Human Physiology Students' Perceptions of etextbooks: Towards Open Access as an Alternative to Traditional Textbooks

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Abstract

Science experts across the globe are requesting educators to teach science in authentic and inquiry-driven ways to prepare graduates to be scientifically literate citizens. Shifting from traditional teacher-centred approaches to models of authentic learning requires new and innovative resources. In an inquiry-driven human physiology curriculum an etextbook, *How to Do Science: a guide to researching human physiology*, was developed as an alternative to a traditional textbook and is an example of how professionally designed electronic textbooks can support new approaches to learning. While the advantages of OER have been documented internationally, there is little empirical evidence to indicate benefits of open etextbooks for students in Australia. This study found a majority of students prefer etextbooks compared to hardcopy textbooks, most often due to accessibility, ease of use and convenience. Regarding *How to Do Science* specifically, a majority of students rated accessibility, attractiveness, ease of navigation, and the quality of the content as high or very high. Students reported that the etextbook contributed most to their learning through assisting in completion of authentic scientific assessment tasks. The etextbook was designed for local use, however, the release as an OER has meant wider dissemination with more impact. We encourage educators to incorporate OERs into their practice.

Introduction

Leading scientists and education experts are urging educators to teach science in authentic, engaging, inquiry-driven and relevant ways to prepare graduates to be scientifically literate citizens who can make valuable contributions to society in the 21st century (American Association for the Advancement of Science 2011; Office of the Chief Scientist 2014). It is essential for student scientists to engage in activities that practicing scientists carry out, from designing and conducting experiments, analysing and presenting data, to communicating results to different audiences via different platforms. However, the move away from traditional lectures towards more authentic ways of teaching science in higher education requires a different pedagogical approach supported by new curriculum resources and innovative methods to develop those resources.

For science educators, replacing a traditional undergraduate biology textbook crammed with scientific facts with an 'active textbook' that facilitates student construction of their own knowledge (Wagner, Campbell, Sly, & Paradise, 2015) is not always easy. To resolve the issue

of matching an authentic learning approach in third year human physiology with an appropriate and relevant 'active textbook' a team of lecturers and professional library staff at La Trobe University (La Trobe) developed an interactive open etextbook. In 2017 this etextbook, *How to Do Science: A guide to researching human physiology* (*How to Do Science*) was embedded in the curriculum to support new ways of teaching human physiology more authentically. Open etextbooks are an example of Open Educational Resources (OER) that offer an alternative for resource development and access, and provide a range of benefits for rethinking how curriculum resources are developed to support new pedagogical practices. While the advantages of OER have been documented internationally there is little empirical evidence to indicate benefits of open etextbooks for students in Australia. This paper contributes to this gap and presents data from a La Trobe study on student perceptions of the etextbook *How to Do Science* as an example of an open etextbook.

In this paper, we first review the literature on open educational resources and open educational practices and their significant benefits to higher education. We then summarise international research on etextbooks in the higher education context before looking more closely at our local Australian context. This provides the background for presenting the results of our study into students' general attitude towards etextbooks and their perspective on the usefulness of *How to Do Science* for scientific skill development in third year human physiology education. The authors also consider how this open etextbook has contributed to learning success in a subject where it is embedded. In this way, this paper adds to the literature a current Australian student perspective on the usefulness and acceptance of open etextbooks. We conclude with possibilities for further research on open etextbooks and reflections on the potential of open educational practice and resources for academics and higher educational professionals. By presenting the outcomes of our investigation into student perceptions and experience of the etextbook our intention is to generate interest in the open education movement among Australian science educators, and we hope that this may lead to further uptake not just of the development and release of OER and open etextbooks in particular, but also of the wider adoption of open educational practice within and across institutions.

