Research

What does an enquiry-based approach offer undergraduate physiotherapy students in their final year of study?

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Background. Physiotherapy students in their final year at Stellenbosch University (SU) complete a module that follows an enquiry-based learning (EBL) approach. This module exposes them to higher-order problem solving and was developed to facilitate independent self-directed learning and improved higher-order thinking skills.
Objective. To describe the perceptions of undergraduate physiotherapy students on the impact of this EBL approach on their learning.
Methods. A cross-sectional descriptive study was conducted with three consecutive cohorts of final-year undergraduate physiotherapy students. A questionnaire was used to obtain information related to the students' perception of this module. Coding and identification of themes were done independently using an inductive approach. Initial themes were compared and discussed to achieve consensus regarding the final themes reported.
Results. Students reported the development of skills such as the ability to source relevant information and problem-solving abilities. Students attributed improvements in their clinical reasoning and performance during clinical work to the skills they developed during this module. The main themes identified as barriers to learning during this module were availability of learning materials, quality assurance and time constraints. Group work was identified as both a facilitator and a barrier to their learning.
Conclusion. Physiotherapy students at SU perceived the introduction of a module following an EBL approach positively. They developed skills such as sourcing information and problem-solving, which they perceived improved their clinical work. The main barriers to learning were time constraints and concerns regarding quality assurance of learning material. Group work was regarded as both facilitatory and a barrier to learning. Programmes considering the implementation of EBL should ensure sufficient resource material and that quality assurance mechanisms are in place to address students' anxiety regarding learning material. Guidance and support to students during the initial implementation phase of an EBL approach are necessary to allay fears and frustrations.

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Khan and O'Rourke[1] consider enquiry-based learning (EBL), sometimes called inquiry-based learning (IBL), as a broad overarching term used to describe student-centred learning approaches driven by enquiry. EBL forms part of a family of approaches such as case-based and problem-based learning (PBL).[2,3] These approaches, especially PBL, are widely used in medical and allied health curricula to enhance problem solving, critical thinking and self-directed learning skills in both undergraduate and postgraduate students.[4,5] PBL has been widely used in undergraduate physiotherapy programmes,[6] but the utilisation of EBL is less documented.[1,7]

EBL is a learning approach that inspires students to be self-directed learners engaged in problem solving of realistic scenarios and often complex problems.[2,4,5] It may entail small-scale investigations, projects that result in products for industry or research-based projects which are assessed.[1] It may be used to facilitate learning and completion of a singular task, as an approach for a module, or incorporated into traditional curricula, and therefore be referred to as hybrid EBL. This approach has been reported in different fields such as engineering, nursing and dentistry.[5] Hutchings[8] encourages the use of EBL approaches if a deep level of engagement with complex problems is required. It has been hypothesised that multifaceted problems will force students to work creatively, to grapple with differing views and find novel solutions, or to come to the realisation that the loop of enquiry remains ongoing and solutions are often elusive.[1,8] Jackson[9] considers EBL a vehicle to prepare graduates for continually expanding and changing information by teaching them skills on how to acquire and appraise knowledge for a particular purpose rather than content only.

Although PBL and EBL have similar attributes, EBL is considered more advanced where students are empowered to take ownership of their learning, thereby fostering a deeper level of engagement.[2] In contrast with PBL, there has been no structured process described for EBL.[3] Similarities have been noted in the roles of lecturers that facilitate learning rather than the source of knowledge.[7] In EBL an enquiry begins with a general theme to trigger learning and may take the form of a real-life scenario or stimulus question, for which there is usually no known answer.[10] Students have to identify what resources they need to solve the problem and embark on a journey of constant questioning, problem solving and seeking evidence-based and relevant solutions.[6] Facilitators in EBL provide guidance to students on the learning process rather than content knowledge. This may take the form of coaching students on how to pose researchable questions, how to access and critically appraise information, and how to reflect on the progressive development of the students' own enquiry skills.[1,10] Facilitators are encouraged to model effective enquiry themselves and promote opportunities for reflection on learning.[10]

Student engagement is further enhanced in EBL by the synthesis and creation of new knowledge.[1] It has been hypothesised that the synthesis of new information results in deeper learning.[2] Group work is the mainstay of enquiry-driven approaches, but students may also do self-directed

individual study and utilise a wide range of information sources to tackle the problems, such as research articles and web-based information sources.[1] Assessment in EBL could be formative or summative in nature and might be completed by facilitators and/or peers. Facilitators may provide feedback on the quality of questions, the depth of study or nature of information sourced. Peer feedback may be useful to identify problems in collaborative learning and communication within groups.[10] Summative assessment could entail a research report or product for industry. Palmer[11] reports on the successful use of written and oral presentations where psychology students presented their research of self-selected topics to the class.

