An innovative approach to teaching research and evidence in health sciences

Shane Erickson
Lecturer, Speech Pathologist, Discipline of Speech Pathology, College of Science Health and Engineering, La Trobe University, Melbourne, Australia.
s.erickson@latrobe.edu.au

Suzanne Hodgkin
Associate Professor, John Richards Centre for Rural Ageing Research, La Trobe Rural Health School, La Trobe University, Wodonga, Victoria, Australia.
s.hodgkin@latrobe.edu.au

Sharon Karasmanis
Honorary Librarian, Borchardt Library, La Trobe University, Melbourne, Australia.
s.karasmanis@latrobe.edu.au

George Murley
Honorary Associate, Department of Rehabilitation, Nutrition and Sport, College of Science Health and Engineering, La Trobe University, Melbourne, Australia.
g.murley@latrobe.edu.au

Abstract

Purpose: This paper reports the development and trialling of a suite of online modules for teaching evidence based practice (EBP), to support introductory EBP teaching for university students undertaking a health science degree, and review the transition to final publication as an open access etextbook.

Setting/Participants/Resources: College of Science, Health and Engineering, La Trobe University. First year health sciences students studying a common, core first year subject: 'Research and Evidence in Practice'.

Brief Description: Evidence based practice and research methods are widely entrenched in the curricula of tertiary level health science degrees. Yet frequently students report a lack of confidence and competency in learning the content, and fail to see its relevance to clinical practice. With increasing availability of new technologies to support teaching education practices, educators should consider ways of making learning about EBP and research methods more effective. The online modules were written in a deliberate conversational and engaging style, and included figures, tables,

diagrams and videos. Modules included the what, why and how of EBP; research design: methods, bias, validity and reliability; and measurement and analysis; and were the major teaching resource for this subject, negating the need for students to purchase a textbook.

Results/Outcomes: Initial feedback and evaluation was received from 220 students and six expert EBP educators. Further analysis of quantitative and qualitative data indicated students and educators viewed the content as high quality, interactive and engaging, whilst successfully achieving pedagogical goals. A comprehensive review of the content was undertaken in 2018 to consider how the modules had supported teaching practice over the previous six years. The reviewed content was published in 2018 as an open textbook, by the University Library's eBureau publishing program http://www.latrobe.edu.au/ebureau. This completes this work as a professional and innovative method of teaching content, critical for health professionals in training, and ensures that students continue to have access to this important resource, which is now open access, and contributes to international open educational resources. 'Research and evidence in practice' is available at https://doi.org/10.26826/1007

Keywords: Evidence-based practice EBP, health sciences, open access; etextbooks; open educational resources OER.

Introduction

The importance of evidence based practice (EBP) for clinical decision making is widely recognised (Fineout-Overholt, Melnyk, & Schultz, 2005; Sackett, Strauss, Richardson, Rosenberg, & Haynes, 2000). As such, research skills and knowledge are commonly embedded in the curricula of health science degrees. Yet frequently educators have found it difficult to develop teaching approaches that students find engaging and meaningful. Providing effective training to students early in their studies is critical for the development of competency in EBP (Callaghan, Lea, Mutton, & Whittlesea, 2011). However, students frequently do not recognise the importance of EBP in clinical practice (McCurry & Martins, 2010) and report low confidence and competency even after being trained (Spek, Wieringa-de Waard, Lucas, & van Dijk, 2013).

