VIDEO SUBMISSIONS AID STUDENTS GRASP THE SPREAD PLATE TECHNIQUES BETTER

Kwan Mei Yam

School of Life Sciences, The Chinese University of Hong Kong (HONG KONG)

Abstract

Students’ laboratory techniques can be brushed up by having teaching videos to show the dos and don’ts. In the online world, various websites hold free, yet high quality lab notes and teaching videos showing the spread plate techniques. However, even after going over these and other in-house resources, students may still find problems when they actually need to do the job. Teaching assistants are crucial to be around to point out any room for improvement on the spot. Very often, teaching assistants are assigned to take care of more than one group of students. While they are monitoring the progress of one group, the other groups’ performance might be overlooked.

We have tried asking students to take videos for every plate they spread and they are to choose the best to submit. By doing this, we found all members of the group became more serious about their work. They will pay more attention to what’s going on even when it’s not their turn. Some peer teaching is also obvious. On the teachers’ side, we now have a very good track of every student’s performance on the assigned task. Snapshots/short clips from these submissions also offer a rich and more connected source of materials for the debriefing session to further boost learning effectiveness.

Keywords: videos, submissions, lab techniques, learning seriousness, learning effectiveness, biology.

1 INTRODUCTION

Spread plate techniques are commonly described in textbooks and laboratory protocols in both Microbiology and Molecular Biology. Using these techniques, cells of microorganisms, usually yeasts and bacteria, can be evenly distributed on sterile agar medium inside a petri dish; viable cell counts of these microorganisms can then be made after an overnight (or longer) incubation at the right temperature. In our undergraduate curriculum, students may have chances to learn and practice these techniques in various laboratory courses. One of the best ways to learn good laboratory techniques may perhaps be one-on-one coaching by an experienced worker in the field. However, this is almost impossible in any undergraduate practical class settings, especially when the class size is not small. While some courses can afford a higher teaching assistants to students ratio, some courses may not be as fortunate.

Videos and virtual labs have been around for some time, there are studies trying to see if they can be used to replace conventional lab classes. While Leonard [1] thought that effects of the two could be treated as equivalent, Stuckey-Mickell and Stuckey-Danner [2] wouldn’t agree as from their student feedback, they believed that face-to-face sessions can do more. Maldarelli et. al. [3] thus studied if prelab videos can help improve students’ perceived knowledge, experience and confidence in the face-to-face session. The results were affirmative, though with varying degree of effectiveness depending on the techniques involved.

With the prelab videos available, students can, at their own pace, get themselves familiar with the procedures before they actually go to class. Besides, the videos would be useful to standardise the procedures as teaching assistants often vary in lab skills [3]. We agreed that having a standard to train teaching assistants and letting students know what exactly they are expected to do will be good. Although the above studies did not cover spread plate techniques, there are in fact, a lot of related educational resources on you-tube (https://www.youtube.com/), on JoVE (https://www.jove.com/) and elsewhere on the web. While some are prepared by instructors, and with nice illustrations, e.g. the one from Sanders on JoVE [4], some are uploaded by learners with various skill levels. While some are with pretty high quality, some would better be watched with care. Even for those with high quality, the equipment used may differ from what we have in our setting. Some videos show the traditional spread plate method using cell spreaders, either L-shaped or with a triangular end, either made of glass or made of stainless steel; some got a turn table to use, while others not. Some have 70% ethanol for surface sterilisation in a sprayer, some in a squeeze bottle, and some just in a beaker. Some videos would even show an alternative way to spread the culture using glass beads instead of
glass or stainless steel rods with a specially-shaped end, i.e. the Copacabana method described by Worthington et. al. [5] or its modified version [6]. Besides, some will use a Bunsen flame to provide an aseptic working environment, while others may use an alcohol lamp, a candle, or even no flame at all. By watching these, students on one hand, might be able to know how people are doing the same thing in various ways, on the other hand, might get confused about what they are expected to do. As every lab has its own set of tools or apparatus to use, and every teacher may have their own sets of criteria that they wish their students to meet, thus, in-house videos prepared by one’s own group may help better equip one’s students with exactly what they are expected to do when they come to the lab.

