

Integrating evidence-based principles into the undergraduate physiotherapy research methodology curriculum: Reflections on a new approach

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Background. The research methodology module was reviewed as part of the overall revision of the undergraduate physiotherapy curriculum of Stellenbosch University. This created an ideal platform from which to assess how to align the principles of evidence-based practice (EBP) with research methodology. Fostering the principles of EBP provides students with research skills and attributes to be able to seek, evaluate and integrate new knowledge and to apply critical thinking in order to effectively facilitate professional growth and support lifelong learning.

Objective. To describe the process of changing the undergraduate research methodology module from a primary research to a secondary research approach.

Methods. We consulted international experts and searched the literature for ideas and concepts of how to incorporate the principles of EBP. The overall objective of the new research module was formulated to provide students with lifelong skills in obtaining, evaluating, synthesising and forming clinical recommendations, as well as applying research evidence to the clinical setting.

Results. Structuring the research methodology module using an EBP teaching framework prepares students to formulate a research question, effectively search for and critically appraise the evidence and formulate clinical recommendations. The barriers and strategies of implementing the new undergraduate research methodology module, as well as lessons learnt, are presented.

Conclusion. Utilising a secondary research approach in the form of a systematic review or meta-analysis in our undergraduate research methodology module provides the opportunity for students, as novice researchers, to be trained in the principles of EBP.

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Undergraduate education plays an important role in fostering evidence-based practice (EBP) to meet the needs and challenges of the twenty-first century healthcare system.^[1] Evidence-based care is widely recognised as a key skill for health professionals, and healthcare students are expected to be competent evidence-based practitioners by the time they graduate and embark on their clinical or academic career.^[2]

The World Confederation for Physical Therapy (WCPT) strongly advocates teaching the principles of EBP in undergraduate physiotherapy curricula.^[3] Herbert *et al.*^[4] defined physiotherapy EBP as 'physiotherapy informed by relevant high quality clinical research, patients' preferences and physiotherapists' practice knowledge'. EBP facilitates quality healthcare by amalgamating clinical knowledge and expertise with scientific evidence and patients' preferences.^[5]

An international consensus statement (the Sicily statement on EBP)^[6] sets out a five-step approach to EBP and recommends that this approach be incorporated into academic curricula by teaching the following steps:

- Step 1. Translation of uncertainty into an answerable question
- Step 2. Systematic search for and retrieval of evidence
- Step 3. Critical appraisal of evidence for validity and clinical importance
- Step 4. Application of appraised evidence to clinical practice
- Step 5. Evaluation of performance and thus auditing evidence-based decisions.

Based on the above model, undergraduate education should provide students with research skills to seek, evaluate and integrate new knowledge

to facilitate professional growth and support lifelong learning.^[7] Because of the time and curricular constraints within professional degree courses, it could be argued that the best place to introduce the principles of EBP is in research methodology modules. The aim of this paper is to explain the rationale for adopting a secondary research approach as a vehicle to teach the principles of EBP as part of the undergraduate physiotherapy research module. Implementation strategies and lessons learnt are also outlined.

Motivation for reviewing the research methodology module and introducing EBP

The research methodology module was reviewed as part of the overall revision of the undergraduate physiotherapy curriculum at Stellenbosch University (SU). This created an ideal opportunity to assess how to introduce and align the principles of EBP with the current mode of teaching research methodology and basic statistics to undergraduate students.

The previous research methodology module spanned the final 2 years of the 4-year undergraduate physiotherapy curriculum and was delivered as didactic lectures covering a wide range of research design and statistical concepts. After completing the series of 30 1-hour lectures at the beginning of their third year, students were divided into groups and each group was tasked to conduct a research project. Two supervisors (physiotherapy lecturers) were assigned to a research group and mandated to assist the students in conceptualising a project, recruiting subjects, collecting data and writing up the research report. There were no guidelines or boundaries

regarding the type, nature and scope of the research projects, and typically the projects were limited by time and financial constraints only. Students were expected to write a primary research protocol, research paper/report and present their research findings at a forum attended by fellow students, clinical supervisors and independent evaluators. Although it was not one of the main outcomes of the research methodology module, publication was strongly encouraged. Despite this, these research projects yielded only two research publications in accredited journals over four decades. This mode of teaching research methodology was carried out for 40 years until the undergraduate curriculum was reviewed.

During the curriculum revision process, all permanent academic staff participated in an in-depth analysis of the former research methodology module. The issues raised are listed below.

