we were editing the films of the labs, we did not reduce the complexity, but we explained concepts by using concepts and objects that students are already familiar with so we do not trigger anxiety. To reduce boredom, we employed three major methods: questioning, humor, and increasing the pace.

To address potential anxiety or reluctance about the in-person part of the lab, we mention at the beginning of every lab session that making mistakes is completely acceptable and, as they make mistakes, we help them understand what went wrong and how to correct it. We also introduce additional activities in some lab sessions to pique their interest. For instance, we ask students to test the effects of Red Bull on crickets and investigate whether students who play more video games have higher conduction velocities in the median nerve.

Thus far, our flipped lab has been quite successful in terms of maintaining video retention rates and in-person attendance rates. A notable example of the effectiveness of improved hands-on skills is the cockroach microscopic surgery. Before implementing the flipped lab, only 10% of students were able to successfully complete the surgery and acquire nerve activity recordings. With the flipped lab, 90% of students were able to obtain a recording independently.

Key words: Flipped lab; Neuroscience lab; limbic brain; Video retention rates; In-person lab attendance rates

The outbreak of COVID brought a lot of inconvenience to college education, especially for labs, but it also brought an opportunity for us to film and document our lab content.

Our neuroscience lab covers a wide range of complicated topics, including gross anatomy, immunohistochemistry (IHC) staining, fluorescence imaging, cockroach microscopic surgery, and measuring nerve conduction velocity in both worms and human subjects. Prior to the pandemic, students were required to read lab manuals before each session to understand the experiments. Comprehending sophisticated experiments through reading alone proved challenging for most students with limited lab experience. Flipped lab methods are well-documented to enhance active learning in the laboratory setting (White et al., 2017). Nevertheless, it remains difficult for students to complete watching complicated experiments from start to finish.

Therefore, we meticulously edit our filmed lab content with the aim of minimizing the likelihood of evoking anxiety or boredom while preserving the complexity of the content. When students come to the lab, we also implement measures to ensure they feel comfortable and are not bored or afraid of making mistakes.

With this flipped lab approach, we have achieved high video retention rates and a high lab attendance rate. Additionally, we have observed a very high percentage of students who can successfully complete sophisticated experiments independently.

MATERIALS AND METHODS

All lab activities were recorded using a Samsung Note 8 and edited with Adobe Premiere Pro. The students' experimental results were collected using a Google Form survey, and their attendance rate was tracked through Canvas grading.

Recorded Lab Demonstration Editing

To ensure that students stay engaged while watching the lab recording, a multiple-choice question was embedded every 3-5 minutes throughout each video. To maintain students' attention, we fast-play the clips used to help students review content and add humorous emojis and music. This ensures that students do not quit watching our videos halfway through due to boredom. Here is an example of how we review cockroach surgery with students: https://youtu.be/I8MS1maaBDk. To reduce the difficulty without sacrificing the complexity of the course content, we aimed to explain concepts using familiar objects and ideas that students were already acquainted with. Figure 1 illustrates how we employed cartoon characters to assist students in sorting mouse brain slices. Students received three brain slices randomly selected from any row in Panel A. We assigned a unique cartoon character to each group of similar brain slices in Panel B to help students distinguish between them.