The majority of health science students are aged 17-24, have been raised in a digital age and are technologically savvy (Cheryl, 2012; Goertler, Bollen, & Gaff, 2012). Researchers contend that in an educational context these students are active participants and want interactive learning that incorporates technology, multimedia and multi-tasking (Berk, 2010). With increasing availability of new technologies to support teaching practices, educators are using more innovative approaches to teach EBP (i.e. Callaghan et al., 2011; McCurry & Martins, 2010). Yet for these to be successful they must consider both the needs and preferences of the students and integrate seamlessly with other traditional teaching methods.
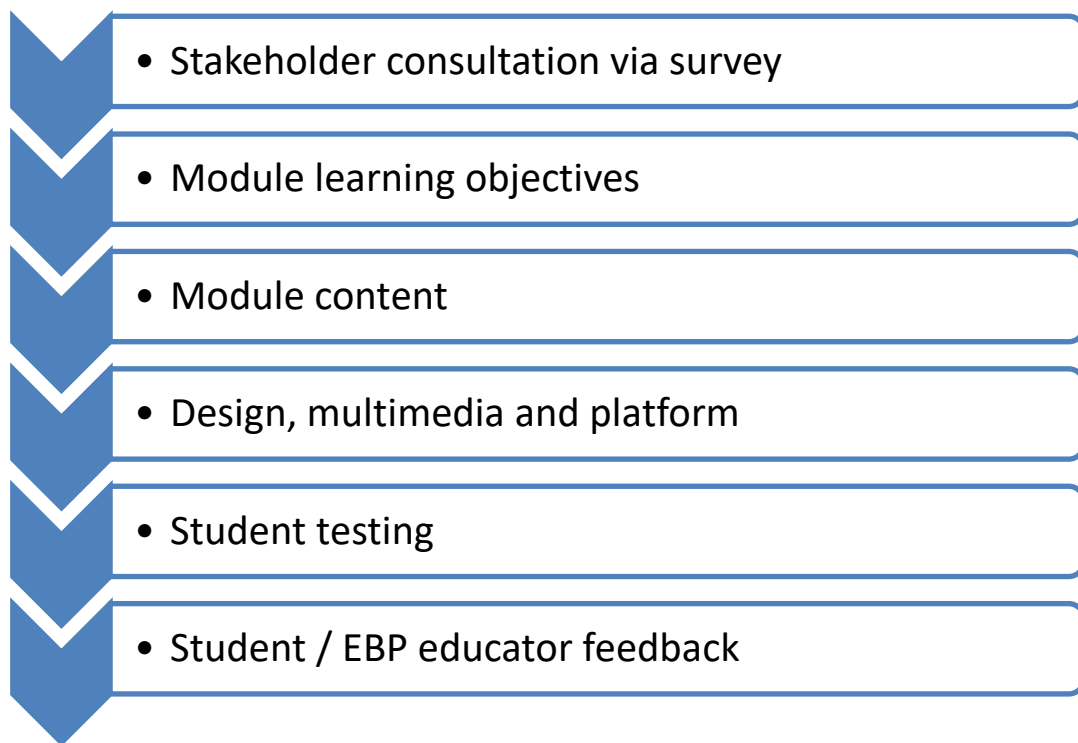
Module Development and Rationale
La Trobe University offers more than 20 health science degrees, all with EBP subjects in the curricula. This paper describes the development of multimedia modules to support the teaching of introductory EBP and research methods in a stimulating learning environment. The modules were designed to be flexible enough to be incorporated into both undergraduate and post-graduate subjects, however also provide additional pedagogical benefits. For example, they overcome the apparent duplication of relevant teaching and learning resources related to EBP and research methods that was occurring across the faculty. Consequently, the modules offer a more streamlined and consistent approach to delivering the material. They were also designed to address a need for multi-campus teaching at the university by providing accessibility to students from both metropolitan and rural campuses. Finally, they provide a framework for the future development of additional advanced modules for students in their later academic years, higher degree research students or students participating in clinical placements at external facilities.

Key stakeholder consultation
A scholarly process underpinned the development of the modules (Figure 1). A Delphi-type survey of all faculty academic staff was used to gauge the priorities of 70 topics. Delphi methods typically draw upon the opinions of experts to guide development of knowledge (Gordon & Pease, 2006). The participating academic staff were asked to "Rate the importance of each topic by choosing a point on a scale of 1 (not important at all) to 5 (extremely important)". Additionally, they were asked to indicate whether they thought the topic should be categorised as 'introductory' or 'advanced'. This process resembled that undertaken by Yousefi-Nooraie, Rashidian, Keating, and Schonstein (2007) when they surveyed a panel of expert EBP educators about appropriate content in EBP courses. Responses from 42 staff were received from a representative range of health science disciplines. Most responders were experienced (mean of 5 years' experience), competent EBP educators with more than two thirds rating themselves as 'competent' or 'very competent'. Topics were included if they had a mean importance rating of at least 3.5 (out of 5) and where at least 75% of staff classified the topic as introductory level.