- The course content focused on epidemiology, research techniques and statistical calculations rather than the application of research to patient care.
- Design of studies was primarily limited to surveys which limited the ability of undergraduate students to recognise the link between research and clinical practice.

- The large number of surveys often duplicated previous research and thereby created research waste.^[8]
- The types of questions did not address important clinical issues and students could not translate their study findings into clinical practice.
- Studies were limited to small sample sizes (because of time and financial limitations) and yielded inconclusive results.
- Students had no exposure to systematic searching and no tools to critically appraise literature, implying that they lacked the core EPB skills and attributes for clinical application and lifelong learning.
- Obtaining ethical approval from the Health Research Ethical Committee and relevant institutions imposed further time constraints for completion of the research projects.
- No funding or equipment was available for undergraduate research projects.
- There were concerns that the course objectives were too broad and did not allow consolidation of research methodology skills.

After reviewing the content, mode and outcomes of the research methodology module, it was clear that the module needed substantial revision.

Table 1. Steps followed for teaching the five key principles of evidence-based practice as part of the research methodology module^[12-15]

Step 1 – asking clinically relevant questions by translation of uncertainty into an answerable question	<ul style="list-style-type: none"> • Students search for interesting systematic review or meta-analysis topics published in the past 3 - 5 years • Students determine if their chosen topic has not been published in the form of a systematic review/meta-analysis or protocol in the past 12 months • If no similar systematic review has recently been published, students proceed to formulate their PICO question and search terms. Searches in relevant databases are conducted to ensure that at least three eligible RCTs were published following the publication of the previous systematic review or meta-analysis. This does not form part of the primary search, but the purpose is merely to determine if eligible RCTs have been published to warrant a new systematic review on their chosen topic • Students then need to conceptualise their topic and ideas and write and submit a secondary research protocol
Step 2 – finding the evidence: systematic search for and retrieval of evidence	<ul style="list-style-type: none"> • In consultation with a librarian, 3 hours of practical small-group library training are allocated to teach students how to conduct effective searches in at least seven different medical databases and how to define MeSH terms and Boolean operators • A 2-hour library session is allocated to teach students how to utilise reference database software (RefWorks)^[12] to capture, manage, and organise bibliographic citations • After approval of their research protocol, students conduct and tabulate structured searches with relevant search terms in at least seven of the following databases: PubMed, Cochrane Library, Cinahl - EBSCOhost, Proquest, Science Direct, Scopus, PEDro, SPORTDiscus – EBSCOhost, OT Seeker and Google Scholar
Step 3 – critically appraising the evidence for validity and clinical importance	<ul style="list-style-type: none"> • The eleven-item PEDro scale^[13] is utilised to assess the study's internal validity (criteria 2 - 9), external validity (criteria 1) and the statistical accuracy for interpretation purposes (criteria 10 - 11) • Students receive extensive training in how to use the PEDro scale for critical appraisal and their skills in using the PEDro scale are also tested as part of formative and summative assessment
Step 4 – interpreting the evidence and applying research evidence: application of appraised evidence to clinical practice	<ul style="list-style-type: none"> • The adapted 'JBI Data Extraction Form'^[14] is used to extract the following data from the selected article: reference, type of study, participants, interventions (treatment and control group), outcome measures (including outcome measure tools), results, as well as the clinical status post-intervention and clinical implications thereof <ul style="list-style-type: none"> • On completion of the data extraction, homogeneous data are combined using the RevMan Review Manager software 5.2^[15] which pools data statistically in forest plots to determine the superiority of one intervention in comparison with the other. Heterogeneous data are summarised in a narrative form • Staff members guide and assist the students to extract relevant data and to interpret the data • Students are expected to interpret the relevance of the project findings to the local context and present contextualised recommendations for physiotherapists. Formal evaluation of their project findings and recommendations for clinical practice is done in presentation format at the Physiotherapy Division's Research Day. They are also strongly encouraged to present at the Faculty of Medicine and Health Sciences Student Academic Year Day, as well as at the combined university Physiotherapy Research Day

Developing an alternative teaching strategy for research methodology

One of the main drivers for the new research methodology module was to develop an understanding of the role of scientific research in informing clinical practice. While the previous mode of teaching research methodology was inclined towards equipping students with skills to conduct research, we decided to deviate from this approach and place the emphasis on the acquisition of skills to become efficient users of published research, rather than personally conducting primary research, i.e. being 'doers of research'.^[9] The primary aim of the newly revised undergraduate curriculum was therefore to train effective clinicians who are able to ask clinically relevant questions, find and critically appraise the evidence, and interpret and apply the evidence to their daily practice.

