



# The impact of an anatomy and physiology open textbook on student satisfaction and engagement in a regional Australian university

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The rising cost of tertiary study-related expenses, including textbooks, has been shown to influence enrolment rates, course choices and quality of learning experiences and outcomes for students. To address issues related to affordability and accessibility, the University of Southern Queensland (UniSQ) has recently implemented alternative learning materials through open educational resources (OERs). Published by UniSQ in 2021, the 'Fundamentals of Anatomy and Physiology' is an opensource, online textbook provided as a supplementary resource for students undertaking first-year anatomy and physiology courses. To investigate student satisfaction and the overall usefulness of implementing this textbook into undergraduate courses, responses to a student feedback survey were analysed. The main themes that emerged from the qualitative feedback included 1. increased student accessibility to course information, 2. improved tertiary education affordability, 3. enhanced course content comprehension, 4. provisioned student agency and choice to interact with formats that best suited the student learning context and 5. overall was rated as a beneficial and useful resource. Although the majority of students who responded to the survey (56%) did not have any negative perceptions about the online textbook per se, there were two negative response themes that emerged regarding the user interface and internet connectivity. Further evaluation regarding retention rates and overall achievement remains to be addressed.

Keywords: OER, Accessibility, Student Satisfaction, Online textbook, Anatomy and Physiology

## Introduction

Over the past 20 years textbook costs have almost doubled (Durbin, 2015). Open textbooks are a viable lower cost alternative that can be freely adapted, contextualised, edited, and revised to suit courses and are provided under an open licence making them free for students to access. Aside from a financial benefit, positive pedagogical and andragogical impacts have been reported. An international review of 16 higher education settings utilising Open Education Resource (OER) textbooks found that students achieved the same learning outcomes as students using traditional textbooks (Hilton, 2016). Similarly, a multilevel modelling approach to control for student, instructor, and course effects, found no difference between learning outcomes and grades achieved by courses using OER and traditional textbooks for continuing students (Winitzky-Stephens & Pickavance, 2017). A more recent study found that students who used open textbooks performed equally well as students using traditional textbooks in the same course with the same instructor (Beile et al., 2020). Engaging with OER has shown equivalent learning outcomes when compared to traditional commercial resource use (Annand & Jensen, 2017); showing positive outcomes beyond affordability including reduced failure rates and time-to-graduate (Colvard & Watson, 2018). For academic staff, the use of open texts can influence practice more broadly at the institution (Jung et al., 2017) by changing perceptions and providing authentic use cases and provide opportunities to explore different pedagogical models (Tualaulelei, 2020).

Usage of OER translates into cost savings for students (Weller, 2014) with an estimated \$3 million savings for students in the US through the OpenStax textbooks initiative (Green, 2013). More locally, the 2017 Universities Australia report on student finances ascertained that three in five domestic Australian students are significantly affected by financial stress, with one in seven regularly skipping meals due to lack of money, and half of working students stated their working hours adversely impact on their studies however they need to work to meet their financial obligations (Universities Australia, 2018). This risk of financial stress increases even more for students who are Aboriginal or Torres Strait Islander, international full fee-paying, from low socioeconomic status (SES) backgrounds, and those in regional and rural centres. Furthermore, negative mental health effects

caused by educational affordability issues were reported as a major concern in the Australian Council of Social Service (ACOSS) 'Starved for Opportunity' report (ACOSS, 2019), with Australian students in designated equity groups more likely to discontinue studies, with lower achievement scores; financial issues and negative health effects (Li & Carroll, 2020). Access to learning resources can be enhanced through OER, and reduce financial stress for all students – not just equity groups – although research indicates these groups benefit more significantly in terms of increased academic achievement, retention, and progression (Bali et al., 2020). Australian students in designated equity groups are more likely to discontinue studies and experience lower achievement scores; financial issues are the most likely reason cited, second to negative health effects (Li & Carroll, 2020). Addressing issues related to affordability and accessibility of tertiary education will play an increasingly important role in improving student enrolment and education attainment. To address these issues many educational bodies are now relying on the use of OERs as either their primary or supplementary study tools (Annand & Jensen, 2017; Colvard & Watson, 2018; Sandanayake, 2019)