Figure 1: Development and testing flowchart

- Stakeholder consultation via survey
- Module learning objectives
- Module content
- Design, multimedia and platform
- Student testing
- Student / EBP educator feedback

Module structure
The structure of the resource is a suite of three modules, each comprising four topics:

Module 1: Evidence for practice: who, what, when and why
Topics: introduction to evidence for practice; ethics in research and practice; asking questions to guide the search for evidence; and acquiring the evidence.

Module 2: Research design: methods, bias, validity and reliability
Topics: introduction to quantitative research design; introduction to qualitative and mixed methods research design; sources of bias and threats to validity in qualitative and quantitative research; and reliability and rigour in qualitative and quantitative research.

Module 3: Measurement and analysis

Topics: outcome measures and scales of measurement in health research; introduction to descriptive statistics and statistical inference; treatment effects: mean difference, odds ratio, risk ratio, confidence interval; and probability, statistical significance and power.

Module content and design
Content was written in a conversational and engaging style, and included figures, tables, pictures and diagrams interspersed with professionally produced videos, screen recordings and quizzes. Development of the multimedia content was an integral component of the modules and designed to facilitate student engagement and understanding. Four humorous videos were produced featuring a maths comedian to engage and connect students to the importance of the topics. To maximise the impact of video content, fifteen videos (each approximately 5 minutes in length) were produced in which researchers from La Trobe University with various research backgrounds, introduced a topic and defined key concepts using related aspects of their research as examples. The use of graphics and animations was viewed as a method to enhance the teaching of difficult concepts (Sowan & Jenkins, 2013). Eight screen capture videos were created to cover probability testing, statistical significance and confidence intervals, and database searching in CINAHL and Medline.

Platform
Students accessed the modules from the University's online Learning Management System (LMS) Moodle (https://moodle.org). The printable modules were designed to appear like a book with topics spread over multiple pages. Videos and the audio visual vignettes were embedded into the pages of each topic. Moodle also supports the integration of diagrams and tables. The Moodle platform allowed the modules to be edited easily and 'rolled-over' annually for new cohorts of students.

Method and Analysis

Participants
Feedback was received from 220 undergraduate and postgraduate students from 20 health disciplines who voluntarily used the resource or were directed to relevant content by lecturers. The majority of students were studying undergraduate level courses (88%). In addition, evaluation was requested from expert EBP educators. These six experts were identified and contacted by the development team. Each had backgrounds in research and EBP education and were not affiliated with La Trobe University. They included a professor of speech pathology from Ireland, an assistant director of an Australian medical library, a head of podiatry and a senior lecturer in occupational therapy from Australian universities and two health science lecturers from Ireland.

Procedure and Student Feedback
The modules incorporated an on-line survey inviting feedback after each topic. Students needed to complete this feedback before progressing to a short multiple choice quiz to assess their understanding of the module's content. Students were asked four questions: 'Overall, the level of intellectual challenge in this topic is?', 'Overall, the amount I have learned in this topic is?', 'Overall, the value of what I have learned in this topic is?' and 'Overall, the quality of this topic is?'. Each question was scored between 1 and 5 whereby, 5=Very high, 4=High, 3=Adequate, 2=Low, 1=Very low. Additionally, students were invited to provide qualitative feedback on the following: 'Which two or three specific aspects of this topic contributed most to your learning?'; 'Suggest two or three specific, practical changes which could improve learning in this topic', and 'Can you provide any additional comments?'