Methods

Journey to design a new research methodology module

We explored avenues to teach the principles of EBP and developed aims for the new research methodology module. During this process, we consulted international experts and searched the literature for ideas and concepts of how we could design a module which would facilitate the drive to understand scientific evidence and its role in clinical practice. We gained valuable advice from colleagues at the University of South Australia's International Centre for Allied Health Evidence (ICAHE), Melbourne University's Department of Physiotherapy and the South African Cochrane Centre. Based on discussions and feedback, we proposed secondary research, in the form of evidence syntheses, instead of primary research as our platform to teach the principles of EBP. In an attempt to reduce the variability of the scope and design of the projects, we envisaged only effectiveness reviews based on randomised controlled trials (RCTs) aimed to establish the effectiveness of a physiotherapeutic intervention. Evidence synthesis/meta-analysis of RCTs is viewed as level 1 evidence for effectiveness of interventions on many evidence hierarchies because it presents the least biased approach for the effectiveness of an intervention.^[10] Therefore, it seemed to be an appropriate approach to assist students in understanding how scientific evidence, generated from research, can be used to inform clinical practice.

Description of the aim and outcomes of the newly designed research methodology module

The overall aim of the module was to provide students with skills in obtaining, evaluating, synthesising and formulating clinical recommendations, as well as applying research evidence to the clinical setting. This module also assists the students to obtain knowledge and develop skills to find and assess evidence to answer a clinically relevant question. Moreover, students are required to work both individually and in teams, and this provides students with the opportunity to develop team skills that are a necessary part of effective clinical practice. The key learning outcomes of newly revised research methodology module outcomes of the third and fourth years are to:

- design an effectiveness research question, using the PICO method (patient or problem, intervention, comparison and outcome);^[4]
- effectively search for and select the best evidence using all available medical databases via the webpage of SU's medical library;
- critically appraise the evidence for validity and clinical importance using a reliable appraisal tool, as well as evaluate and grade the articles' hierarchical level of evidence;

- extract and analyse data from primary research articles and apply basic statistical concepts (meta-analysis);
- apply evidence to clinical practice and formulate clinical recommendations;
- formulate implications and recommendations for future research.

These outcomes concurred with the graduate attributes that are promoted by the Faculty of Medicine and Health Sciences, SU, and are also in keeping with the work of Laidlaw *et al.*,^[11] who used different methodologies to define and rank the most important graduate attributes and skills for undergraduate medical programmes from both a research and a professional perspective. The seven most important graduate attributes and skills were listed as follows:

- inquiring mind/curiosity
- core knowledge
- critical appraisal
- understanding of the evidence base for professional practice
- understanding of ethics and governance
- ability to work in a team
- ability to communicate.

Laidlaw *et al.*^[11] suggested that these core attributes should be mapped to current learning activities to ensure that there are opportunities within the curriculum for students to develop and practise these skills. Teaching strategies were set in place, aimed to incorporate at least four of the five-step principles of EBP into the undergraduate research methodology module (Table 1) to address some of the graduate attributes and skills as defined by Laidlaw *et al.*^[11] A total of 120 hours were allocated in the third year and 110 hours in the fourth year of the physiotherapy curriculum to achieve these outcomes. The course materials included handouts and the textbook by Herbert *et al.*^[4] on *Practical Evidence-Based Physiotherapy*. Step 1 of the five-step module was accomplished during the second term of the third year when the students were divided into groups of four to six members and had to formulate relevant research questions and complete a systematic literature review protocol. Steps 2 to 4 of the five-step module were completed in the first semester of the fourth year, when the students conducted a systematic literature review and wrote a systematic review article. As part of step 4, the students had to deliver a scientific oral report of their research findings at the Division of Physiotherapy's Annual Student Research Day.

Action plans to implement EBP within the new research methodology module – barriers and solutions

The main barrier was that less than a third of the permanent academic staff who were eligible to supervise undergraduate research groups had been trained in conducting systematic reviews. This barrier was addressed by training staff in conducting systematic reviews using a 'train the trainer' approach. Staff are required to 'train/supervise' students and therefore these skills are needed. The main training event was conducted by an expert from the University of South Australia's ICAHE. The focus of these training sessions was to equip staff members with the Sicily statement's five-step approach to EBP including question formulation, skills on how to conduct the most effective database searches, critical appraisal of RCTs as well as other types of research designs, and applying the evidence to clinical problems.