However, even with these different video resources in place, we found students may still face problems when they are actually there to perform the task. This has been observed in the same course for our previous batches of students. Although there are teaching assistants around to help coach the students, each teaching assistant is to take care of 2 groups of 2-3 students each sitting on the two sides of a bench; thus, it may be difficult for them to closely monitor the progress of each and every one. We propose that having students to videotape their work for submission may make them work more seriously. Besides, from the submissions, the teaching team can have a better idea of how the whole class is doing. Besides, collective feedback to the whole class and specific feedback to the individuals can then be given to enhance students’ performance on the same task afterwards. Feedback on videotaped tasks has been shown to enhance teaching and learning of psychiatric interview skills [7] and preclinical operative dental skills [8]. Learners’ performance captured on videos is commonly used to provide a basis for self-, peer- and instructor’s feedback to drive better performance in sports [9, 10], in dance [11] and musical [12, 13] performances, and in nursing [14, 15, 16]. However, similar studies or practices in teaching and learning biology lab skills appear not as common. The present study would like to add to the literature in this area.

2 METHODOLOGY

Four classes of undergraduate students (mainly in their Year 2 (89.5%), 105 altogether) taking the course BIOL2313 Genetics Laboratory offered by School of Life Sciences, The Chinese University of Hong Kong, in Term 2 of the 2016-17 academic year were asked to videotape their work on spreading plate and have their videos uploaded to our elearning platform (Blackboard Learn) as an assigned task when they were doing the exercise on UV Mutagenesis in Saccharomyces cerevisiae. As students were working in groups of 2s or 3s, while one student was doing the job, his/her groupmate(s) would help with the shooting using their smart phones. The students were to use the spread plate techniques again two weeks later in another exercise on Transformation of Escherichia coli. Before the students did their spread plate again in the latter exercise, a debriefing was held using pictures taken from the student-submitted videos with the hope to make students understand better how they might improve further. On-site observations were made onto how students did their job after they knew they had to send in a video of their work, as well as students’ on-the-spot responses to the debriefing session and their spread plate performance right after attending the debriefing. Students’ performance was also noted from the teaching assistants by word-of-mouth.

Besides, two online questionnaires (one for students and another for teaching assistants) were designed, to get the respondents’ views regarding the video submission exercise, the subsequent debriefing session, and the perceived learning/teaching experience on the spread plate techniques. All stakeholders were invited to submit their inputs at the end of the term. The questionnaire for the students was administered using our university’s elearning system (Blackboard Learn), while that for our teaching assistants were done using Google Forms.

3 RESULTS

Results from onsite observations, word-of-mouth feedback (from both students and teaching assistants) and the questionnaires all indicate that the video submission exercise can enhance teaching and learning. Response rate for both questionnaires (for students and teaching assistants) were over 90%. Major findings from students, teaching assistants and reflection from the teacher are summarised in the following sections.
3.1 Students’ responses

Just before the term ended, all students were invited to complete a questionnaire to voice out their views on the video submission exercise and the way they learn. Of the 105 students enrolled, 99 of them had responded. The response rate was 94.3%. Students’ feedback was summarised below:

3.1.1 Video submission increases students’ seriousness and engagement towards the task

Having to submit a video on how they did their work, most students indicated that they did it more seriously (85.9%, n=99), see Table 1. Other students might think they would be as serious whether or not their work had to be videotaped. Besides, 89.9% of the students claimed that they had tried to video tape every (or at least not just one) plate they spread and chose the best one to submit. This implies that many students treat this exercise seriously. At the same time, 87.9% agreed or strongly agreed that they had paid more attention to how their groupmate(s) was/were doing the task, even when that was not their turn. We believe that having to help videotape their groupmates’ work might have increased not only their own engagement in assigned task but also how the task can be better done.