'[Fundamentals of Anatomy and Physiology](#)' (FAnP) is an OER published by the University of Southern Queensland (UniSQ), as an adaptation of the open textbook 'Anatomy and Physiology' by Betts et al., an OpenStax resource from Rice University in Texas, US (OpenStax, n.d.). The adapted OER delivers an Australian perspective including Australian terminology, information regarding Australian disease statistics, and contemporary career pathways in Australia. Additionally, the amended textbook includes interactive learning tools such as quizzes, appendices, and a glossary. The amended text was designed to reflect Australian standards and requirements, striving to enhance student retention rates and to improve student satisfaction and academic achievement. Although the OER provided an Australian perspective, as of July 2022 it has over 58,000 unique pageviews and 3,000 downloads, has been accessed by both non-UniSQ higher education referrals and high school students from 190 different countries.

The aim of the current research study was to investigate student satisfaction when using FAnP, a freely available online textbook in a blended learning course, and any features or improvements students would find useful to their studies. The study utilised a student feedback survey to assess the number of students utilising the textbook, the usefulness of the textbook and its elements, and the feedback they had regarding the OER.

## Methods

### Study participants

Participants (n = 93) were drawn from student cohorts enrolled in first-year courses at the University of Southern Queensland (UniSQ), a regional university in South-East Queensland, Australia. Participant cohorts were recruited from the following courses: 'Human Anatomy and Physiology 1' offered in semester 1, 2021 (Cohort A) and 2022 (Cohort B), 'Human Anatomy and Physiology 2' offered in semester 2, 2021 (Cohort C), and 'Bioscience for Health Professionals' offered in semester 1, 2022 (Cohort D). Students enrolled in these courses were from a range of undergraduate bachelor degrees, including nursing, paramedicine, sport and exercise science, biomedical sciences, medical laboratory science, and education. All courses were conducted within 13 calendar weeks and provided students with access to the OER textbook as a supplementary resource throughout the semester. No incentive for research study participation was offered.

### Student feedback survey

The student feedback survey contained 16 questions designed to measure student satisfaction with 'Fundamentals of Anatomy and Physiology' and OERs in general. The questions included quantitative five-point Likert scale questions, yes/no questions, and broad qualitative questions based on similar questionnaire themes (Craft & Ainscough, 2015). An example of the questions included 'Have you used [FAnP] free online textbook throughout your studies?', 'How useful was [FAnP] to your study?', 'What did you enjoy about [FAnP]?', and 'What are the biggest issues with using a free online educational resource?'.

Survey responses were thematically analysed (Braun & Clarke, 2006) and NVivo Release 1.5.1 (940) (QRS International Pty Ltd, Burlington, MA.) was used for qualitative content analysis. This process outlined by Braun and Clarke (2006) allowed for a familiarisation with the data, generation of initial data codes, searching for emerging themes, reviewing emerged themes, defining, and naming feedback themes and producing a thematic report.

## Ethics

Ethics approval for the study was gained from the University of Southern Queensland Human Research Ethics Committee, (UniSQ HREC) ID: H20REA157 (v2).

## Study limitations

The study was limited to voluntary survey participation of four cohorts of first year university students.

## Data analysis and results

### Student demographics and survey participation

Of the students enrolled in the four cohorts (n=1668), 5.5% of students chose to participate in the research study. This included 8.3% of students enrolled in Cohort A (n=58), 2.94% of students enrolled in Cohort B (n=8), 6.61% of students enrolled in Cohort C (n=16), and 2.42% of students enrolled in Cohort D (n=11). The student demographics are outlined in Table 1.

