

Using Enquiry Based Learning in Sports and Exercise Sciences: A Case Study from Exercise Biomechanics

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Abstract

Enquiry Based Learning (EBL) has been used to develop student autonomy and independent thinking. However, few authors have documented how EBL has been integrated into sports-related courses. Fewer still have examined differences in the student experiences of EBL when it is introduced at different stages in the curriculum. This paper documents the student experiences of EBL when introduced to students in either a first year or second year undergraduate module. Following completion of each module, students participated in focus group interviews. Results revealed that, common across both year groups, students believed EBL to have developed skills and helped them engage in a more student-centred form of learning. Year 2 students also believed that EBL offered more in terms of social justice compared to traditional, lecture-led teaching. However, although Year 1 students saw the introduction of EBL positively, comments from year 2 students emphasised an assessment driven approach to learning and a preference to be 'told' what was needed rather than explore the subject in their own way. These results seem to indicate that EBL may be most effective when

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introduced early into the undergraduate curriculum to emphasise student's autonomy for learning and to avoid an assessment driven approach being fostered in students.

Keywords: student experience, sports science, constructivism, enquiry based learning

Introduction

There is a substantial body of evidence that indicates student learning is maximised when students can work co-operatively, can build on previous knowledge, to enable learners to make comparisons with their peers' knowledge and to refine their understanding as they gain experience in dealing with the topics they confront (Camp, 1996; Myers and Burgess, 2003). This is particularly so in scientifically-based disciplines where student enquiry is central to development of a deep approach to learning (Biggs, 1999). This is because the process of enquiry necessitates students describing objects/phenomena, asking questions, constructing explanations and testing those against current scientific knowledge and then communicating those to others (Myers and Burgess, 2003).

In many ways the process of enquiry is also consistent with current philosophical views on student learning in higher education and, in particular, constructivism (Savery and Duffy, 1995; Savin-Baden and Howell-Major, 2004). Constructivism posits that understanding comes from interactions with the environment, cognitive conflict stimulates learning and knowledge is developed when students negotiate particular situations and evaluate individual understanding (Cooper, 1993; Savin-Baden and Howell-Major, 2004).

Despite this and the apparent congruence between investigative science and approaches to learning in Higher Education, traditional, information driven curricula appear to be commonplace within Higher Education (Kolkhorst, Mason, DiPasquale, Patterson & Buono, 2001). Indeed, Kolkhorst et al. (2001) have noted that in the majority of cases laboratory work tends to involve only a few students and comprises predominantly of demonstrations with the majority of students gathered round a computer screen to view the data. This in turn can lead to problems such as student disinterest and diminished learning.

In contrast to traditional type teaching, enquiry based learning involves inductive reasoning, is more student centred and places more emphasis on students taking responsibility for their own learning. This teaching strategy explicitly attempts to develop scientific process skills such as hypothesis development, manipulation of experimental variables and discussion of data (Kolkhorst et al., 2001). The focus of the enquiry should also be based on real phenomena. The information, resources and skills developed come directly from the requirements and specifications of the problem. The advantage is that real problems do not have simple solutions, and require comparison and analysis of resources, strategies and costs. As such, the learner develops skills of retrieval, selection and discrimination and applies these in a holistic way allowing development of a deep approach to learning (Biggs, 1999). Additionally, the learner significantly increases real-world skills compared to more didactic delivery (Dochy, Segers, Van den Bossche & Gijbels, 2003; Willis et al., 2002).

Recently, Kolkhorst et al., (2001) examined the impact of EBL within an undergraduate exercise physiology module. Students undertaking this module engaged in two independent research projects over a 9 week period. They reported that the students' perceived EBL to provide greater autonomy, greater application to possible future careers and that students felt empowered by having more ownership of their own learning. Myers and Burgess (2003) have also examined the utility of EBL on student's ability to interpret physiological data and design experiments. In their study, students opted to either take a lecture only course or a lecture plus laboratory practical course (EBL course). During the last five weeks of this course all students were asked to design a physiological experiment. Results from this study revealed a significant positive impact of the EBL based course compared to the lecture only course. Myers and Burgess (2003) suggest that EBL may therefore be advantageous in developing student learning.