Expert EBP Educator Feedback
After accessing the modules for a period of approximately three months, the six expert EBP educators were provided with a link to an online survey for feedback. The survey asked the reviewers to respond to the following four questions with either 'Very high', 'High', 'Adequate', 'Low' or 'Very Low': 'Overall, how do you rate the organisation of the modules/topics'; 'Overall, the level of intellectual challenge of the modules is?'; 'Overall, the value of what is presented in the modules is?', and

'Overall, the quality of this modules is?'. Additionally, qualitative feedback was sought on the following: 'Do the learning outcomes match the assessments tasks and do the learning activities support the assessment tasks?', 'Indicate what you liked most about these modules?', 'Suggest two or three specific, practical changes which could improve learning in these modules?' and 'Can you provide any additional comments?'

Analysis
Quantitative data was analysed descriptively, with the mean score and standard deviation calculated for each topic. A thematic analysis of the qualitative data was completed by a researcher independent of the project using NVivo 10 software[1].

Results

Student Feedback
As presented in Table 1, mean feedback scores for all topics ranged from 3.5 to 4.0 (from a maximum of 5) across the domains of 'intellectual challenge', 'amount I have learned', 'value of what I have learned' and 'overall quality'. These mean scores indicate students rated topics as 'adequate to high'. Furthermore, in each topic more than 50% of students rated each of the domains as either 'high' (4) or 'very high' (5).

Table 1: Mean student feedback on each module (n = 220)

	Module 1 (SD)	Module 2 (SD)	Module 3 (SD)
Intellectual challenge	3.5 (0.9)	3.8 (0.9)	4.0 (1.1)
Amount learned	3.8 (1.0)	3.7 (1.0)	3.6 (1.2)
Value of what was learned	3.8 (1.0)	3.6 (1.1)	3.6 (1.2)
Overall quality	3.9 (0.9)	3.7 (1.1)	3.7 (1.3)

Qualitative responses were arranged into two primary categories: positive and negative feedback with several sub-categories. Figure 2 presents a word cloud illustrating the nature and frequency of the student feedback. There were 175 responses coded as being 'positive' and 47 responses broadly coded as being 'negative' feedback, however these largely related to suggestions for improvement.

[1] https://www.qsrinternational.com/nvivo/what-is-nvivo

Figure 2: Student qualitative feedback
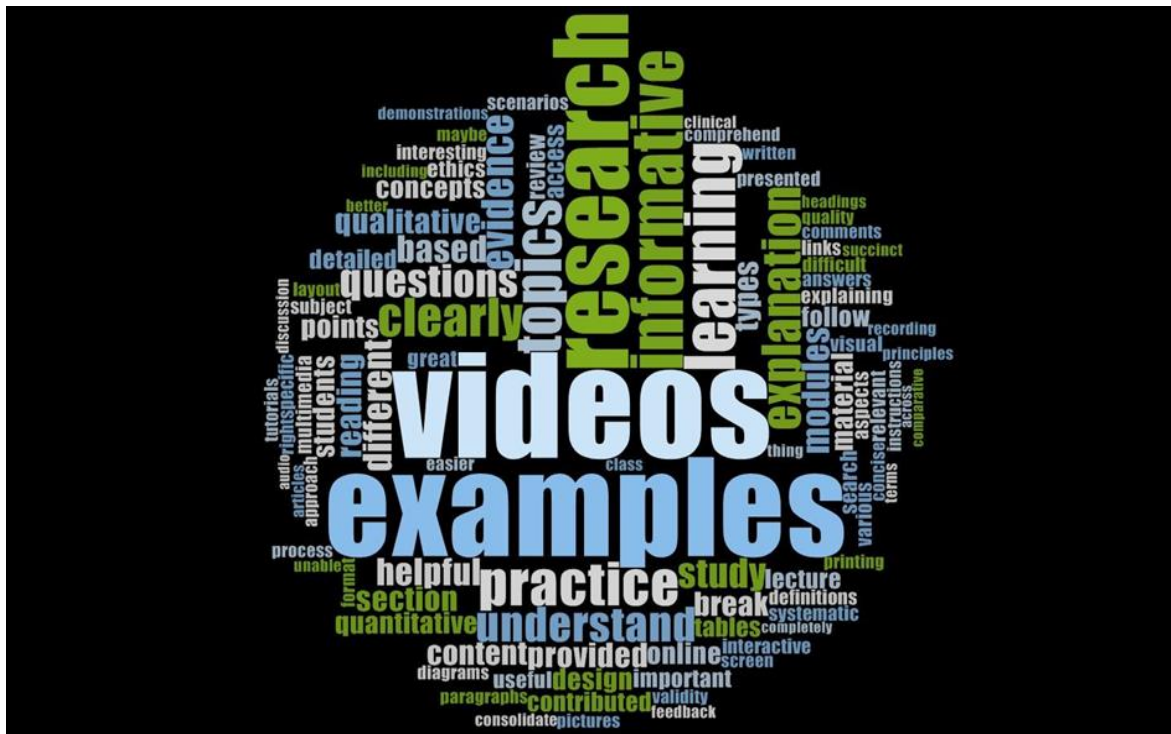
Positive Student Feedback:

Imaginative resources
It is apparent that the students valued several of the technical aspects of the modules (65/175 responses), in particular using multimedia resources. Students reported that this enhanced their overall understanding and engagement in learning. "Videos are good they break it up a bit and give a human face to learning", and "Clear illustrations and succinct precise instructions on the videos".

Relevant examples
There were many positive comments (48/175) related to the use of a clinical context to enhance understanding of concepts. The feedback demonstrates that students engage in their learning through the use of 'real life examples'. For example, "The clinical examples of the difference between qualitative and quantitative research assisted in remembering the information as it was easy to relate", and "The case studies were very helpful as they contributed to my understanding of the various research methodologies".

Guided learning
Many students (62/175) commented that the clarity of the learning objectives and content was most beneficial to their learning: "Careful step-by-step teaching", and "Clear and concise explanations of factors which are important in research design".

Suggestions for Improvement:
While students generally responded positively to the modules, there were several suggestions for improvement. "*Layout of the text material*". The most obvious theme was related to the layout of the text material (19/47 responses) and ways to improve this: "I would have the information in smaller chunks to make it more accessible and less intimidating to read", and "Break up the long slabs of texts, maybe have an interactive activity linked to it…makes it more fun".

Technological limitations
Not surprisingly, given the novel nature of this delivery method, there were a small number of students who identified technological limitations (9/47). "The videos were a little unclear due to the resolution, even at full screen", and "Please provide pdfs to read on Kindle with video links. Too difficult to read from the screen".

Expert EBP Educators' Feedback:
Responses to the quantitative questions assessing the overall aspects of the modules were as follows: for 'Organisation' two educators responded with 'very high' and four with 'high'. For 'Intellectual Challenge' one reported 'very high', four reported 'high' and one reported 'adequate'. For 'Value' three reported 'very high' and three reported 'high'; and for 'Quality' three reported 'very high', one reported 'high' and two reported 'adequate'. In the qualitative feedback two educators commented on the flexibility: "These modules would be an excellent way to prep students for a class or could be used to follow up or reinforce learning, they provide a very good resource to support student learning".

Similar to the students, the educators also noted the benefits of multimedia technologies: "The videos were well done and appeared to be professionally produced. The visual and audio quality was very good", and "The use of 'people videos' and exemplars to illustrate key points were helpful and 'lightened' the content." The educators were unanimous in indicating that the learning outcomes were achieved and appropriately assessed: "The learning outcomes helped set expectations appropriately and mapped quite well to the content of each section", and "The self-checking of knowledge by use of the quizzes was great and is well planned."

Review and Publication into Open Access eTextbook format

The online modules have been operating as the major teaching resource in a core first year subject for Health Science students for six years (Research and Evidence in Practice, with approximately 2,000 students enrolled annually). Whilst the stakeholder consultation, development, trial and evaluation of the original modules has been undertaken, there was an urgent need to review and update the content. This was also an opportunity to upgrade the format of the modules, as the Library had commenced publishing academic teaching content in open textbook format through the new eBureau service[2]. The eBureau was established "to facilitate the development and publication of quality open access resources to support online and blended learning" (Julien et al, 2018, p.43). Library staff manage all aspects of the eBureau publication process including: feasibility and discussion around suitability of content, author agreements, design, copyright issues, copy editing, professional peer review, final publication and promotion. The team decided that a comprehensive review and a new format could enrich the teaching content, provide easier accessibility for students, and utilise the open access domain to release the content to a national and international audience.