Students following an EBL approach report satisfaction with their training, better retention of knowledge, deeper understanding of subject matter and the ability to apply their skills in solving new and complex scenarios.[7,12] The collaborative nature of small-group learning in EBL facilitates the development of teamwork, communication and leadership skills. It has been reported that an EBL approach is suited to the development of interpersonal and social skills.[13] Cairncross[14] considers these transferable skills prerequisites for successful professional careers. In addition, Kahn and O'Rourke[1] highlight the many advantages that EBL poses for contemporary issues in higher education related to the goals for student learning. Some of these include preparing graduates for employability, and the development of skills and personal attributes to ensure lifelong learning.

Small-group teaching approaches are often staff, resource and time intensive.[7] The literature recommends that staff and students should be supported when embarking on EBL, especially during the transition phase between other more traditional pedagogies.[1] The complexity of the clinical scenarios faced by physiotherapy students in the real world necessitates higher-order problem solving and clinical reasoning. Students are required to work as first-line practitioners on graduation. The ability to solve complex problems and develop new understanding of an ever-changing multidimensional healthcare context are necessary skills to help students to function independently as healthcare practitioners on entry to the physiotherapy profession. EBL – as progression to PBL – has been identified as a strategy that could facilitate students' transition to this higher-order thinking and level of functioning.

The aim of this paper is to describe the perceptions of undergraduate physiotherapy students on the impact of this EBL approach on their learning.

Context

A hybrid curriculum was implemented in 2007 in the Division of Physiotherapy, Stellenbosch University (SU). The curriculum consists of 2 years of didactic teaching in basic sciences and physiotherapy modules followed by a PBL approach in the third year and EBL in the final year. The aim of these two modules is to provide students with the opportunity to integrate knowledge, techniques and concepts covered during the two foundational years within the context of pathology, personal circumstances of patients and healthcare structures. This level of integration is essential for clinical reasoning.

The EBL module consists of five complex cases spread over the academic year. These cases are facilitated by academic staff over a 3-week period with contact sessions once per week. Students work clinically for the rest of the week. The whole class or smaller groups may attend contact sessions. Various stimulus activities are used at the start of cases, e.g. clinical guidelines, videos or clinical records of patients. Students complete self-directed research and/or group work to source, appraise and synthesise information in an attempt to solve the complex EBL case scenarios. Assessments entail individual and group tasks. The final product may be a pamphlet or an educational talk in a community setting. Tables 1 and 2 provide information regarding the various cases and how each was assessed.

Table 1. Outcome of fourth-year module following an EBL approach

By the end of this module, the student will be able to:
• Integrate the theoretical concepts and principles of the biomedical sciences (e.g. pharmacology, pathology); social sciences (psychology, sociology) within the concept of physiotherapy practice (client management)
• Have a sound knowledge of the medical and surgical management of the client, as well as disease processes applicable to physiotherapy intervention
• Understand the role of the other team members in the total management of the patient
• Have basic knowledge of diagnostic tests (e.g. chest X-ray, MRI, blood gases, etc.) and understand their impact on patient management
• Execute evaluation techniques skilfully, with the necessary adaptations, on a model
• Interpret the findings of an evaluation, formulate a physiotherapeutic diagnosis/hypothesis and prioritise problems
• Motivate the choice of selected physiotherapeutic interventions and/or the different approaches that can be followed in the management of patients
• Execute physiotherapeutic interventions skilfully, with the necessary adaptations, on a model
• Set specific, measurable, realistic aims that are attached to a time scale
• Source and critically appraise relevant subject literature

PBL = problem-based learning; EBL = enquiry-based learning; MRI = magnetic resonance imaging.

Methods

A cross-sectional descriptive study was conducted. Ethical clearance was obtained from the SU Health Research Ethics Committee (N08/10/301). Participants were assured of confidentiality and all provided written informed consent. The project was conducted with three consecutive cohorts of final-year physiotherapy students from 2008 to 2010.