Although the usefulness of EBL has been demonstrated in various subjects related to the study of sport such as Exercise Physiology (Kolkhorst et al., 2001) and Psychology (Palmer, 2003) it appears that few studies have examined the impact of EBL on the student experience in Sports Sciences. Furthermore, the studies that are available on this topic have tended to only examine either the student's perceptions of this form of

teaching from one cohort of students (e.g. Kolkhorst et al., 2001). This has taken place within final year undergraduates. This may be an issue as by this time in their academic career, students might already have adopted a surface approach to learning and be predominantly assessment driven (Biggs, 1999). Therefore, there is a need to address these issues by examining the student experience of EBL within Sport and Exercise Sciences and exploring these experiences of EBL across different years of study. By examining the student responses to the introduction of EBL in different years of the undergraduate curriculum practitioners could be more informed regarding the most effective time to introduce EBL for maximum impact on students' teaching and learning practices. Therefore, the aim of this study was to examine the student experience of EBL in Sport and Exercise Sciences with particular focus on differences across years of undergraduate study.

Method

The impact of EBL on students' learning experience was examined using a single module approach (Savin-Baden, 2003) in both a first year and second year undergraduate module within the institution's BSc Sports Studies course. The first year module was titled 'Introduction to Human Movement Analysis' and 41 students (25 male, 16 female) were enrolled on this module. The second year module was titled 'Biomechanical Basis of Human Movement' and 28 students (17 male and 11 female) were enrolled on this course. All students gave consent to participate in this study.

Both modules ran over 10 weeks and involved students engaging with various topic/scenarios from the area of sport and exercise biomechanics. The first year module was designed to examine the major biomechanical factors that influence human movement, with an emphasis on application to sport and exercise. The second year module was designed to emphasise concepts and competencies related to sport and exercise biomechanics and biomechanical support for specific groups. Each topic/scenario was designed to necessitate student's working in small groups (4-6 students per group) to explore biomechanical concepts/methods in order to design an experiment/test an hypothesis related to the biomechanics of sport and exercise. Neither the Year 1 nor the Year 2 group had prior experience of EBL.

Module Structure

In both modules the first two sessions in each module were used to outline the module themes and assessment requirements and to provide a lecture type overview of basic concepts in biomechanics. The tutors felt that this session was necessary to introduce students to or remind students of some of the critical concepts in biomechanics (e.g. Newton's laws, Forces, Torque) in the case of the year 1 and year 2 modules respectively. These were needed to explore the new themes within this module. Following this, students were presented with a particular topic scenario. They were then left to investigate the problem in groups for one timetabled session of the module. During this period the tutor was available as a resource (providing lab time and equipment) in accordance with suggestions made by Savin-Baden and Howell-Major (2004). This initial period typically involved a number of skills including literature searching, computer/internet use, discussion among group members, formulation of investigative strategies and working with particular pieces of scientific equipment. Seminar, workshop sessions and laboratory practical sessions were then set up depending on how or what the students wanted to pursue in their acquisition of information and development of a critical independent stance. The second session in each topic scenario comprised student demonstrations of experimental techniques and an overview of relevant theory associated with the topic (provided by the tutor).

Assessment Tasks

The assessment tasks for each of the modules concerned varied. However, in both cases the assessment tasks attempted to assess some process-based activity and provide experience of working with clients, peers, or people they may experience in a professional capacity. In this way we hoped to mimic best practice for the assessment of problem-based learning (Macdonald and Savin-Baden, 2003) within EBL. Students undertaking the first year module were required to complete a laboratory write up of their scenarios (two scenarios were written up) whereas in the second year module, students were required to complete a written report on one of the experimental procedures undertaken as part of the various topic scenarios.