<p>| Table 1. Students’ attitude towards doing the task when they have to submit a video of their work. n=99 |
| % of students |</p>
<table>
<thead>
<tr>
<th>Strongly agree/Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree/Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>When I knew I need to videotape and submit my work, I did it more seriously.</td>
<td>85.9 (28.3+57.6)</td>
<td>11.1 (2.0+1.0)</td>
</tr>
<tr>
<td>I did try my best to videotape every (or at least not just one) plate I spread, and choose the best one to submit.</td>
<td>89.9 (51.5+38.4)</td>
<td>6.1 (4.0+0.0)</td>
</tr>
<tr>
<td>With the videotaping in place, I paid more attention to how my groupmate(s) was/were doing, even when that was not my turn.</td>
<td>87.9 (26.3+61.6)</td>
<td>10.1 (1.0+1.0)</td>
</tr>
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3.1.2 Debriefing helps increase learning effectiveness

Before students need to use the spread plate techniques again in another lab exercise, the teacher used pictures taken from the students’ submitted videos to let them know what could be improved and how they could improve further. During the debriefing, students were eager to point out what might be wrong and how something could be better done. From the questionnaire, most students indicated that they could understood the dos and don’ts better (94.9%; Fig. 1A), they felt more confident about what to do (72.8%; Fig. 1B) and they were sure that they could do the spread plate techniques better (84.8%; Fig. 1C).

The slightly lower percentage (just over 70%) observed for the increase in students’ confidence may be explained by the notion that confidence can better be built through practices instead of just watching, listening, thinking about and pointing out what should be done and what not to be done. Thus, the time allocated for students to try out the techniques should not be compromised.
3.1.3 Students appreciate the teacher’s effort

Despite more work needs to be done, 93.9% (n=99) of the students did indicate that they appreciate the teacher’s effort in having the video submission exercise in place and having the debriefing with them using pictures taken from their submitted videos to discuss with them what could be improved and how they could improve further right before they were to do the same techniques again. This appreciation can also be found in some of their free comments listed in the following section.

3.1.4 Other comments from students

Apart from indicating how much they agree to certain statements, students were also asked to put down any other comments and/or suggestions they might have. In general, some students found the exercise a bit stressful, yet many of them appreciated that this pressure could help them do better and they had treasured the learning process after all. One common complaint is about problems encountered during video uploading. We need to work more closely with our Information Technology Services Centre (ITSC) to ensure a smoother uploading experience for our students. In fact, students were asked to upload just a link to their videos hosted either in you-tube or Google drive (if their file size is large), but some of them still preferred uploading the file directly. Below are some of the free comments from students:
“Video submission is stressful but it can push us do better.”
“It was a bit stressful though good learning process.”
“This submission let us know what we’ve done wrong so we can do it better next time.”
“Video taking makes me anxious about performing well, yet I think such pressure is acceptable and the teaching effect is good.”
“Submission of the video surely can make us more aware of the details of the procedure.”
“It surely became a lot more stressful when you told us to video tape it... But all in all it was quite an experience and was probably one of the most memorable lab sessions … We should all be really clear about what we should be doing during spread-plate procedures.”
“This shows that the teacher has strong passion to help us and teach us how to conduct an experiment. This is the best kind of teacher a student could have.”
“It was a nice try and this video-taping indeed helped me in improving my performance, and I can also avoid many mistakes that had happened to my fellow classmates. Unfortunately, the server of our elearning system responded slowly and brought some trouble when I uploaded the video. Overall, I think this helped a lot and appreciated May [the teacher]’s effort.”
“Uploading video is quite troublesome but the review afterwards helps me a lot.”
“Nice, constructive and elaborated comments received from both May [the teacher] as well as the demonstrators [teaching assistants], learned a lot from them all.”
“It is good to have debriefing which makes me learn more.”
“I wish we can have more video-tapings in labs because I can understand whether my operating skills need to be improved or not. Therefore, through these video-tapings, I can find my mistakes and correct them.”
“The video submission could be a great chance for the demonstrators [teaching assistants] to look at our work with more focus and tell us about the mistakes we’ve made since they have to take care of 6 students [at a time] and sometimes they might overlook our lab techniques performances.”