A questionnaire was designed to obtain information on the perception of students of the EBL approach. This paper reports on the two open-ended questions students were posed regarding facilitators to their learning and barriers to their learning. All the data were collected after implementation of the module. The questionnaire was completed during scheduled class time before the final assessment opportunity.

Responses were typed in Microsoft Word (SS) and coded by the research team (SS, SH, GIJ). Coding and identification of themes were done independently by two researchers in the team using an inductive approach. Initial themes were compared and discussed to achieve consensus regarding the final themes.

Table 2. EBL module content – information related to cases

Diagnosis or clinical context	Stimulus given at start of case	Assessment (final product)
Head injuries (HI)	Direct observation of patients with HI (different clinical presentations)	Scientific written task on evidence-based physiotherapy management of patients with HI
Intensive Care Unit (ICU)	Records of patients admitted and managed in ICU	Development of a patient assessment form to facilitate evidence-based practice in ICU
Whiplash	Clinical guidelines for the management of whiplash-associated disorders (WAD)	Group presentations on evidence-based physiotherapy management of WAD
Headaches	Evidence-based physiotherapy management of headaches	Educational talk at community health centre on prevalence, pathogenesis and physiotherapy management of headaches
Guillain-Barré syndrome (GBS)	Video of patients with GBS (psychosocial impact and prognosis)	Educational pamphlet on role of physiotherapy in GBS

EBL = enquiry-based learning.

Table 3. Student feedback related to additional skills development with implementation of EBL approach

Sub-theme	Quotes
Source information	'Improved my ability to research for evidence based information & my ability to interpret that information.' 'This module, as difficult as it was to adapt to, gave us the skills to problem solve and find resources by ourselves to find out more about things.'
Problem solving/clinical reasoning	'We learnt a lot about research & how to base your Rx (treatment) on evidence, this enables you to ensure that you are effective.' 'I learnt to think more practically and to research and have evidence-based arguments/knowledge with treatment of my patients. Clinical reasoning rather than "parrot learning" of theory is more important.'
Life skills	'Learnt to be strong.' 'Achieving knowledge and practical skills. Learned how to be responsible when made student facilitator.' 'Taught me not only physiotherapy skills but life skills as well.'
Critical appraisal of information	'Helped me to source appropriate information and analyse information.' 'Criticising research.'
Independent learning	'Learn to help yourself and source information on your own.' 'Was responsible for own progress.'
Scientific writing skills	'Improved scientific writing.'

EBL = enquiry-based learning.

Results

All final-year students were invited to participate over the 3-year period of this study. Questionnaire response rates were 85% (n=35/41) in 2008, 86% (n=37/43) in 2009 and 89% (n=41/46) in 2010.

Facilitators to learning

The main themes identified in this category were skills development, collaborative learning, impact on clinical reasoning, and integration across modules.

All three cohorts commented on the development of additional skills with the new learning approach (Table 3). Feedback centred on the ability to source relevant information, solve clinical problems and critical appraisal of literature.

Students attributed improvements in their clinical reasoning and performance in clinical work to skills developed during the EBL module. Comments reflected an improved ability to problem solve with patients. They felt empowered to source information and follow similar steps in critical appraisal of information. Improved patient outcomes were attributed to their ability to assess patients more holistically and develop relevant management plans. A few comments described how this module facilitated integration of theoretical and practical components across modules.

Some students found the collaborative learning of group work enjoyable and insightful in terms of self-knowledge and getting to know their peers. They appreciated peers as colleagues and sources of knowledge with new insights. They enjoyed working together and learned to value different opinions. However, there were students who experienced group work as a barrier.

Barriers to learning

The barriers to learning were availability of learning materials, concerns regarding the quality of sourced information, time constraints and group work (Table 4).

Some students experienced difficulty in sourcing relevant literature. Students were particularly concerned about the quality of information and felt insecure about the accuracy and relevance of information received from peers. Lack of lecturer-developed hand-outs remained a source of anxiety for students and left many frustrated. Preparation for assessments was particularly daunting.