After the initial training, staff members were trained and supported via a peer-mentoring approach by a fellow staff member who already had

a track record of published systematic reviews. Subsequently, this staff member (the mentor) attended a 5-day international course on training health professionals to conduct secondary research and on return trained colleagues in these skills. Newly appointed staff members supervised research groups with a trained colleague. In this way skills were imparted to new staff members in an experiential manner.

Another barrier was ensuring that the staff and students were ready to change to the new research approach. At the time when we changed the research methodology module, there was much scepticism as it did not involve any primary data collection and required new methodological and statistical knowledge. This was addressed by the training outlined above, as well as bi-annual sessions with staff to update their knowledge and skills, and thereby improve their confidence and willingness to supervise research groups.

A final barrier was to find suitable research topics to formulate an effectiveness question. Students often wanted to conduct a research project on a topic that interested them, only to discover after an extensive database search that a systematic review or meta-analysis had recently been published on the topic, or that they could not find any suitable RCTs to evaluate and include in their systematic reviews. We addressed this problem by guiding the students to search for interesting systematic review or meta-analysis topics that had been published in the past 3 - 5 years. Students needed to search for RCTs on the same topic published after the systematic review of their choice. Students could then utilise the recently published RCTs for secondary research in the form of evidence synthesis and compare their findings with the previous systematic review(s) on their topic. Students were thus encouraged, where possible, to conduct updates of existing systematic reviews or meta-analyses.

Results and discussion

Lessons learnt and the way forward

We managed to define the core research skills appropriate for undergraduate physiotherapy students, and by integrating EBP principles in the research methodology module we hope to foster important graduate attributes to equip new graduates for their professional career.^[11] Structuring the research methodology module using an evidence-based teaching framework may successfully prepare our undergraduate students for a postgraduate academic career. We hope that teaching the principles of EBP will have a positive impact on improving clinical practice and their transition to a research career, and the throughput of current and future postgraduate students.

From the time we implemented the revised research methodology module we noted a lack of high-quality evidence for many of the physiotherapy interventions which were reviewed by students.^[16] Consequently RCTs of poor methodological quality often had to be included in the systematic reviews. Conclusive recommendations to support or refute current practices, as well as the translation of the new-found evidence into their clinical practice, were often impossible. This lack of evidence enhanced the students' awareness of the need for high-quality research to advance EBP in the physiotherapy profession. It also nurtured and stimulated critical thinking and improved their appraisal skills of the current evidence. Similar traits were also reported by Seymour *et al.*,^[17] who noted that undergraduate research resulted in a professional and personal growth experience with many transferable benefits such as critical and reflective thinking, problem

solving, and an increased confidence in students' ability to effectively communicate, explain and defend their work to others.

Since implementing the new research curriculum in 2007, we have published three undergraduate research papers^[18-20] and another two are under review in accredited international journals. Annually, the best abstracts are also published in the *South African Physiotherapy Forum*. We have a much higher publication success rate with systematic reviews and meta-analyses (secondary research) in the revised undergraduate research methodology module as compared with the previous module.

Supervisors of undergraduate research groups spend on average 100 hours per group assisting them in the research process and writing the scientific protocol and paper. We found that the students and supervisors who published their papers felt a great sense of achievement and that the hours spent synthesising evidence were not wasted. The way forward will be to support and encourage all supervisors of undergraduate research groups to ensure that evidence syntheses are published.

Limitations of incorporation of EBP principles as part of the research methodology module

The key limitation of incorporating EBP principles is that it was not possible to fully incorporate and formally assess all five steps of the Sicily five-step approach to EBP,^[6] namely the interpretation and application of research evidence into daily clinical practice (step 4) and the evaluation of performance and thus auditing evidence-based decisions (step 5). The best vehicle to fully incorporate steps 4 and 5 of the Sicily five-step module should be introduced during the undergraduate clinical training, and this still needs to be investigated.

Conclusion

Utilising a secondary research approach, in the form of conducting a systematic review or meta-analysis to teach our new undergraduate research methodology module, provides the opportunity for physiotherapy students, as novice researchers, to acquire basic research skills and become clinicians who provide evidence-based clinical services. We were able to define and align core research skills with the graduate attributes as promoted by the Faculty of Medicine and Health Sciences. Evidence synthesis in the form of systematic reviews and meta-analyses is a time-efficient and sustainable method, which has led to an increase in undergraduate physiotherapy publication outputs. Integrating the principles of EBP into the undergraduate physiotherapy research methodology module may contribute to preparing our students to become healthcare professionals with an interest in EBP and/or researchers who advance the field of physiotherapy.

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