Literature review

The international context: Open educational resources and practices

OER are defined as 'learning materials that have been released under an intellectual property license, permitting their free use or re-purposing by others' (OER Foundation, 2011). They include videos, interactive learning objects but also textbooks, lecture notes and other types of material. The open education movement is a 'technology-empowered effort to create and share educational content on a global level' (Bossu, Browne, & Bull, 2014), and has been steadily gaining momentum over the last decade due to the many benefits of sharing resources openly. While the Open Education movement started with a focus on increasing access to resources, this focus is shifting towards Open Educational Practices (OEP), as fundamental change will not be facilitated through a 'narrow focus on OER rather than OEP' (Bossu et al., 2014). There is a need to embed OER into learning and teaching practice and develop innovative open educational practices (Ehlers, 2011).

OEP is regarded as a high priority in the United States (US), where a national action plan was established in 2014 with $2 billion investment as a commitment to promote open educational resources. More than 2000 US community colleges are using open textbooks driven by the College Open Textbooks Collaborative which has a focus on driving awareness and adoptions of open textbooks to reduce the cost of public education. In the K-12 sector, studies are

conducted to explore business models for successful and sustainable publishing of OER materials covering whole curricula (K12 Handhelds, 2015). The OERu network works through the OER Foundation towards providing pathways for students to achieve credible credentials for approved courses based solely on OER. 'It will shift the question from how to achieve sustainable OER projects to how institutions will remain sustainable without OER' (Bossu et al., 2014). The Open Education Consortium, on the other hand, is a global network of educational institutions that promotes, supports and advances openness in education worldwide. An overview of further significant international initiatives in the open education space may be found in Wilson, Whelahan, and Sadler (2013).

The Organisation for Economic Co-operation and Development (OECD) Report on OER (Orr, Rimini, & Van Damme, 2015) emphasises that OER are a catalyst for innovation, contain educational costs, improve the quality of educational resources and widen distribution of high quality educational resources. Among the 11 hypotheses on commonly stated beliefs and motivations regarding OER are that the open aspect of OER creates different usage and adoption patterns, and that the use of OER leads to critical reflection by educators, with evidence of improvement in their practice (Weller, de los Arcos, Farrow, Pitt, & McAndrew, 2015).

The benefits of OER and OEP in Australian higher education

Recognising the importance of engaging with the open education movement, the Australian Government Office for Learning and Teaching (OLT) and its predecessor funded a number of open education projects to investigate feasibility, challenges and benefits, and to raise awareness of OER use and adoption across the Australian Higher Education sector (Bossu et al., 2014); to produce an open micro course to explore, evaluate and adopt OEP (Bossu & Tynan, 2011); to develop a national policy roadmap and case studies (Wills et al, 2015); to develop a good practice toolkit for publishing OER (Wilson et al., 2013) as well as an open education licensing toolkit (Wright, 2014).

Findings from these projects indicate that the majority of Australian academics have never used OER but would like to get involved. Identified challenges were the perceived poor quality of available resources (free must be low quality) and limited discoverability of quality and relevant resources (Bossu & Tynan, 2011); the sustainability of OER initiatives in the long term (Smith & Wang, 2007), insufficient institutional support (Bossu & Tynan, 2011) and copyright and intellectual property issues. At the same time, benefits highlighted were that OER and OEP are aligned with the academic tradition of sharing knowledge; increase collaboration institutionally and internationally; lead to faster development of new learning resources and less duplication; improve learning material and learning and teaching at decreased time and financial cost; lead to new pedagogical practices and are a catalyst for institutional innovation; and they can increase access to education and wider participation in higher education in Australia (Bossu et al., 2014). There is also the perception that universities that do not engage with open education are at risk of losing their competitive advantage. Stagg, Nguyen, Bossu, Funk, Partridge, and Judith (2018) provide an overview of OEP in the Australian higher education sector, and call for a national OEP initiative or national policy on OEP.

In addition, 'open education can play an important role in positioning Australian higher education on the global stage through showcasing the expertise contained within our universities' (Wills et al., 2015). Despite these promising results, 'there is a lack of solid and publically available data on the extent of the impact of these resources on learning' (Bossu et

al., 2014). This need for more research is also highlighted by Shear, Means and Lundh (2015), who ask for rigorous, controlled studies on the impact of OER on learning outcomes and the cost of education.