**Table 1. Student demographics across the four surveyed cohorts.**

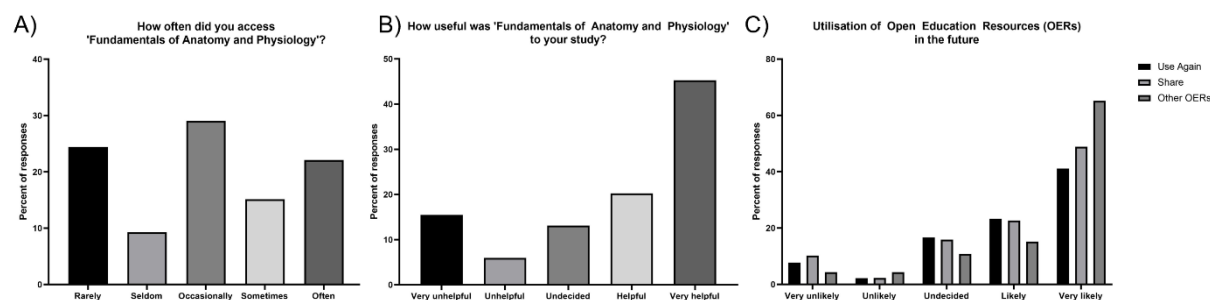
Demographics	Percentage (%) of enrolled students				
	Cohort A (n=699)	Cohort B (n=242)	Cohort C (n=272)	Cohort D (n=455)	Total (n=1668)
On Campus	76.97	72.79	79.75	71.21	75.12
Online/External	23.03	27.21	20.25	28.79	24.88
Part-time	13.73	18.01	12.81	9.67	13.19
Full-time	86.27	81.99	87.19	90.33	86.81
School leaver	39.77	39.71	38.84	39.78	39.63
Non-school leaver	60.23	60.29	61.16	60.22	60.37
Low Social Economic Status	31.47	30.51	31.4	28.13	30.40
Aboriginal or Torres Strait Islander	4.15	5.15	3.31	3.52	4.02
English Second Language	18.31	8.46	10.33	32.31	19.36
Disability	6.58	9.19	9.09	4.62	6.83

Cohort A: Human Anatomy and Physiology 1 S1 2021; Cohort B: Human Anatomy and Physiology 1 S1 2022; Cohort C: Human Anatomy and Physiology 2 S2 2021; Cohort D: Bioscience for Health Professionals S1 2022

### Utilisation of the free online textbook

The freely available, online textbook FAnP was offered to students as a supplementary resource and advertised through lectures and online learning management platforms. Of the 93 study participants, 72.83% of students (n=67) used the OER throughout their studies. Among the 28.26% of students (n=26) who did not use the resource, 38% of students did not know it was available, 19% of students forgot it was available, and 4% of students could not access the textbook and/or website link. The remaining 38% of study participants chose 'Other' as their reason for not utilising the textbook.

To further analyse the trends regarding overall interaction with the online textbook, the study participants were asked how frequently they incorporated the OER into their studies and how useful they found the textbook to their studies. Of the students who accessed the OER, 65% reported using the textbook at least 'occasionally', 'sometimes' or 'often' with only 35% of students reporting 'seldom' or 'rarely' (Figure 1A). Moreover, these students indicated that the OER was very useful to the comprehension of their course content with 65% of students reporting the textbook to be either 'Very Helpful' or 'Helpful' (Figure 1B).



**Figure 1. Student feedback survey results.**

A) Frequency of utilisation; B) Usefulness of resource; C) Utilisation of OERs in the future. ‘Use again’: If you used "Fundamentals of Anatomy and Physiology" for your studies, how likely are you to use it in your further subjects?; ‘Share’: How likely are you to share/recommend "Fundamentals of Anatomy and Physiology" to friends and other students?; ‘Other OERs’: How likely are you to use free online resources (such as textbooks) for future courses/study?

The survey found that approximately half of the students (44%) preferred using online textbooks or both the (8%) physical printed text and digital text. An overwhelming majority of students (95%) stated they would like free online educational resources to be provided in their remaining courses. To further analyse the preferences of utilising OERs, participants were asked to indicate how likely they were to use the OER FAnP in their future courses, whether they would share the resource with other students, and the likelihood of using other OERs in their future courses. The results indicated that most students were ‘very likely’ to continue utilising the OER in their further courses (41%), would share the OER with their colleagues and others (49%), and were willing to use other offered OERs such as textbooks in future courses and study (65%) (Figure 1C).

The opportunity to engage with the free online textbook also allowed 62% of students to save money on tertiary education related expenses, as gathered from the question ‘Did you save money using the online resource?’. One student, although selected ‘no’ as their answer, stated that the OER was ‘*Excellent. I wish I had [of] known about it before buying the text book*’.

### Themes from the qualitative feedback option

The open-ended feedback response questions were grouped into emerging themes which addressed positive and negative aspects of utilising a free open educational resource such as the FAnP online textbook (Table 2.). The positive feedback theme was further divided into five different sub-themes which included accessibility, affordability, course comprehension, favourite features, and resource usefulness. The negative feedback theme was divided into two sub-themes, including user interface and internet connection. It is important to note that an overwhelming amount of feedback regarding what students disliked about the online textbook was noted as ‘nothing’.