Both methods of assessment required students to engage with at least one of the scenarios presented to them within each module and provide a practically-based response to a scenario. This was short (600 words for the first year module and 2000 words for the second year module) to encourage a concise, critical stance. This adhered to the guidelines proposed above as it assessed process-based activity (i.e. how they used particular protocols, equipment and the procedures they employed) and necessitated working with some form of client group. The objectives, learning outcomes and teaching methods were aligned accordingly. Marking criteria were presented to the students at the beginning of the modules and the assessment did not simply assess the student's ability to provide knowledge but rather assessed the students acquisition of practical skills, their ability to use or engage with particular equipment/techniques, and the collection of data from client groups in the process of their enquiry into a particular topic. In order to achieve this, these elements featured in the assessment criteria

Evaluation of EBL

In order to examine the student's experience of each of the modules focus group interviews were conducted in groups of 4-6 students at the end of the module. Focus group interviews were chosen as they provide a more naturalistic data collection method compared to interviews or questionnaires (Wilkinson, 2004). They also allow respondents to build upon the responses of other group members and the relatively free flow of talk can provide an excellent opportunity for hearing the language and experiences of the respondents' (Wilkinson, 2004). Data from the focus group interviews was analysed using thematic analysis and followed guidelines recently proposed by Braun and Clarke (2006). In this way we sought to describe patterns both within modules and across years of study (Braun and Clarke, 2006). On completion of the thematic analyses for each module comparisons were drawn across both modules to identify any common themes or differences in the student experiences of EBL across the two years of undergraduate scrutiny.

Results

Results from focus group interviews revealed a number of themes within the student experience of EBL. Some themes were consistent across years of study whilst others appeared to be specific to the particular year of study/module studied. Of those enrolled in each module 50% (n = 20) of the Year 1 students and 71% (n = 20) of the Year 2 students fully took part in the focus group interviews following completion of the module. The students who did not take part in the interviews were either ill, on a European work placement or unavailable for interview.

Themes evident across both years of study

Two overarching themes appeared to be evident across both year 1 and year 2 experiences of EBL. These were the development of new skills and engagement with a more student centred approach to learning.

In regard to the development of new skills both groups of students reported that EBL helped them to develop new skills related to their course of study that they thought traditional didactic teaching would not have done. For the year 2 students this particularly included developing strategies to find and examine literature and the development of presentational skills. For example, students reported the following in terms of development of skills:

'We looked at loads more stuff, journals and books than if you had of just stood up and told us what was what [i.e. didactic teaching]' (Student A, Year 2)

and:

'It makes you better at finding stuff so finding journals on pubmed and then going through them to find the bits you want then putting it all together to sort your issue [the assessment task] out' (Student C, Year 2)

This was then followed by the comment:

'Yeah its like we learnt to argue about the stuff in biomechanics but we can then use that in our other modules' (Student F, Year 2)

In respect to presentational skills:

'Having to present back was good cos at first it was a bit daunting and everyone was crap at it then we got more confident and actually better at doing it because your answer, you have to defend it and you cant do that without knowing the information and being able to tell people about it' (Student B, Year 2).

Likewise, the Year 1 students also reported similar developments in terms of their ability to extrapolate the most pertinent information:

"When you gave us the first problem I hadn't a clue how to solve it but when we went off and started to go through the stuff [book resources] in the library, it actually didn't take our group that long to find the most important bits" (Student F, Year 1).

Similarly, Student B reported:

"When we got the scenario we decided to split up and some looked on the internet, some went to the library and some stayed in the resources room down here [Human Performance Lab]. Then our group met up and we put all the information that everyone had collected together. To be fair it worked quite well I thought".

In respect to engagement with a more student centred approach to learning, both year groups picked up on this aspect of EBL however, there seemed to be some discrepancy between the experiences of the Year 1 and Year 2 students. Principally, the results of the focus group interviews seemed to indicate that EBL was seen in a positive light by those students in Year 1 (who had yet to experience traditional university teaching). For example, Year 1 students stated:

"I really like these labs better cos it meant you had to do the work yourself which is good in a way. Sometimes in lectures you can switch off or your there but nothing is going in. With this, I think you're more likely to remember it" (Student B, Year 1).