Students and etextbooks

In this paper, we are specifically interested in the development of etextbooks and student perceptions as a way to explore open practices and OERs. Etextbooks, released as OER, have been the focus of a number of studies across a range of disciplines and mostly from the US that report on student preference and student performance when commercial etextbooks are made available. The research is not conclusive, with a range of different outcomes, both positive and negative, reported. Shepperd, Grace, and Koch (2008) showed that when introductory psychology students were given the choice of purchasing an etextbook or a more expensive hardcopy textbook, 90% of students chose to purchase the traditional hardcopy textbook. Similarly, Woody, Daniel, and Baker (2010) showed that their cohort of general psychology students did not prefer etextbooks over hardcopy textbooks. We note that both these studies were undertaken before the ubiquitous spread of tablet devices, started by Apple's release of the iPad in 2010 and culminating in students entering university having high levels of access to smartphones, laptops and tablets (Farley et al., 2015), which should make it easier for students to access etextbooks. A study by Jesse (2014) reported that students studying in a variety of disciplines still had a preference for traditional textbooks (46% of respondents) over etextbooks (36% of respondents). Furthermore, Records, Li, Prichard, and Beling (2015) surveyed students from a small private northeastern university in the US and found that 80% of responders preferred hardcopy texts compared to 21% who preferred etextbooks.

In contrast, there are also positive reports, for example Peng, Ratan, and Khan (2015) found that undergraduate students from an introductory course in media history and theory at a large Midwestern university in the US generally perceived etextbooks positively, with respect to usefulness and ease of use. These students were provided free commercial etextbook access by the university via the course management system. Chuklov and Van Alstine (2013) surveyed students studying introductory economics courses at a regional campus of a public US university and found that the cost, and ease of use, both rated above 4 on a 5-point Likert-type scale as factors considered when purchasing a textbook.

Students and open etextbooks

Two community colleges in the US reported on a successful move to OER textbooks in tertiary mathematics education, saving students significant expenses for books. In one case, this led to measurable performance increase (Pawlyshyn, Bradlee, Casper, & Miller, 2013) while in the other student performance remained at similar level (Hilton, Gaudet, Clark, Robinson, & Wiley, 2013). There are further studies from the US on OER textbooks that have found at least the same, if not better student performance when an open textbook is used in psychology (Hilton & Laman, 2012), business (Feldstein, Martin, Hudson, Warren, Hilton III, & Wiley, 2012), and across disciplines in a multi-institutional study (Fischer, Hilton III, Robinson and Wiley, 2015). It is reassuring that a study by Allen, Guzman-Alvarez, Molinaro and Larsen (2015) utilising the ChemWiki OER as primary textbook and comparing with a control class using the traditional textbook found that etextbooks deliver no negative impact on learning. Research on the impact of OER has often focused on the financial benefit for students and institutions (Bliss, Hilton III, Wiley & Thanos, 2013; Wiley, et al., 2012).

Westermann Juárez and Venegas Muggli (2017) investigated the effectiveness of OER use and factors that explain success or failure in first year mathematics in Chile. One of the types of

OER evaluated in their study is an open textbook (available in electronic form and in hardcopy) written by the teacher. Notable in this approach is that the etextbook was available online via a Wiki, allowing students to edit the content. This textbook did not lead to improved student performance, in fact, in some cases performance was worse than when students were studying with the traditional commercial textbook. On the other hand, student perception of the OER was very positive, with students requesting more examples in the textbook. Westermann Juárez and Venegas Muggli (2017) conclude that:

> *...although there is more evidence today on how the "free" aspect of digital resources has a measurable educational impact, we are only at the beginning of assessing how the "open" aspect might contribute to accessible, high quality education. While 'openness' does not necessarily produce an impact in itself, it is part of a greater set of tools and practices in which many variables exert* (p.188).