An intense review process in 2018 focussed on content, in consideration of six years of teaching experience in this subject; and student performance, perceptions and success using the online learning content. The review process included updating and reorganising the content for a more rigorous and experiential learning experience. Content update was managed using SharePoint[3] as a collaborative workspace. Each author had expertise and responsibility for various topics, which were reviewed by all members of the team. The eBureau functionality allows for importation of rich video content (through FigShare[4]), illustrations, and interactivity. The final product has multiple interactive elements that extend and expand upon the content. Video interviews are embedded throughout the etextbook, which are presented by specialist academics to engage and further develop the discussion. Fillable tables allow the reader to complete activities (practice-related questions and scenarios) to engage with the content in a different way. Annotating this etextbook is a useful tool and is great for

---

[2] https://library.latrobe.edu.au/ebureau/
[3] https://products.office.com/en-au/sharepoint/collaboration
[4] https://latrobe.figshare.com/

taking notes on the pages (using the sticky note tool in Adobe Acrobat). Images within the content are checked for copyright compliance and authority to use. In some cases images are purchased, or alternative content found which is compliant. Copyright in this work is vested in La Trobe University. Unless otherwise stated, material within this work is licensed under a Creative Commons Attribution-Non Commercial-Non Derivatives License.

Two further rounds of expert peer review provided suggestions for added richness, which added value to the teaching content. 'Research and Evidence in Practice' was published in December 2018, and has been downloaded 6,612 times, and videos have been viewed 9,493 times until 10 September 2019. This number will increase in coming months, as the new resource is introduced to approximately 2,000 students for teaching into the subject in semester 2, 2019.

Discussion

The availability of new technologies means educators can use innovative teaching approaches and introduce enhanced models of authentic learning experiences. Many tertiary institutions use online Learning Management Systems (LMS), meaning educational resources can be available anywhere and anytime. Probably related to their vast exposure to technology, the current generation of tertiary students want educational resources that are interactive and multimedia laden, as noted in Julien, (2018, p. 38). One excellent example of a professionally designed learning resource is the open textbook: *How to do science: a guide to researching human physiology* (Lexis & Julien, 2017).

Yet producing such resources is not as simple as uploading materials that would otherwise be delivered in a traditional face to face format. Instead, development must include careful planning and testing of content, design and usability. This must include all relevant parties such as key stakeholders, educators and students. This paper has presented the development of a suite of three online modules designed to support introductory level EBP teaching for health science students, from publication in the LMS (closed environment) to a professionally designed open access etextbook.

The range of student users is significant when interpreting the student feedback data. Students ranged from second year undergraduate students with little professional experience or research training, to postgraduate students with both professional experience and research training. Additionally, students' academic capabilities and disciplines varied to similar extents. Taking into account these factors, the feedback, while preliminary, provides good evidence supporting the overall quality of the teaching content. Predominantly, students valued the interactive nature of the content, not surprising given the characteristics of students raised in a digital age, with their focus on interactive learning.

Providing salient real-life examples contextualised the content and enhanced student engagement. The use of experts and notable people were frequently mentioned in the student feedback as being critical to learning and interest. This is particularly important considering previously reported difficulties in maintaining student engagement with this content. Additionally, the use of experts provides a sense of authority, and well known people help students to recognise the broad appeal and importance of the content. The expert educators were equally complimentary about the design and content of the modules. They acknowledged the benefits of using multimedia technologies to engage students while also recognising that the modules achieved their pedagogical goals. There was broad recognition that the flexibility of the modules means they can be widely incorporated into a health science curriculum. This is important given a goal of the modules is that they can be incorporated into multiple subjects at both the undergraduate and post-graduate levels.