The positive feedback sub-themed ‘Favourite Features’ was also supported by other survey results which found that 63% of students used the readily available ‘review’ and ‘critical thinking’ practice questions embedded at the end of every chapter.

### Discussion and Conclusion

The current study sought to understand students’ opinions on using the Fundamentals of Anatomy and Physiology (FAnP) online textbook throughout their studies, and to measure student engagement with the online textbook. The survey feedback, while limited to approximately 5% of the enrolled student cohort, showed that the students utilised the supplementary OER throughout their study semester. The main themes that emerged from the qualitative feedback included accessibility, affordability, course comprehension, favourite features, resource usefulness, user interface, and internet connection.

**Table 2. Student (n=93) opinions regarding Fundamentals of Anatomy and Physiology free online textbook.**

Theme	Sub-theme	Students	Example
Positive Feedback	Accessibility	12	<i>It can also be used 'out and about' Easy access It would save money buying a textbook and make it a lot easier to access anywhere and at any time.</i>
	Affordability	20	<i>Bridge the gap for students unable to afford textbooks Students and parents cannot afford the huge [expense] of textbooks I am thankful to have free textbooks available for use throughout my course as it can become very costly to purchase them.</i>
	Course comprehension	21	<i>If I was unable to gain a clear understanding from the [publisher] textbook I was able to go through the similar chapter online on the fundamentals textbook and most times gain clarity through a different way of explaining a concept. More specific to our course Directly related to course topic</i>
	Favourite features	21	<i>I like the flash cards that is available, they are quick and easy to use. Also like the check your understanding option, that gives a range of ways to further develop your understanding Short quizzes at the end of every chapter Practice questions / check understanding questions</i>
	Resource usefulness	42	<i>Extremely helpful and great resource Fantastic opportunity It was great! Very useful</i>
Negative Feedback	User interface	12	<i>Harder to do things like annotate or bookmark certain sections Always having to go through each and every tab Sometimes wanting to take notes on your computer and needing your screen to see the textbook</i>
	Internet connection	9	<i>Poor network connection and electricity Internet quality Internet issues in downloading huge files</i>

### Accessibility

Students highlighted the key beneficial feature of online textbooks was the ability to access credible information from any device capable of being connected to the internet. The textbook publisher, Pressbooks, also provided the option to download the textbook in various formats including PDF files, ePub files, and HTML book, which allows readers to access the textbook without internet connection or provide the ability to print either all or selected parts of the book. Additional features provided by the Pressbooks publisher allows the online textbook to include a range of compatibility features with screen readers and other assisted technologies to ensure the text is inclusive and aid in bridging the gap (Navarrete & Luján-Mora, 2018). "Bridging the gap" refers to reducing inequality between groups of people, especially those from a disadvantaged background. While Australian educational policy is established around inclusivity of all people, Boyle and Anderson (2020) have recently highlighted the increasing inequality within the educational sector. This inclusivity primarily arises from challenges in the policies and governance of Australian education and educational reforms (Boyle & Anderson, 2020). While advertising inclusivity and equality within the educational sector, there is clear evidence showing that people from disadvantaged and minority backgrounds do not meet key developmental milestones in early schooling, or continue full time education in early adulthood (Smith Family (Charity), 2016). Across the four student cohorts explored within the current study, 60% of students identified as non-school leavers, which means that students did not proceed with tertiary education directly after high school graduation. Andragogy varies quite significantly from pedagogical teaching techniques, as highlighted within Knowles five assumptions of adult learning. Knowles highlighted that adults have different motivations, approaches, and styles of learning which need to be considered when making assumptions of how adults learn, which included: self-concept, adult learning experiences, readiness to learn, orientation to learning, and motivation to learn (Knowles, 1980). There

are also two main barriers that adults face when approaching learning, the external/situational barriers, and internal/dispositional barriers (Falasca, 2011). It has been suggested that utilising OERs such as online textbooks reduces some of the obstacles faced by adult learners by providing an equitable platform (Sandanayake, 2019). Although themes of equity were not directly assessed by the student satisfaction survey, the feedback comments alluded that the accessibility to textbook information provided by the FAnP online textbook would allow financially disadvantaged students to have access to otherwise unobtainable resource.