Given the global drive towards OER as part of a set of tools and approaches that can be leveraged in developing authentic student learning experiences, we believe the usefulness and student attitude towards open etextbooks urgently needs further research. In particular, there appears to be little if any research undertaken on this topic in the Australian context.

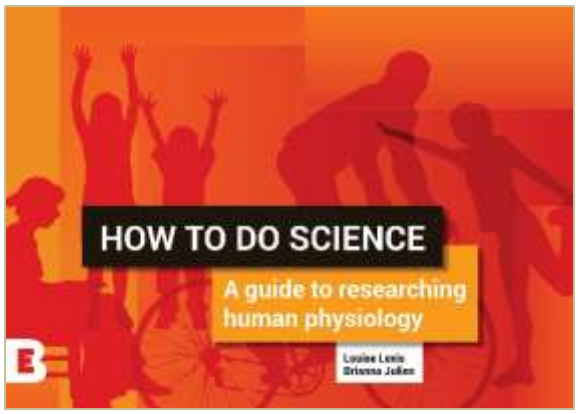
Our local context: Transforming human physiology curriculum at La Trobe University

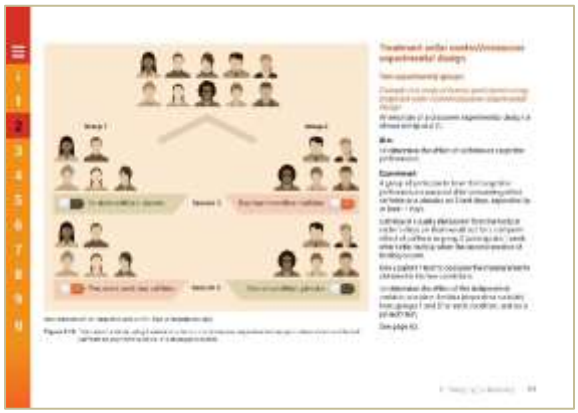
La Trobe is a multi-campus university serving the need for higher education in both urban and regional areas often classified as low-socio economic. The university is guided by a strong sense of social justice, and aligned with this mission, has recently embraced the idea of publishing etextbooks as OER.

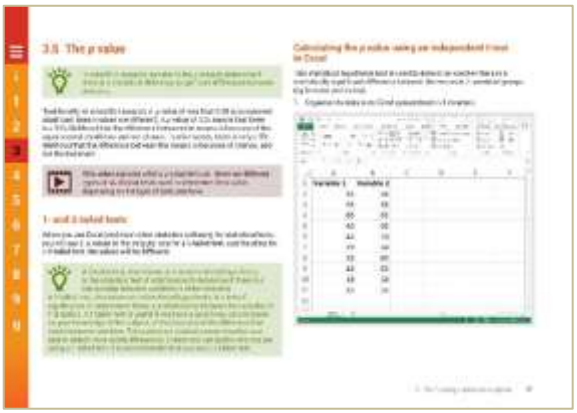
In 2011, the advanced human physiology curriculum delivered to health sciences, biomedical sciences and nutrition students that had previously been delivered in a traditional way was transformed into a capstone program (Julien, Lexis, Schuijers, Samiric, & McDonald, 2012), consisting of two final (i.e., third) year subjects both equivalent to two units (50% of full time study load). The new curriculum provided students with the opportunity to develop their discipline-specific research and communication skills through undertaking authentic scientific tasks such as writing a literature review, supported (Julien & Lexis, 2015) and independent (Lexis & Julien, 2014) research projects, and communicating science to non-scientists.

While in the traditional curriculum there was sufficient support available for students learning scientific facts, resources to support students' engagement in authentic scientific activities were limited. As part of the re-design of the curriculum, and to support students to take on the role of a scientist (Julien et al., 2012; Lexis & Julien, 2014; Julien & Lexis, 2015), a simple guide for the student scientists was written by the subject designers/coordinators in 2014 that provided an innovative and flexible way of helping them along their journey of scientific discovery. The guide enabled students to interact with the material in an authentic and appropriate context, outside classes scheduled on a particular topic. The guide contained explanations and guidance on designing a sound scientific experiment, writing a literature review and research article, alongside how to guides for activities such as accessing scientific literature, referencing using EndNote and conducting statistical analyses using Excel. The guide was released in relatively conventional form as a basic PDF via the subject learning management system (LMS) and as a hard copy for purchase from the university bookshop.