3.2 Teaching assistants’ responses

Apart from asking feedback from students, our 10 teaching assistants were also invited to send in their views by filling out an online questionnaire. The response rate was 100%. All of them agreed that these video submissions did help enhance teaching and learning. 8 out of the 10 teaching assistants agreed that students were more serious about their work with the videotaping in place and the same number agreed that students did try their best to videotape more than one plate and choose the best to submit. However, only 50% of them agreed that students were paying more attention to how others were doing, even when that was not their turn, compared to 88% as perceived by the students themselves. This discrepancy might be explained by the different standards as perceived by the two groups.

When asked about if they had watched the videos uploaded by students of their own groups, of the 10 teaching assistants, 4 indicated that they had watched all of them, 1 watched most of them and 4, some of them, while 1 did not watch any at all. When asked about if they had watched videos submitted by students from other groups as well, only 4 of them indicated that they had watched some, while the other 6 indicated that they did not watch any. These figures indicated that not all teaching assistants could spend the time watching the videos so as to give more tailor-made feedback to the corresponding students as wished. This might be due to their busy research schedule as many of them were PhD candidates. However, this also indicates that quality feedback given to students from different groups might vary quite a bit, depending on the teaching assistants assigned to them.

Besides, only 5 of the 10 teaching assistants agreed that the videos helped them know better how each of their students was performing, as they could not focus on more than one student at a time when they were teaching them in the lab. This might be another reason for some of them not watching all the videos from even their own groups. One teaching assistant even claimed in the free comments that he could track his groups’ performance very well in class, so there was no need to watch the submitted videos; but it would be difficult to understand how one can focus on two different students working simultaneously at the two sides of a bench.
On the other hand, 7 of the 10 teaching assistants agreed that from what they saw on the videos, they could better tell their students how they might improve further; and the same number agreed that with their further coaching, they could see that students were doing better. So, most of them did see some value of the videos.

For the effectiveness of the debriefing session, 8 of the 10 teaching assistants agreed that students did understand the dos and don’ts better; and the same number agreed that they saw students were actually performing better. Besides, 7 of them agreed that they could learn from the debriefing how other students in class were performing and thus, could teach their own students better.

3.3 Teacher’s reflection

3.3.1 Why try this at this time?

The idea of having students to videotape their work for submission has been around my mind for some time. We have been shooting teaching assistants, who are serving as chief-demonstrators of that particular exercise in order to have some video clips showing the different procedures for the internal training for our different batches of teaching assistants, as well as our undergraduate students. The videos shot were never perfect, and I often need to play them and comment on them at the same time. This is not bad though, as we do want our students to understand why things would better be done in this way or that, not just to mimic how others are doing it without understanding why. Apart from this, I can see that although students appear to understand what they are to do, a lot of funny things can happen when they are actually performing the task. This is understandable, as many of them are novice learners of these techniques.

We are lucky to have teaching assistants assigned to us to help coach the students on the spot; however, the skill sets of these teaching assistants vary, while some are very experienced, occasionally, there would be one or two who have no prior training in Biological Sciences at all as they have been majoring in Computer Science or Engineering and have been recruited into our PhD programme to help develop computer programmes for big data analyses in Biological Sciences. Although we did try very hard to equip them with what they need to know, we cannot just assume that they will be giving as accurate, as critical, and yet constructive feedback to the students like others who have been trained in the area for years. So, the central briefing and debriefing could not be skipped nor relaxed, or else, it would be unfair to the groups that are assigned with perhaps not as experienced teaching assistants.

With the high penetration of smart phones, we do see students taking pictures and making video clips of reasonable quality for their different society activities. Perhaps this would be the right time to try asking them to make good use of their smart phones to enhance their learning experience in our lab class. I raised this during our prelab session with the teaching assistants and they all agreed that we could give it a try. Thus, students were told in an online announcement that they were to send in a video of how they spread their plate after class.

3.3.2 During and after the trial - Students’ serious attitude, critical self- and peer-review and the improvement in their performance were obvious.

During the actual practical class, we clearly observed that students were treating the spread plate task and the videotaping seriously. This is also evident from the questionnaires for both the students and the teaching assistants. Having a serious attitude is a good start. We are to see if this intervention can really help enhance the teaching and learning.