### **Affordability**

Financial affordability is especially important when taking into consideration the student demographic enrolled in these regional university courses. A quarter of the students in the current cohorts were enrolled as external or 'online' students, majority of the students identified as non-school leavers (60%), and 30% of the students identify as having a low socioeconomic status. Survey studies in recent years have shown that the increasing expenses associated with textbooks play a vital role on the choice of courses students are able to enrol into and influence the quality of their learning experiences (Senack & Donoghue, 2016). The education statistics for Aboriginal and Torres Strait Islander peoples (2018-2019) found that "financial reasons" and "high expenses" were the main reason (20.4% responses) for persons aged 20 years and over did not study or continue educational qualifications within the last 12 months (Australian Bureau of Statistics, 2020b).

Access to OERs can reduce financial stress for all students, however, indigenous, low socioeconomic background, regional/rural, and international students have a significantly higher academic achievement, retention, and progression when provided with resources to reduce financial stress (Bali et al., 2020). These equity groups are also more likely to experience lower academic achievement scores and discontinue their enrolment in educational institutes due primarily to financial issues (Li & Carroll, 2020). It is also important to note that these studies were collected prior to the COVID-19 pandemic, which has shown to further increase the unaffordability of tertiary education (Australian Bureau of Statistics, 2020a; Barnes & Noble College, 2020). The effect of COVID-19 pandemic has not only been felt by the students, but by the tertiary institutions as well. Forbes released an article in June 2020, several months prior to the major COVID-19 wave in the USA, which highlighted the financial burdens felt by tertiary institutions due to interruption of tuition and fee revenue, as well as revenue generated from student's on-campus presence (DePietro, 2020). Some American institutions, such as the Pennsylvania State System of Higher Education and the University of Wisconsin had each projected a loss of approximately \$100 million due to the COVID-19 impact (DePietro, 2020).

The estimated modelling of Australian university revenue projected a \$16 billion loss by the year 2023 (Universities Australia, 2020). Actions implemented by tertiary institutions to reduce costs have included the review of expenditure costs and the "scaling-back" of infrastructure aspirations (Marshman & Larkins, 2020). Given the severity of the financial losses associated with COVID-19 to both individuals and institutions, and the inevitable shift to virtual teaching, the implementation of digital textbooks and OERs is crucial to maintain and increase enrolment rates and assist in student's completing their chosen degrees.

### **Course comprehension**

The consensus from this study was that the supplemental OER resource provided the same key information as the printed textbook, however, was overall presented in a simpler language which made it easier for first-year students to comprehend the course content. This was especially noted by students who highlighted they did not study science in high school or have not been exposed to scientific concepts in many years, which made comprehension of anatomical and physiological concepts more difficult.

Pedagogical studies have also found that there was no difference in student academic achievement when comparing the use of OER versus traditional textbooks. Hilton and colleagues observed 16 tertiary education institutions which implemented OERs into their teaching, finding that students achieved the same learning outcomes as those who used traditional textbooks (Hilton, 2016). The same finding was observed in a multilevel modelling study which took into consideration course effects, instructors, and students (Winitzky-Stephens & Pickavance, 2017). Studies controlling for pedagogical differences by observing the same courses and instructors prior and post OER incorporation also recorded no differences in student academic achievement (Beile et al., 2020). The Covid-19 pandemic, while having forced educators to shift their teaching style out of necessity, has also provided educators with novel teaching strategies and opportunities (Lockee, 2021). The shift to virtual learning has accelerated the use of technology within the learning environment, offering more opportunities within the classroom.

The implementation of OERs such as the digital textbook FAnP aligns with this recent pedagogical shift to virtual learning. This is largely due to the ability to amend OERs to fit a tailored requirement of individual courses, disciplines, and settings. These resources are frequently used as supplementary materials as they tend to lack detail and clarity provided by standard resources, contain outdated information, and/or provide information that is not applicable in an Australian setting. One of the most important implications being discussed in the recent literature is the need to develop practical measures to ensure open textbook quality (Fischer et al., 2017; Jung et al., 2017), including the use of open peer review. This process is currently implemented by the Open Textbook Library and UniSQ texts.

### **Favourite features**

When creating novel tools and resources designed to improve student satisfaction and course engagement, it is important to evaluate and note the physical features important to the students. This was highlighted in the sub-theme '*Favourite features*' which explored the key aspects of the provided OER that students utilised most frequently. An overwhelming majority of the respondents highlighted the benefit and need for tools which help to test student's comprehension of the learnt topics. This was done by providing a range of 'review' and 'critical thinking' questions embedded in every chapter. The style of questions included a range of multiple-choice questions and short response questions.