At the beginning of 2017, the La Trobe eBureau was launched, with the mission to facilitate the development and publication of quality open access resources to support online and blended learning. One of its first projects was the development and publication of a new edition of the science guide as an open etextbook (Lexis & Julien, 2017). Professional review, editing and redesign of the student guide resulted in a cohesive textbook that guides students through each stage of the scientific method (Figure 1). The etextbook begins with a chapter describing scientific research and the scientific method and leads into chapters on experimental design, statistical analysis and visualising data (including step by step instructions). The next chapters explain how to access scientific literature and reference, communicate scientific discoveries to peers (i.e., research articles, posters and oral communications), write a literature review, and communicate science to non-experts. The final chapter focuses on what it means to be a scientist and the valuable skills developed by student scientists. The etextbook is optimised for viewing online and includes interactive elements, including embedded videos, links to videos and websites, and an always visible navigation bar that allows for easy movement between chapters. This development was also aligned with university strategy for student-centred approaches in both blended and fully-online contexts.







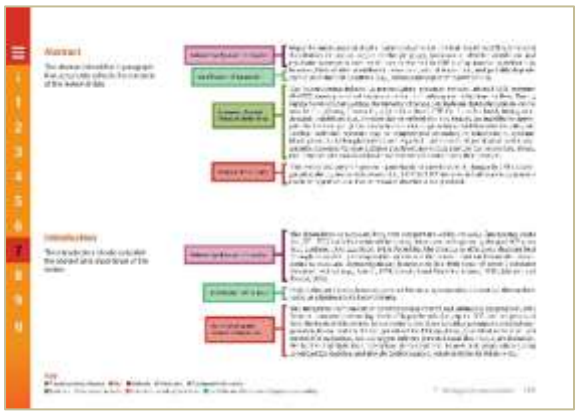


Figure 1: Images from *How to do science: A guide to researching human physiology*

As an OER the new etextbook was designed for the curriculum, but made freely available via the La Trobe eBureau website and the library catalogue. It was also released via the subject LMS to the third-year human physiology student cohort at La Trobe for the first time in semester 1 of 2017 to support their active participation in the practice of science. Students were referred to the etextbook to support: designing simple two-group experiments; writing aims, hypotheses and conclusions; and analysis of data and presentation in the form of scientific figures. This introduction of the new etextbook was an opportunity to collect feedback on the students' perception of an etextbook and the advantages of this particular resource for supporting their learning. These insights are a starting point for academics and professional library staff to consider why open resource development is a valid alternative for the future.

Methods

In this paper, we analyse quantitative and qualitative data from a survey made available to the third year human physiology student cohort. Out of the 108 students in the cohort, 56% were female. The students were enrolled in the Bachelor of Health Sciences (82%), Bachelor of Biomedical Science (6%), and Bachelor of Human Nutrition (5%). Students were invited to complete an in-class survey to determine their perceptions of the benefit of the etextbook content in supporting scientific skill development, and the benefits of etextbooks in general. The survey comprised Likert scale questions and open-ended questions; 67 students completed the survey, which corresponds to a response rate of 62%. The qualitative open-ended data underwent an inductive or data-driven thematic analysis using the approach described by Braun and Clarke (2006). Two researchers generated initial codes and searched for themes individually before coming together to review, define and name the themes.

In particular, we addressed the two research questions:

1. What is the student perception of electronic textbooks?
2. How do students perceive the *How to do Science* etextbook?

Ethical approval was obtained for this project (E17-037) from the La Trobe University Human Ethics Committee.

Results

What is the student perception of electronic textbooks?