Shah et. al. mentioned that videotaped feedback increased observational learning and provided the participants with a chance to accelerate their learning by knowing what errors could occur. [8] This is particularly true. Our students also reported that they could learn not only from their own mistakes but from others’ as well, this had helped them do a better job.

Since students were to help shoot their groupmate(s) using their smart phones when it was not their turn, students did focus more on how things could be better done, rather than doing something else while waiting for their turn. Pretty often, peer teaching was evident. This could be noticed both by observation on the spot, and from the submitted videos, which captured also what the groupmates were talking about. The same peer-to-peer feedback or the “buddy system” has been shown useful by Buday and Jones in their ballet and contemporary dance classes for Year 2 Fine Arts (Dance Performance) students where learners were asked to alternate between performing and observing (and/or recording with a smart phone), followed by review and critique. [11]
Besides, students had to choose their best recording to submit; during the course of time when they were reviewing their different video clips, students had already gone through an honest reflection on what they had done well, what not, and how things could be done otherwise.

I went through all the submitted videos, picking scenes with high discussion value and put together a powerpoint file for discussion before the students were to use the spread plate techniques again for another lab exercise. Students were very responsive and could point out almost everything that I wish to bring up for their attention. Our findings concur with Shah’s [8] in that feedback using both ideal and non-ideal examples from the videos did enhance students’ performance. With this debriefing, students expressed that they know better the dos and don'ts, they were more confident to do the job again, and they were sure they could do a better job this time. Teaching assistants also reflected that the debriefing was useful and that students were actually performing better. So, this video feedback is effective in our case as in many others in different fields. [7-16]

3.3.3 Teaching assistants’ dedication

One concern lies on the teaching assistants’ dedication, as the central debriefing could only address major and minor problems with just some examples; detailed and tailor-made feedback was expected to be given to the individual students by the teaching assistant responsible for the group. However, though some of them were very dedicated, having watched all the videos from their group and even watched some others, others might not be as dedicated. While some students responded positively to the constructive feedback given by their own group’s teaching assistant, a sign that indicates the system was working well; in other cases, specific and constructive feedback given to individual students might be lacking. We need to communicate more with our teaching assistants, so that they can understand more what is expected from them. We want them to understand the importance of having them trained to be educators as well as researchers. The same was raised by Handelsman in her article on “Teaching Scientists to Teach”. [17] Anyway, apart from relying on the teaching assistants, we do want to train our undergraduate students to take ownership in their learning; thus self- and peer-evaluation, and subsequent feedback for improvement should perhaps be allowed to take up a more important role, given that students can have the opportunity to learn and practice how to critically evaluate from an expert’s point of view.

3.3.4 The way forward

With this experience, I believe having students to videotape their work and have it submitted can indeed help increase students’ seriousness towards the task. With students buy-in, despite the slight increase in stress and workload, self- and peer-review and subsequent feedback can indeed help improve how they master the techniques. Having students to annotate their clips as well as asking them to shoot their work a second time to see how much they have improved will be considered as two optional tasks to be rolled out next. Though these exercises may help act as a further boost, the time involved, the stress brought about for the different parties should not be overlooked; thus making this an optional task with some bonus marks given for students as an incentive may be the way to go. Although we are not going to use ipsative assessment [18], students might still want to keep all their video clips in their personal portfolio. However, we do need to improve the submission platform so that students can get a better uploading experience. Uploading should not be a burden if we want the whole teaching and learning experience to be meaningful as well as enjoyable. Another area to work on is to improve teaching assistants’ dedication, knowledge and skill sets, so that they can help play a bigger role in providing timely feedback with expert quality to all our students. All in all, we do want our students, as well as our teaching assistants to know, we do not want them to just complete the task, but to strive for excellence. Some tips on videotaping might need to be developed as well.

4 CONCLUSIONS

Asking students to videotape their work and have them submitted will inevitably increase students’ workload and thus pressure a bit, and both the teacher and teaching assistants would also need to spend more time on watching over the videos and giving students more specific comments; yet, all the teaching and learning parties agreed that this videotaping exercise, with its subsequent debriefing session, did help enhance teaching and learning of the spread plate techniques. Similar practices can be extended to other lab techniques as well, if time allows.
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