Integrating Scientific Practice Into Online Environments

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Abstract

This paper focuses on an innovation converting laboratory based food microbiological activities into a flexible online format for a subject offered at the La Trobe Rural Health School (Bendigo). Until 2012, this subject contained face-to-face laboratory sessions to demonstrate the applications of a number of microbiological techniques. Offering this subject in a face-to-face format alone has become impractical with more students choosing to learn off campus. It is important to note that the outcomes of the laboratory sessions were not for the students to gain a level of competency but a clear understanding of the microbiological techniques and processes.

The laboratory sessions were replaced with a series of short purpose made videos demonstrating techniques such as sampling and culturing; the findings were presented in PowerPoint presentations supported with verbal commentary; and the learning outcomes were assessed using an online quiz. Additionally, online activities included a project activity booklet that incorporated general questions for the students to undertake prior to attempting that quiz. The students demonstrated good understanding of the key aspects of food microbiology, sampling techniques, and food safety management approaches through the quiz results. Additionally, the students were supportive of the online format, as reported in the survey data, as it provided a flexible study-option and higher level of accuracy within the demonstrations.

Introduction

As universities transition towards a more student centred approach to teaching and learning, academic staff are faced with new challenges in the design, delivery and educational outcomes required to meet the changing needs of students enrolled in higher education courses. Students, particularly those coming from regional areas, may have challenges with geographic distance and competing priorities such as paid employment (McInnis, James & McNaught, 1995), forcing universities to explore avenues to increase access and flexibility in course delivery. Also to keep students motivated, academics must design a curriculum that is engaging, relevant and conducive to the online environment.

As a minimum, students expect universities to utilise newer teaching techniques and approaches including computer assisted learning strategies to increase flexibility within programs (Johnson, Charchanti & Troupis, 2012; Quinn, 2011; Movahedzadeh, 2012). The changing nature of students enrolling in higher education programs must be addressed as they are accustomed to absorbing information from a variety of mediums simultaneously (Tapscott, 1997). The downside of meeting this expectation, according to Candy, Crebert and O'Leary (1994), is that students are expected to become selfdirected learners. It then falls on academics to inspire their students to remain connected with the learning process and this can

be challenging when working within the online environment. Academics must also consider the different styles, times, paces and places of learning to encourage engagement and retention. Hughes (2006) added the importance of providing students with clear guidance to assist their transition from the face-to-face medium to an online learning environment.

Graduates from university must be work ready and in response to this, La Trobe University has implemented the Future Ready: Strategic Plan 2013-2017 to address the changing needs and attitudes of students. Academics are being encouraged through the implementation of this plan to be creative in their teaching strategies by blending traditional face-to-face delivery with online educational resources (La Trobe University, 2013). This movement in higher education is well supported in the literature with numerous authors reporting success with online content delivery, confirming that this medium can work as well as traditional face-to-face delivery (for example: King and Hildreth, 2001; Gilman, 2006).

While online learning is now a recognised teaching method, there are still various limitations in the types of activities that can be effectively conducted in this environment. Scientific laboratory based activities have traditionally been offered in face-to-face classrooms where techniques and skills are a required learning outcome. However, the student cohorts within this trial come from non-biology majors and do not have skill development as a learning outcome. McConnell and Schoenfeld-Tachner (2001) suggests that course objectives may still be met in non-biology majors where the development of the skills needed to manipulate laboratory equipment are not as important as developing an understanding of the process undertaken along with the outcome of the experiment.

This paper examines students' perceptions of undertaking an online practical activity as a substitution for hands on experiments in a food microbiology class.

Background

This paper reviews a trial of the integration of an online food microbiological learning experience into cohorts of undergraduate and graduate students within the Environmental Health programs delivered by the Faculty of Health Sciences, La Trobe University (Bendigo). The majority of undergraduate students had access to the Bendigo campus and received a mixed mode delivery of face-to-face lectures and tutorials, while the postgraduate students had virtually no direct access and received all content for the subject online. Both cohorts undertook the food microbiological practical online. It is important to note that the purpose of these activities is to build knowledge on food microbiological techniques and not to provide skills training.

The online content was available to students twenty four hours a day through the La Trobe University *LMS* site (delivered through *MOODLE 2.1*). The online package involved videos, food safety guidance material, assessment quiz a project activity booklet. The project activity booklet had been developed for the face-to-face sessions and it was decided to continue its use for the online practicals. Seven videos, ranging from two to five minutes in length, were specifically developed for this activity by a microbiologist and an environmental health academic. These videos demonstrated the key techniques of food microbiological sampling; swabbing and culturing (including different agar mediums and incubation conditions); poor food handling techniques (e.g. cross contamination); common food safety approaches (cooking, pickling and dehydration); and applications of the 2 hour / 4 hour rule (a time based food safety strategy). The videos showed each process up to the agar plates being put into an

incubator. Figure 1 provides an indication of the production quality of the video and PowerPoint resources.