Students were asked for their opinion about etextbooks compared to traditional hardcopy textbooks. A majority of the respondents reported a preference for etextbooks (50%) compared to hard copy textbooks (16%) while 34% of respondents indicated no preference. Students were further asked to explain their preference. The themes emerging from the open-ended responses are summarised in Table 1. Those who preferred etextbooks mentioned accessibility, ease of use and convenience most often, followed by the ability to search and navigate more easily, and the ease to transport. Student comments included *"Easy access and I don't have to bring it to Uni. Can still access it even if you have forgotten the physical textbook"*, as well as *"For my situation on the tablet it is easy to scroll and browse information"*. Students who indicated no preference commented *"I think that both types are just as useful. It just depends on how you like to learn"* and *"whichever is available to me, however, for certain subjects I would prefer a physical copy of a book (textbook). But usually ebook is fine."* The small minority who prefer hard copy textbooks cited reasons such as *"I feel as if hard copy will have more of an impact*

to my memory" and *"I prefer not reading off a computer"*. They also commented that *"hardcopy texts are easier to navigate"*.

Table 1: Themes emerging from student feedback on preference for type of textbook. N=56 responses received.

Students who preferred etextbooks 1. Accessibility / ease of use / convenience (28% of comments) 2. Ability to search for keywords, easily navigate the book (19% of comments) 3. Easier to transport, not heavy like traditional textbooks (17% of comments) 4. Cost (7% of comments)
Students who preferred hard copy textbooks 1. Prefer not to read from screen, more comfortable to read (3% of comments) 2. Ability to search for keywords, easily navigate the book (2% of comments) 3. Can annotate (write notes, highlight) (2% of comments)
Students with no preference 1. Benefits to both formats (9% of comments) 2. Depends on situation (5% of comments)

Most students accessed the etextbook by downloading and accessing via laptop (67.9%), via tablet (14.1%) or via desktop computer (12.8%); the remaining students used a printed copy (2.6%) or accessed via their mobile phone (2.6%).

What role does the cost of a textbook play for a student?

The cost of hardcopy textbooks can be a barrier to access, and one of the benefits of an OER etextbook is that it is available free of charge.

Table 2 shows student responses to a 4-point Likert-scale question on the impact of cost on the students' decision to buy. More than half indicated that the cost very much impacts on this decision, and no student indicated that the cost does not at all impact on the decision to buy.

Table 2: The impact of the cost of textbooks on students' decision to buy a copy. N=67 responses received.

	Not at all (1)	**A little (2)**	**Somewhat (3)**	**Very much (4)**	**Mean ± SD**
Number of students	0	12	19	36	**3.4 ± 0.8**

How do students perceive this particular etextbook?

A vast majority of students rated aspects of accessibility, attractiveness, ease of navigation, and quality of the content as high or very high (Figure 2).