Table 4. Student feedback related to facilitators of and barriers to learning

Facilitators of learning	Quotes
Clinical reasoning	'I found it easier to get a holistic picture of the patient and as a result plan and implement a treatment plan for the patient.' 'You had a much better ability to adapt in the clinical setting as the cases were focused but you had to adapt what you had to your own patients.' 'My clinical reasoning and skills improved a lot and by the end of the year problem solving was much easier. This will help me in future with patient management.'
Group work	'It was fun to consult with colleagues and challenge the ideas to ultimately get to the best solution.' 'We learnt a lot from each other and got to know each other at other levels.'
Barriers to learning	**Quotes**
Availability of learning materials	'Was sometimes difficult to source the correct references.' 'Everything must be evidence based, but for certain topics no best evidence articles could be found (Pubmed).' 'Not getting info from other groups regarding the topic being researched; only researching a small aspect of the topic.' 'The information you receive depends on other students. Everyone is not as motivated to perform well.' 'We did not receive well-compiled information sheets or learning material.' 'There were no notes provided which was a barrier to the learning process.'
Quality assurance of learning materials	'We did not receive feedback on the information we sourced, so we did not know whether what we read and what we are supposed to do is the same.' 'No real control over the correlation of information between groups.' 'Everyone's information was not necessarily the same.'
Time constraints	'Sometimes time (clinical, research, social, sport) was limited.' 'Time management of clinical and applied physiotherapy cases, as well as researching the first semester.' 'Spending too much time at individual task and none at understanding cases as a whole.' 'It feels as if I spent 80% of my time sourcing literature instead of learning.'
Group work	'Not always easy to work in groups with diverse personalities.' 'Group members not doing their work/not supplying enough information.' 'Lack of enthusiasm from some group members.'

There were many comments related to time management. Students indicated not having sufficient time to prepare for contact sessions, to source and appraise information, or to study and consolidate learning. They ascribed it to a full academic programme and commitments to other modules, especially clinical work. Some students focused more on assessment activities such as the completion of the final product than the process of learning.

Dysfunctional groups with diverse personalities or lacking in cooperation reported more negative comments related to group work. Some students were unhappy if group members delivered poor quality work and did not meet agreed expectations.

Discussion

We found that three cohorts of final-year physiotherapy students consistently reported the development of skills, such as enhanced clinical reasoning, integration across modules, and collaborative learning as facilitators to learning attributed to an EBL approach. Barriers to learning included time constraints, group work and anxiety due to the lack of lecturer-developed learning material.

EBL has become increasingly popular as a teaching and learning approach in health education in recent years.[5] The reported benefits of an EBL approach are many and include improved understanding of evidence-based practice, use of information resources, and enhanced critical thinking skills and clinical reasoning.[2,5] Koh *et al.*[13] believe that an enquiry-driven approach to learning results in the development of interpersonal and life skills. Improvement in transferable skills such as interpersonal communication skills and holistic patient management was observed in physiotherapy students exposed to EBL.[4] The students in our study reported similar development in skills related to research, as well as personal growth. Khan and O'Rourke[1] advocate EBL as an approach to develop many key transferable skills needed for lifelong learning. The inclusion of an EBL module in our final year of the physiotherapy programme at SU offers unique opportunities to hone these skills in a classroom environment and could extend to clinical placements.

It has been reported that, although students enjoy EBL,[15] these approaches do not directly lead to improved management of clinical cases in comparison to conventional curricula.[7,12] Gunn *et al.*[4] reported that physiotherapy students exposed to this approach demonstrated increased knowledge and client-centeredness which correlated with positive self-directed learning behaviours. The student's level of maturity, learning approach and motivation were key factors that influenced how different individuals performed and coped.[4] Although the students in our cohort partly ascribed their improved clinical reasoning to the new EBL module, it needs to be corroborated by other sources such as the clinical supervisors who facilitate their learning on clinical placements. Understanding why certain students in our cohort found an EBL approach challenging needs

further study. We are in agreement with Gunn *et al.*[4] that mechanisms should be implemented to identify and support students who have difficulty applying EBL principles during clinical work, and therefore we need to investigate what strategies might be best suited to our context.

The implementation of the EBL approach at SU was not without challenges and student feedback has highlighted areas that need further consideration. Our students' perception that the open-ended nature of the enquiry cycle was daunting and anxiety-provoking is well documented in the literature. We reflected on whether students were adequately prepared for independent study and if they had received the necessary guidance to develop these skills. Simons and Ertmer[16] highlight that students who are supported through scaffolding and preparation tend to perform better and are able to transfer their problem-solving strategies more effectively.