Photographs were taken of the resulting agar plates showing growth of key food poisoning microorganisms present. The photographs, along with brief discussions explaining different agar mediums used, numbers of colonies, and interpretation of results were placed in separate PowerPoint presentations for the students to review. The project activity booklet guided students through each step of the experiments shown within the videos and provided a mechanism to guide students to analyse and interpret each activity being demonstrated. Once completed, this booklet aided the students in completing the assessment (an online quiz).

The quiz was aligned to the subject objectives and tested knowledge on key concepts of microbiological food safety. The questions were multiple-choice to allow electronic marking, and students had one hour to complete the test and were limited to one attempt. This online test made up 10% of the overall mark for the subject.

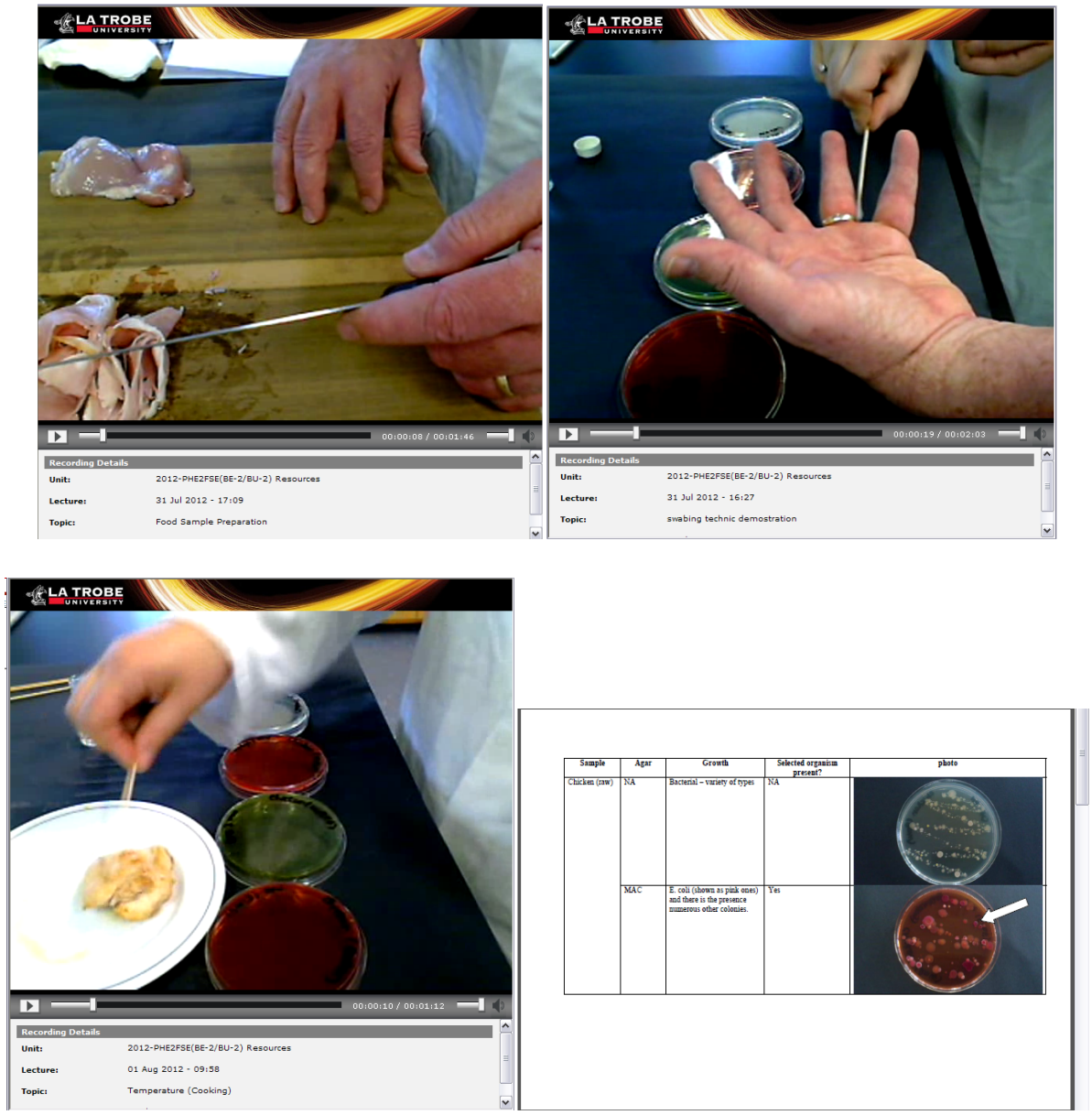

Figure 1: From left to right, preparing meat for sampling, swabbing hands, swabbing food and results

The study

A cross sectional design was used for this study (Morton, Hebel and McCarter 1990; Protney and Watkins 1993) involving a survey methodology for the collection of self-report data from the study cohort. This study was conceptualised as an exploratory study so no formal hypothesis testing was conducted. The results are presented in a descriptive form only in tables showing counts and percentages. *Survey Monkey* was used as the data collection tool as study participants were off campus.