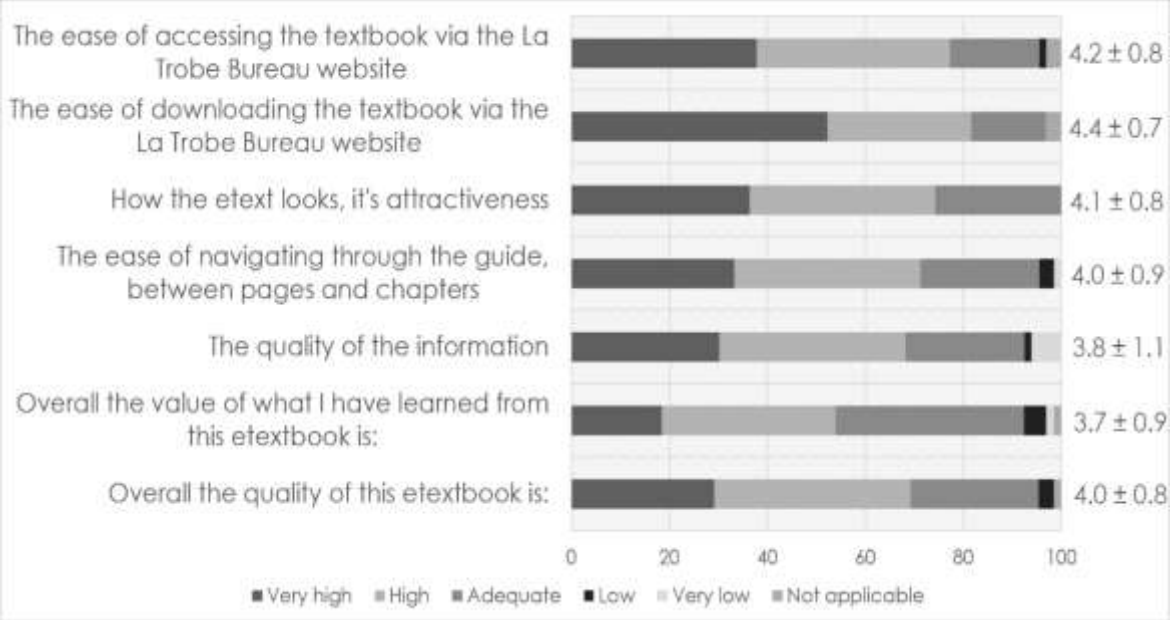


Figure 2: Student ratings of aspects of *How to Do Science*. N=62 responses received. Mean ± standard deviation values shown at right.

When asked what specific aspects of the etextbook contributed most to their learning, students most commonly reported responses related to the themes presented in Table 3; representative quotes are included. In particular, the chapter on experimental design was mentioned.

Table 3: Themes that emerged from student feedback on specific aspects of the etextbook that contributed most to their learning. N=45 responses received.

Chapter on experimental design (31% of comments) *"Helping with making a hypothesis aim and conclusion and designing an experiment. Very good layout, eye catching"* *"Descriptive diagrams and very clear definitions"* *"Clear definitions and examples on how to design and conduct experiments"*
Help it provided with completing assessment tasks (18% of comments) *"Contains vital information for our studies that is presented in an easy to follow way."* *"Helps in answering quizzes and statistics"*
Help it provided on data analysis and statistics (13% of comments) *"information on statistical analysis"*
Help it provided on scientific writing (9% of comments) *"The areas that run through how to formally write things for research, like the hypothesis."*

Students were asked to suggest practical changes they believe could improve the textbook. More examples and improved layout were mentioned most often; representative quotes are provided in Table 4.

Table 4: Themes that emerged from student feedback on practical changes that they believe could improve the textbook. N=18 responses received.

More examples (22%) *"more statistical testing for example when to use an ANOVA and paired t-tests"* *"more content and examples"* *"More examples of writing scientific literature. Greater detail."*
Updated layout (e.g., simpler, more sub-headings, different colours) (22% of comments) *"more subheadings to quickly access specific topics"* *"different colour scheme"* *"make it more concise get rid of unnecessary information"*
More pictures (13% of comments) *"Needs to be more visual"* *"Input more practical pictures rather than words"*
No changes needed (13% of comments) *"No changes as it is already very good"* *"no changes are needed"*

Discussion

Factors affecting student preference for textbook type

In our study the majority of La Trobe third-year human physiology students indicated a preference for etextbooks over traditional hard copy textbooks. This finding is in contrast to studies involving psychology students and students from a range of disciplines from the US (Shepperd et al., 2008; Woody et al., 2010; Jesse, 2014; Records et al., 2015), but in agreement with other studies from the US (Peng et al., 2015; Chuklov & Van Alstine, 2013). The most common explanations for this preference for etexbooks were accessibility and convenience, ease of navigation throughout the text, and ease of transport. We note though that while students who preferred etextbooks commented that the electronic medium was easier to search/navigate than the printed medium, students who preferred hard copies also cited ease of navigation as a reason for their preference. It also appears that perhaps the way a student interacts with technology influences their preference, as those who prefer hard copy textbooks also commented that they found it easier to read in print, and that they wanted to be able to highlight and write on the text. This of course is possible on etextbooks when tablet devices are used; however, only 14% of students reported using a tablet to access our etextbook.