The survey also explored any new or additional features students would like to see implemented in OERs, and while many respondents (63 %) chose additional practice questions and quizzes, some of the other requested features included videos, labelling activities, more illustrations, and flash cards.

### **Resource usefulness**

The most frequently stated positive feedback provided by the students was the overall usefulness of the resource. The provided feedback highlighted the utilisation of online textbooks and the high engagement with the offered alternative resources. The majority of feedback from this sub-theme (n=42) included comments as the resource being 'great' and 'helpful'. These comments were also often combined with other sub-themes such as accessibility and affordability. These results corroborate the findings of other similar international studies where students perceived the use of OERs as being very useful to their studies (Branson et al., 2021; Cheung, 2018; Venegas-Muggli & Westermann, 2019).

### **User interface**

One of the negative themes that emerged was the user interface. This was not directed at FAnP specifically, but rather at the Pressbooks publisher user interface. Students highlighted issues regarding inability to annotate the webpages and needing to skip tabs to access the next chapters. These issues can be readily addressed by providing informational videos to expose students to a range of annotation tools such as hypothesis.is (open-source annotation software) or by providing additional links to the Pressbooks user guide to assist readers.

### **Internet connection**

As an open educational resource, the FAnP textbook is a web-based digital text that requires access to a stable internet connection to access the information. The second negative feedback received regarding the use of digital textbooks and issues in utilising OERs centred around the reliability on internet connection to access the textbook. As a regional university, the majority of UniSQ students live in rural, regional, and remote areas, especially those who study externally. It has been noted that although digital inclusion in Australia is improving overall, areas of rural and regional Australia with low socioeconomic background and poor education rates do not have the same inclusiveness, with the gap appearing to widen across these disadvantaged groups (Wilson et al., 2019). For enrolled students residing in these areas, access to a reliable internet connection could become an issue, however this is one of the many reasons why Pressbooks offers the option to download the book in various formats. Additionally, while internet connection and access to appropriate technology could be limited for some students, the vast majority of course content is provided digitally on the University's online learning management system 'StudyDesk'. This includes lecture content, assessment information, additional resources, and an assessment submission portal. Students are required to connect online throughout their tertiary studies and as such internet connection is not an issue limited to OER access and usage, but a wider issue experienced by many students especially in the rural, regional and remote communities that enrol at UniSQ (Hay & Eagle, 2021). Recently, the Australian Government's Higher Education Participation and Partnership Program undertook a project which formulated a framework for both Australian universities and public libraries to



support Regional, Rural, and Remote (RRR) students. The framework formulated an adaptable guide for the development of learning support required to assist RRR communities with low socio-economic higher education students (Partridge et al., 2021). Implementation of such frameworks in the future could aid in reducing the issues of connectivity, not just for students in RRR communities but also those from disadvantaged or low socioeconomic backgrounds.

## OERs in Australia

The use of OERs is not a novel concept in Australian tertiary and secondary educational institutions. The Open Education Practices (OEP) was first established in Australia in 1998 by the Australian Government (Miao et al., 2016; Picasso & Phelan, 2014). The Open Education Resources Foundation, a New Zealand based organisation supported by UNESCO, established a “parallel learning universe, in order to widen access to more affordable education for learners” (Open Education Resource University, n.d.-a). This new collaborative project was named Open Education Resource University (OERu). Today, the OERu is associated with almost 40 international tertiary and secondary institutions across five continents, including Australia (Open Education Resource University, n.d.-b). Although the use of OERs in Australia has been increasing, there is a severe lack of their incorporation in tertiary education. There are, however, several key benefits of utilising and creating OERs in tertiary institutions, including student engagement and satisfaction, cost reduction, and ability to tailor information.

## Conclusion

The main goal of the current study was to evaluate student satisfaction and engagement with the supplementary resource Fundamentals of Anatomy and Physiology, an opensource online textbook. The most marked finding to emerge from this study was the student eagerness to utilise OERs throughout their studies. Although further evaluation regarding retention rates and overall academic achievements needs to be explored with a larger student population, the current study has highlighted an evident benefit in the development and implementation of OER textbooks in tertiary institutions.

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