Survey Instrument

The survey tool for the study was designed to collect data on student perspective on the overall learning experience, functionality of the activity, linkages with the assessment items and general satisfaction as a participant. The survey was delivered through *Survey Monkey*. The survey instrument had been piloted and modified prior to the study. The questionnaire was designed for completion in 15 to 25 minutes and contained a combination of closed and open questions.

Statistical methods

The associations between variables are summarised in tables showing counts and percentages. As this was an exploratory and descriptive study, little statistical testing was employed.

Study Participants

The study participants were students enrolled in Food Science Essentials (PHE2FSE) with 21 students enrolled in 2012 with 62% (n=13) participating in the review of the online microbiological activity. The study cohort consisted of undergraduate and postgraduate students within the Environmental Health academic programs provided at La Trobe University (Bendigo, Victoria).

Findings

Participants were asked to comment on a range of general factors such as instructions and support, with Table 1 providing a summary of these results. The participants considered there was adequate instruction to complete the online task, it was detailed enough and there was adequate support given to those who needed it. Overall, the participants considered the instructions were "*detailed enough*" and "*super easy to understand*". Additionally, "*the information we required [to do the practical] was presented in lectures and in the project activity booklet that we completed before doing the online quiz*".

Most participants rated their learning experience completing the online microbiological activity as "*good*" and with "*enough detail*". No participants rated their experiences as poor (refer to Table 2). One student surmised doing the online practical was "*way easier! and no possible way to stuff it up*".

Table 1: Summary of survey participant responses to level of instruction and support provided for the online practical activities

Questions	Yes	No	NA
Were there adequate instructions provided to allow you to navigate through all the practical activities?	100% (n=13)	0 (n=0)	0 (n=0)
Did you consider there was enough detail provided to support your learning experience?	93% (n=12)	7% (n=1)	0 (n=0)
If you needed assistance while undertaking these activities did you receive adequate support from staff?	31% (n=4)	0 (n=0)	69% (n=9)

Table 2: Summary of survey participant responses to their learning experience and the quality of the online practical resources and quiz

Questions	Good	Average	Poor
How would you rate the overall quality of the learning experience as a result of doing this online microbiology practical?	77% (n=10)	23% (n=3)	0% (n=0)
How well did you think the videos demonstrated the procedures and processes associated with culturing and sampling microorganisms from food?	92% (n=12)	8% (n=1)	0% (n=0)
How well did the quiz questions link to the activities within the online microbiological practical?	77% (n=10)	23% (n=3)	0% (n=0)
How well did you think the results pages demonstrated the findings from the practical activities?	92% (n=12)	8% (n=1)	0% (n=0)

For the video component of the activity the view was that "*the videos were very informative and were done well*". One student did however suggest that it would be better to have *"...one video with the [sampling process] and the results in one would be more beneficial*".

The quiz was seen as linking well with the objectives of the activity as *"...the questions for the quiz [clearly focused on] the concepts of basic good food safety management conditions*".

Overall, participants considered that the online activity was "*clearly set out [and] very helpful*" and the materials were "*very easy to understand*" and "*helped me to grasp the topic much better*".

The participants with previous laboratory experience compared this activity with their other experiences with the majority of this group saying the experience was similar or better. As one student explains "*I found it a better experience, although my previous ones were in high school. It was good to know the tests were done under controlled circumstances and that the results were accurate*". From the remaining participants, 16.5% or two participants reported there was no comparison between their previous lab experience and the online activities while 33.5% or four participants reported having no previous lab experience to compare against.

The students provided positive feedback on their experiences with the online microbiological activities. Most commented on the flexibility the online activity provided them ("*you can take your time"; "could have my notes open"; "didn't feel under time pressure";* and *"nobody else to distract me or ask questions").* The students found the content relevant ("*gained a bit of experience of how food safety can be managed");* the activities were "*easy to follow*" and they received "*instant feedback*" on their work.