With this broadly positive feedback it seems clear that this resource can successfully support various tertiary level EBP and research methods teaching. However, future investigations should attempt to investigate the impact of using the resource on academic performance. Whilst the content has been evaluated for pedagogical rigour and effectiveness in the student learning environment, ongoing review and feedback on the new open textbook format will be analysed for teaching and learning effectiveness, and how the interactivity can be enriched to contribute more fully to student learning.

From the University perspective, the La Trobe eBureau provides a method for academics to publish their own unique teaching content in an engaging, high quality, open-access ebook to support online and blended learning. Additionally, this process showcases La Trobe academics' teaching content in an open access environment. It also supports La Trobe students, by providing easy access to free textbooks, intentionally designed to support particular subjects. The etextbooks are uploaded into the Library catalogue and the National Library of Australia. From the Library perspective, it provides librarians with the opportunity to be involved in curriculum conversations around teaching content, and also contributes significantly to the open access etextbook movement.

The etextbook also has utility beyond the university setting. Given clinicians in the workforce have reported low competency and confidence using EBP even after training (Spek, Wieringa-de Waard, Lucas, & van Dijk, 2013), this resource could be made available to practising health professionals as a professional development tool, and now open for wider dissemination in open access format, to any researcher or student for download and consultation.

References

Berk, R. A. (2010). How do you leverage the latest technologies, including Web 2.0 tools, in your classroom? *International Journal of Technology in Teaching and Learning, 6*(1), 1-13.

Brown, C. (2012). University students as digital migrants. *Language and Literacy*, *14*(2), 41-61.

Callaghan, L., Lea, S. J., Mutton, L., & Whittlesea, E. (2011). Enhancing health students' understanding of generic research concepts using a web-based video resource. *Nurse Education in Practice, 11*(6), 375-379.

Erickson, S., Hodgkin, S., Karasmanis, S. & Murley, G.S. (2018). *Research and evidence in practice* [E-Resource]. DOI: https://doi.org/10.26826/1007

Fineout-Overholt, E., Melnyk, B. M., & Schultz, A. (2005). Transforming Health Care from the Inside Out: Advancing Evidence-Based Practice in the 21st Century. *Journal of Professional Nursing, 21*(6), 335-344.

Goertler, S., Bollen, M., & Gaff, J., Jr. (2012). Students' readiness for and attitudes toward hybrid FL instruction. *CALICO Journal, 29*(2), 297.

Gordon, T., & Pease, A. (2006). RT Delphi: an efficient, "round-less" almost real time Delphi method. *Technological Forecasting and Social Change, 73*(4), 321-333.

Julien, B.L., Lexis, L., Salisbury, F., Russell, K. & Loch, B. (2018). Human physiology students' perceptions of etextbooks: towards open access as an alternative to traditional textbooks. *International journal of innovation in science and mathematics education, 26*(7), 38-51.

Lexis, L. & Julien, B. (2017). *How to do science: a guide to researching human physiology.* [E-Resource]. DOI: https://doi.org/10.26826/1001

McCurry, M. K., & Martins, D. C. (2010). Teaching undergraduate nursing research: a comparison of traditional and innovative approaches for success with millennial learners. *The Journal of Nursing Education, 49*(5), 276.

Sackett, D. L., Straus, S. E., Richardson, W. S., Rosenberg, W., & Haynes, R. B. (2000). How to practice and teach EBM. *Edinburgh: Churchill Livingstone*.

Spek, B., Wieringa-de Waard, M., Lucas, C., & van Dijk, N. (2013). Teaching evidence-based practice (EBP) to speech–language therapy students: are students competent and confident EBP users? *International Journal of Language & Communication Disorders, 48*(4), 444-452.

Sowan, A. K., & Jenkins, L. S. (2013). Use of the seven principles of effective teaching to design and deliver an interactive hybrid nursing research course. *Nursing education perspectives, 34*(5), 315.

Yousefi-Nooraie, R., Rashidian, A., Keating, J. L., & Schonstein, E. (2007). Teaching evidence-based practice: the teachers consider the content. *Journal of evaluation in clinical practice, 13*(4), 569-575.