"I think this way [EBL practical's] is better as you are kind of in charge of your own learning, cos we had to go out and get the info, we had to put it together and then we had to do a presentation and everyone had to say something. This way everyone has something to do and has to get involved which is good" (Student G, Year 1).

However, for students in Year 2 the use of a more student-centred approach to learning was not seen in as positively. Although the year 2 students seemed to indicate that this

enabled them to look into more depth at particular aspects of their work they also expressed a wish to be 'told' what they needed to know in order to pass the module. This is illustrated in the following comments from some of the students involved. Student D noted:

'I kind of liked it [EBL] because it was more interesting than normal lectures but I didn't like the idea of it. I wanted to have it like last year where you just get a lecture so you know what you have to do to pass, there was more choice with this so we didn't know the right answer all the time'

And Student J expressed a similar opinion:

'I know we should really want to get into the stuff we need to learn but I really just wanted you to tell us what to do, how to do it and then how to get a good mark for the work, I think it would have been easier to do that by just having us in a lecture each week'

This was followed up by these two comments:

'With this we have to do more of it so we cant just sit there and switch off like the way it was done last year. You could sit there not take it in but you get a solid answer that you can use in the exam. With this there was no solid answer to the assessment because it depended on what you did and found...' (Student G, Year 2)

and

'Yeah because when you lecture us then you know what the answer is and you know what needs to go into your work with this I had not clue at first so had to really find out about it but I suppose that's the point really'

Different themes across years of study:

While there were some similar themes across the Year 1 and Year 2 experience of EBL there were also several themes that were raised in only one of the Year groups involved. In the case of the Year 1 students, they reported that this method of delivery was more engaging, enjoyable and fostered critical thinking:

Some of the points raised were as follows:

"I actually enjoyed these [EBL] labs a lot more than the others as you are given a real issue and you really have to think and do lots of reading to find out how you solve it and I think I actually did better in these labs as well" (Student B, Year 1).

"I think this is more enjoyable than sitting in lectures and someone telling us all the information or how to solve it, your just more involved this way" (Student A, Year 1).

"I think with this [EBL] everyone has to do their bit, and in our group we worked well together, you actually have to do a lot more work as well to come up with the solution than the other labs" (Student F, Year 1).

However, for the Year 2 students a theme related to social justice in learning was raised where students seemed to think that EBL was better suited as a differentiated learning experience compared to traditional type teaching. To illustrate, Student A stated:

'I reckon its good [EBL] because like XXX [Other student's name] is a genius and she gets stuff much quicker than me or some of the others do so this [EBL] could be pitched at her level, she could run with it, but for me and some of the others we could also look at stuff maybe not as much but more on where we are in terms of academically if you know what i mean'

Student K also noted:

'its not like with normal teaching where somebody will be miles ahead in what they understand with having to do practical bits in this you kind of develop what you know and how you understand it'

Discussion

Overall, the student experiences of EBL appear to be positive with all students reporting that EBL offered something different to traditional, lecture-led teaching, that it enabled the development of transferable skills such as information retrieval, ability to develop an argument and to present effectively that could be used in other areas of their study. These findings are consistent with research from other studies on the impact of EBL and problem-based learning (Kolkhorst et al., 2001; Palmer, 2003; Myers and Burgess, 2003; Duncan and Al-Nakeeb, 2006). It is also interesting that both groups of students highlighted the move to a student centred form of learning as an important aspect of EBL but that the groups had somewhat differing views related to this. For the Year 1

students, giving them more autonomy for their own learning was seen as a positive aspect of the module. Students seemed to enjoy this level of autonomy and the challenge of EBL, and greater enthusiasm for the subject was evident. Some students also noted that EBL allowed them to engage with the subject area at different levels. This would imply that by allowing greater student autonomy within the module, the students were able to participate in the teaching and learning tasks at their own pace. Thus, in this instance, EBL is congruent with the concept of social justice in teaching and learning.