The greater majority of the participants were satisfied with the overall experience ("*was a good assessment");* however, one commented that "*it was hard to see the overall flow of how these experiments are done"*. Two students did provide recommendations -*"having longer videos, putting more information in one video instead of breaking them up"* and *"[The quiz] could have been longer to really test you"*.

Additionally it was noted that student learning outcomes, measured by the associated assessment, improved by 10% over the previous years cohort of students. This supports student comments that the experience of an online practical did not disadvantage their learning as they *"still got the same information from it [the online practical] as if had attended [a face-to-face practical] and it took less time than if we had completed the practical ourselves"*.

Discussion

The online food microbiological trial discussed in this article was considered by the academic staff and students to be innovative and successful at transitioning face-to-face laboratory activities to the online environment. Particular strengths of this activity were the use of professional laboratory staff to develop the instructional videos; the supportive project activity booklet that guided student analysis and knowledge development; and the flexibility of undertaking the activity at their leisure. Meeting student expectations was a key measure to the effectiveness of this trial with students providing constructive feedback as shown in the findings. Overall the participants found the online activity was easy to follow and aided in their understanding of the key topics associated with food safety.

From an academic perspective, the learning outcomes for the exercise were met as the greater majority of the class demonstrated a strong understanding of the main causes of microbiological contamination of food, and were able to identify key strategies to manage food safety through successfully answering the quiz questions and completing the project activity booklet. This cohort also attained a higher average mark for the equivalent assessment from the previous cohort. This was encouraging and supported the positive feedback provided by the students through their survey responses. It is important to note that considerable effort was taken to ensure that constructive alignment between the learning outcomes and the assessment task occurred.

Dewhurst, McLeod, and Morris (2000) have highlighted concerns about the effect of eliminating of peer interaction when courses are delivered in an online environment. However, studies by Bernard, Abrami, Lou, Borokhovski, Wade, and Wozney, Wallet, Fiset, and Huang (2004) and Russell (1999) have shown no significant difference between face-to-face and online learning modes of delivery (Wray, Lowenthal, Bates and Stevens, 2008). One of the key issues identified in measuring success of online programs in these studies was student motivation, which is known to be a strong factor that influences learners' engagement and hence learning success (Herrington, Oliver & Reeves, 2003). Even though a face-to-face

activity has been redeveloped into the online learning environment, it cannot be assumed that learners will engage with the learning process. With this in mind and to compensate for losing the face-to-face contact, students were encouraged to actively participate in online forums to discuss the linkages between the theory and observational outcomes expected from the demonstrations in the week prior (through the La Trobe University *LMS* site). The general forums for discussion between students were available twenty four hours a day which were moderated by academic staff members as required. As suggested by Lim (2004) detailed guidance information on access, navigation, technical requirements and expected time required to complete the activity were provided the week before and academic staff were available at specific times to answer any technical or content questions during the activity.

Lance and Kitchen (2007) have suggested that the use of video footage within a teaching and learning strategy could 'enhance or support a students' preferred learning style' in the higher education environment (Lance and Kitchen, 2007, p. 115). Consequently this strategy was adopted as the main pedagogical focus and a series of short, videos depicting key food sampling and safety demonstrations were developed. The challenges were numerous as there was no funding, training, or technological support for the developmental process and the production costs had to be kept low. As a result the making of the videos was based on the "*YouTube"* style of production that Duffy considers 'popular, forceful and familiar' (Duffy, 2008, p.124). This meant the videos were developed using simple language and visual effects, and focused clearly on the activity being demonstrated (and not the demonstrators). The use of video recordings has added benefits in the online environment as it can be relayed to large numbers of students simultaneously, is available on demand, is can be paused, re-viewed, and as described by one student "*[You can] take your time, such as watching the videos, you could do it at a time that was suited to you".*

Recommendations

The key recommendations from undertaking this online food microbiological activity were:

- Ensure that the students are provided detailed guidance information prior to commencing the activity;
- Development of video footage that includes simple language that is targeted, concise and straight to the point with the visual focus on the activity being demonstrated in a medium that is natural (not over produced); and
- Ensure the online activities are aligned to the expected learning outcomes.

Conclusion

This paper focused on an innovation that involved converting laboratory based food microbiological activities into a flexible online format. The laboratory sessions were replaced with a series of short purpose made videos demonstrating the techniques such as sampling and culturing; the findings were presented in PowerPoint presentations supported with verbal commentary, and the learning experience was assessed using an online quiz. Additionally, online activities included a project activity booklet that incorporated general questions for the students to undertake prior to attempting that quiz. The students demonstrated good understanding of the key aspects of food microbiology, sampling techniques, and food safety management approaches through the quiz results. Additionally, the students were supportive of the online format as it provided a flexible study option and higher level of accuracy within the demonstrations.

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