One could argue that students in the final year have skills and experience to deal with EBL as a result of the third-year PBL module. Training students to source literature coincided with the start of PBL and research methodology modules, where critical appraisal was a key learning outcome. We anticipated that the PBL module would facilitate collaborative learning and the skills needed for more complex scenarios. PBL supporters argue that students familiar with PBL who are exposed to a novel problem, are often better problem solvers because of their experience with the steps involved. In contrast, Kirwan and Adams[5] found that students exposed to EBL for the first time, found it challenging to adjust and had to adapt learning styles and time management. Srinivasan *et al.*[7] argue that senior students who have developed some context for their work would cope better with open enquiry. However, the more structured and guided enquiry in our PBL module may still provide insufficient preparation for advanced independent enquiry.

Dahlgren and Dahlgren[15] reported that preprofessional students engaged in PBL were especially frustrated by the ambiguity of facilitation and unsure of the correct amount of information to source. It could be argued that our cohort were exposed to PBL in their third year and should have grappled and subsequently resolved some of these issues. Based on the findings of this study, our students continue to experience similar frustrations with the EBL module, especially with the lack of resources and not trusting the quality of information gathered by peers.

Bruder and Prescott[17] are adamant that students' prior knowledge and understanding influence their performance in EBL. Preconditions such as personality and learning style, exposure to group and independent work, and experiences with different learning strategies influence the success of learning situations.[15] This could explain why some of our students, who were grappling with basic concepts and knowledge gaps, coped less well with EBL, since it requires flexible application of prior knowledge and personal learning strategies. Students who perform poorly in foundation courses, especially the PBL module, might experience the EBL module as more challenging. One could argue that management of time to source, appraise and synthesise appropriate information would be challenging for these students too; this is an additional motivation for students seeking lecturer-developed notes or reassurance about the quality of information.

Srinivasan *et al.*[7] see feedback on the process of enquiry as essential to the development of higher-order reasoning skills. An EBL approach becomes less effective when facilitators are inflexible and do not model enquiry behaviour during contact sessions.[17] According to Ashby *et al.*,[2] students new to EBL tend to have difficulty with the transition from traditional teaching and learning to a more self-directed approach to learning. This experience could be ascribed to the preparedness and willingness to change, of both lecturers and students. EBL facilitators are encouraged to create a safe space for peer interaction, to probe skilfully and make sense of students' ideas, and to guide and support students to question assumptions and challenge one another's viewpoints.[15] Students need to receive feedback on their progress during an EBL module to progressively develop these enquiry skills.

To optimise the learning experience during our EBL module, one needs to reflect on how students may gain abilities in self-regulation to work successfully as individuals and in groups.[15] Ashby *et al.*[2] warn faculty wishing to adopt EBL to plan well, consider logistical management (especially resources like time) and to support students during the transition phase. Our advice to prospective users of this approach is to encourage students to set ground rules, to manage group dynamics proactively and timeously, to facilitate enquiry in terms of how to phrase questions, and offer support to students in information appraisal. The challenge remains as to the most suitable support to offer in the learning process. Academic staff requires support through professional development to hone facilitation skills and enhance feeling comfortable with the open-ended nature of EBL.[15]

Student feedback was collected prior to the final assessment to obtain more objective reflection of the module and its impact on learning. Another strength is that the data were collected for three cohorts of students. The data only reflect the perceptions of students at a single institution and this can limit the generalisability of findings. However, the data provide some insight into students' perceptions of EBL. Programmes considering the implementation of EBL should ensure sufficient resource material and time for students to engage in group discussion to enhance understanding and synthesis. Quality assurance mechanisms should be implemented to address students' anxiety about learning material. Student preparation for the module should include reflection on learning strategies. Support during the initial implementation phase of an EBL approach is necessary to allay fears and frustrations of both staff and students.

Conclusion

Based on findings of this study we conclude that physiotherapy students responded positively to EBL. They developed skills such as sourcing information and problem solving which they perceived improved their clinical work. The main barriers to learning were time constraints and concerns regarding quality assurance of learning material. Group work was regarded as both facilitatory and a barrier to learning. Programme designers could use perceptions of our cohorts when planning an EBL module. Whether this approach is more effective in developing self-directed learners with higher-order thinking skills than other learning approaches will need to be established.

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