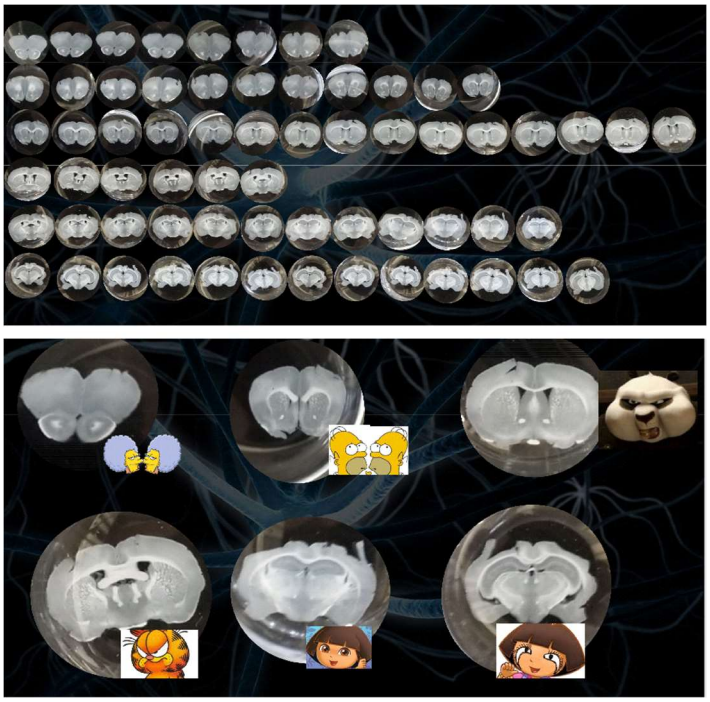

Figure 1. We utilized cartoon characters to assist students in focusing on distinctive structures in various mouse brain slices. This helped them sort the slices before mounting them on a slide.

In-Person Lab:
To ensure that students do not become bored during their in-person lab (since they already watched the demonstrations of the lab activities), we made minor adjustments to the experiments. For instance, we demonstrated how to measure and calculate the effects of alcohol on nerve activities in crickets. When they arrived in the lab, students were tasked with measuring and calculating the effects of an unknown substance (in this case, Red Bull) on crickets. In the module covering the measurement of nerve conduction velocity, instructor demonstrated the procedure for measuring conduction velocity in both the median and sciatic nerves on their group mate. When students came to the lab, we had them test whether gamers exhibit faster conduction velocity in their median nerves, followed by discussions on the experiment's results and potential design pitfalls.

RESULTS AND DISCUSSION

Video Retention Rate

Our average weekly demonstration video length was 53 minutes. The average viewing duration per user for each weekly video was 54 minutes in the spring and fall semesters of 2022 (some videos are watched more than once). The high video retention rate serves as a valuable indicator of the success of our demonstration videos.

Lab Attendance Rate

Another indicator that demonstrates the success of our labs is the attendance rate. According to a global survey of academics conducted by Times Higher Education in 2022, (Williams, 2022) 76% of educators in the survey reported a decrease in attendance rates despite COVID-19 restrictions easing. During the 2022 semesters, however, our average lab attendance rate was 90.5%. It is worth noting that attendance was not mandatory in 2022 due to ongoing COVID concerns.

Experiment Success Rate

The third indicator of the success of our flipped lab is that students are willing to try again after initial failures, and the majority of them eventually succeed in complex experiments. Take, for example, the cockroach microscopic surgery. In the semesters of 2022 spring, 2022 fall, 2023 spring, and 2023 fall, 23.3% +/- 4.2% (mean +/- SD) of students initially failed with the first cockroach but persevered with the second, and 2.6% +/- .5% (mean +/- SD) even attempted a third cockroach. In the end, 94.1%+/- 6.8% (mean +/- SD) of the 326 students successfully isolated the nerve cord from a cockroach under the microscope and recorded signals from the nerve cord. Notably, students completed the experiment entirely on their own, with Teaching Assistants (TAs) only assisting with double checking equipment and computer settings. This is a significant improvement compared to the time before the pandemic when, without the assistance of demonstration videos, only 10% of students could independently complete the experiment successfully.

REFERENCES

White AO, Javier LK, Goldberg NR, Boucquey V, Overman J, Ochaba J, Marsh S, Huffman D, Nicholas A (2017) Front and Back Flipping for Neurobiology! Developing a Hybrid Upper-Division Lab Course. J Undergrad Neurosci Educ 16(1): A95–A101.

Williams T (2022) Class attendance plummets post-Covid. Times Higher Education, June 9. Available at https://www.timeshighereducation.com/news/class-attendance-plummets-post-covid.

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