A review of the utility of EBL in promoting social justice is beyond the scope of this paper, readers are directed to the text by Savin-Baden and Howell-Major (2004) for a more in-depth outline of this issue. A strong theme was also the preference of this method of teaching over traditional lecture-led teaching. However, for the Year 2 students much more attention was focused on the assessment of the module, gaining a good grade or passing the module compared to their Year 1 peers. There seemed to be an acknowledgement that EBL required them to engage more with the subject content but there also seemed to be some resistance to this. Some students expressed a preference for lecture-led delivery as it provided them with the information that the tutors or markers expected back from them in any assessment task.

In the case of the Year 2 students involved, the assessment regime they had experienced during their first year of study primarily consisted of completion of laboratory practical's, essays and examinations usually completed at the end of each module. Thus, the change in assessment strategy from their prior experiences to that used within EBL may have prompted some of the themes reported in the focus group interviews. This is an important consideration within the implementation of EBL. It may be that the Year 1 students, who were new to university teaching, were more receptive to EBL and to the development of a deep approach to learning but that by the second year of undergraduate study, the students were more assessment driven, were more prepared for the form of assessment they had experienced in their first year of study and had developed a surface approach to learning. This may have been amplified as, for both groups; this was their first exposure to EBL. A deep approach to learning is characterised by relating evidence to conclusions and relating new ideas to previous knowledge whereas with a surface approach to learning students tend to focus on

completing task requirements without reflection and are assessment driven (Savin-Baden and Howell-Major, 2004).

A number of studies on both EBL and problem-based learning have been conducted with final year students (Duncan and Al-Nakeeb, 2006; Kolkhorst et al., 2001) and have all reported student difficulties in engaging with student centred learning because it has been the students' first experience of this form of delivery. In the case of the current study first year undergraduate students seem fully capable of engaging with EBL and may be the most receptive to this form of learning. With this group habits in relating to assessment may not yet be developed and early experience of greater student autonomy in developing their own learning might be beneficial in developing a deeper approach to learning overall.

Conclusion

The findings of the current study are consistent with constructivist perspectives of learning and the concept of social justice in learning (Savin-Baden, and Howell-Major, 2004). By enabling students to engage with the module material at their own level, EBL automatically differentiates specific to the needs of each student whereas traditional lecture-led delivery does not. As EBL requires students to deconstruct and then reconstruct their own understanding, EBL reaches all students and all students can engage with EBL specific to the way they have constructed their own understanding of a topic or subject. This is typically not the case with lecture-led delivery. In addition, by using enquiry based learning students were placed in a position where they had to investigate a particular issue and construct their own understanding based on their own knowledge and skills base.

This study examined the impact of EBL on 2 undergraduate year groups and thus, the conclusions that can be drawn are tentative. Further research is needed that examines the student experience of EBL across all years of undergraduate study. A study of this nature would provide practitioners with information regarding potential best points to integrate EBL with groups new to this method and may also be able to elucidate any link between EBL and approaches to learning in the context of the demands of undergraduate study. They appeared to be more resistance to EBL from Year 2

students compared to their Year 1 peers. As this was the first exposure to EBL for both groups this raises the issue of the timing of EBL intervention. Based on this study Year 1 students, who had not experienced traditional University teaching, felt more positive about EBL than Year 2 students who had previously experienced lecture-led delivery as part of their first year of undergraduate study. It may be that timing of EBL is important in 'switching students on' to constructing their own learning rather than simply memorising information for assessment purposes. Examining the most effective time to introduce EBL into an undergraduate curriculum would be beneficial for practitioners as would an examination of the relationship between actual academic achievement and learning and teaching methods. This could provide an explicit rationale for inclusion of EBL at a particular point in undergraduate teaching. Likewise, the impact that EBL has on academic self-efficacy appears to be a relatively untapped area of study.

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