Our students, like others (Missingham, 2016a; Missingham, 2016b), are sensitive to the costs of a textbook, which may impact on their decision to purchase. Chuklov and Van Alstine (2013) made similar observations and the outcome of sensitivity to textbook cost can range from not purchasing and doing without (Stein, Hart, Keaney, & White, 2017) to influencing course selection (Morris-Babb & Henderson, 2012). More than half of our students indicated in a Likert-scale question that the cost very much impacts on this decision, and no student indicated that the cost does not at all impact on the decision to buy. However, when asked for the reason for their preference for etextbooks, only 7% of students explicitly stated costs which may also take into account that not all etextbooks are OER and therefore free. Provision of an OER

etextbook solves issues related to cost and ensures students get access to resources (if they are unlikely to buy expensive textbooks) in an online format that is increasingly preferred by most students. The impact of textbook cost on student access warrants further investigation given that access and cost contribute to student experience and satisfaction.

Specific benefits the etextbook provides in supporting student scientists

Overall, quantitative and qualitative student feedback indicates that a majority of the students are of the opinion that the etextbook has been helpful in supporting the development of scientific skills, with comments centering on helpfulness in completing an online assignment on experimental design, designing experiments, scientific writing, conducting statistical analyses, and creating scientific figures. Horsley, Knight and Huntly (2010) found that students appear to have a preference for 'fast access to specific assessment-related information' rather than 'lengthy textbooks and readings'. These authors suggested that cost of textbook was less important than whether the textbook provides 'time-efficient access to materials that enhance potential successful completion of assessment tasks'. When asked to cite specific aspects of *How to Do Science* that most contributed to their learning, 18% of comments related to 'Help it provided with completing assessment tasks'. This highlights the importance of providing students with resources that support the learning activities and assessment tasks within the curriculum. Wagner et al. (2015) cite one of the benefits of their online-only active textbook as being the option for instructors to 'customise' their versions of the textbook by writing new sections or chapters' for their students. Creation of *How to Do Science* in collaboration with the La Trobe eBureau means that revised versions can be created to keep pace with changes in curriculum and with student feedback. There were a number of suggested improvements to the etextbook, including more examples [consistent with the findings of Westermann Juárez & Venegas Muggli (2017)] and updated layout.

The 'active textbook' provides students with more opportunities to interpret data, solve logic problems, and apply quantitative reasoning through examples and reference to primary literature. Wagner et al. (2015) argue that students using an active textbook 'contribute to a new teaching dynamic that helps them become scientists rather than memorizers of terms, mechanisms and phyla'. We agree, as our etextbook is also an example of an 'active textbook' with the added benefit of being in digital format and available as an OER.

Towards open access

While initially written for local cohorts of students, the release as an OER has meant wider dissemination with more impact, as the etextbook has been directly downloaded 1797 times and viewed from over 10 countries across the world. It is currently being used at Indiana University and Penn State University in the USA, as well as the University of Southern Queensland in Australia, and the Ciputra Medical School in Surabaya, Indonesia. Usage at other institutions has been determined via personal communications. The concept of making our textbooks available for free is new to La Trobe, however it has been a very rewarding experience to see such wide use, and to receive positive feedback from colleagues elsewhere.

Conclusions

In this study, we reported on the perception of third year human physiology students of an open access etextbook. Student feedback indicates that the etextbook is a valuable resource for students and it supports their active participation in science and skill development in this area. The majority of students had a preference for etextbooks over traditional hardcopy textbooks.

We will continue to use the text for our students and to use student feedback to create revised versions. The plan is to investigate opportunities for increased interactivity through introduction of review quizzes, interactive graphics, and more multimedia. We will conduct further research on where and how the text is being used and investigate how we can measure success outside of our own student population. Future work will investigate the impact of textbook cost on student access. We encourage educators involved in design and delivery of authentic, inquiry-driven learning activities and assessments to incorporate the use and development of OERs into their practice.

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