

UNDERGRADUATE STUDENTS' PERCEPTIONS OF A PROBLEM-BASED LEARNING BIOMECHANICS MODULE

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The purpose of this study was to explore student perceptions of problem-based learning and provide recommendations for practice. Five students enrolled on a 2nd year sports biomechanics module at a UK institution participated in semi-structured focus groups at the mid- and endpoints of the module. Thematic analysis, with an inductive focus, identified themes related to successes, challenges and recommendations. Successes included intellectual development, teamwork and inclusivity. Challenges included uncertainty, engagement and retreat in intellectual development. Recommendations were integration of some traditional methods and choice of assessed problems. Educators can be confident that problem-based approaches can develop desired skills for practice but should be conscious of their students' stage of intellectual development.

KEYWORDS: intellectual development, recommendations, higher education

INTRODUCTION: Developing biomechanics skills within a sports science degree can be challenging, given students' perceptions of physics (Breen & Knudson, 2022). Biomechanics educators need to develop effective teaching strategies to develop theoretical and applied skills in sports biomechanics. A high proportion of university lecturers teaching sports biomechanics throughout the world are familiar with active learning strategies (Breen & Knudson, 2022). One advanced active learning strategy is Problem based learning (PBL), which challenges small groups of students to define and solve real-world problems using knowledge and data. PBL has been demonstrated to improve intrinsic motivation (Martin, West & Bill, 2008), provide autonomy (Miller, Maiti & Besterfield-Sacre, 2017) and develop critical thinking (Mandeville & Stoner, 2015). PBL has also been demonstrated as effective in developing students with respect to Perry's model of intellectual development (Zhu et al., 2019). PBL can be an effective method for teaching sports biomechanics (Wallace, Knudson & Gheidi, 2020), but may be challenging to implement based on student motivation and the difficulty in defining effective problems (Benson, 2012).

Our UK-based institution includes a problem-based learning module that is delivered at the 2nd year undergraduate level across multiple three-year degree programmes within the sport sciences. Prior to this module, the students have completed a year-long module in functional anatomy and biomechanics that covers a broad range of concepts. Over the course of the 12-week module, students complete three practice case studies. Each case study presents an athlete scenario, with realistic data. Students must critically appraise the literature, and propose solutions to problems, facilitated by an understanding of data and data collection techniques within biomechanics. Students work in small, self-selected groups on three practice case studies, leading to a final assessed case study, completed individually. Although biomechanics pedagogy is developing as a field of research, there is currently limited information about the ongoing experiences of students whilst undertaking a biomechanics module that adopts PBL as its pedagogical design. It is in this context that the aim of this study is twofold. Firstly, it aimed to explore sport undergraduate students' perceptions of the successes and challenges experienced whilst engaging on a Biomechanics PBL module. Secondly, it aimed to identify recommendations to guide the development of PBL modules.

METHODS: Upon Institutional Ethical approval, a purposive sampling strategy was used to select participants. More specifically they were required to be enrolled in the second-year biomechanics module and willing to complete reflective logs and/or focus groups during the study duration which was aligned to the module duration (i.e., 12 weeks). In total fourteen students (8 male, 6 female) provided voluntary consent for their reflective logs to be used for the study and eleven for taking part in focus groups. Of these, five students participated in the focus groups, representing three of the PBL groups. The total sample represented 26% of enrolments on the module (24% of males, 32% of females).

Each participant was requested to keep a reflective log (similar to De Martin Silva et al., 2015) during the 12 weeks. The focus was on capturing ongoing perceptions of the use of a PBL approach within the module, one that could be tracked and explored further in focus groups. The focus groups were semi-structured in nature, following a similar structure to De Martin Silva and Francis (2020), providing room for further prompting and the collection of rich data. The key areas focused upon were student conception of PBL, successes, challenges and recommendations. The focus groups were facilitated by a biomechanist who was not involved in the module. The purpose of this was to make the students feel more comfortable and promote more honest responses that may not have been forthcoming with the module leader, whilst retaining subject knowledge. Focus groups were in-person and recorded using Microsoft Teams and were then transcribed. Both the reflective logs and focus groups were analysed using thematic analysis (Braun, Clarke & Weate, 2016). This way of analysis provides flexibility and is in alignment with the interpretivist paradigm in which this study is situated. It also allows for an inductive and 'latent' focus when analysing data "where you code and develop analysis around more implicit ideas or concept that underpin what's explicitly expressed" (Braun, Clarke & Weate, 2016, p. 193).

RESULTS AND DISCUSSION: Six themes were conceptualised based on the data and the aims of the study which are presented in Table 1. Trustworthiness was accomplished by using triangulation and peer scrutiny of data, with two of the researchers completing the data analysis separately and later agreeing on themes.

The successes of the approach (Table 1) support and challenge existing evidence on the use of PBL. Group work has been cited as an issue (Benson, 2012) and we faced similar challenges, however, groups that are able to delegate tasks and maintain motivation can have a positive experience. The development of critical skills (Mandeville & Stoner, 2015) and intellectual development (Zhu et al., 2019) have been previously identified. Within Perry's model students' progress through stages from a dualistic way of thinking (where knowledge is absolute and they rely on the Authority for the right answer) to relativism and commitment where they are more comfortable with the contextual and uncertain nature of knowledge as well as accepting their role in its creation (De Martin Silva et al., 2015; Perry 1970). The students who participated were receptive to this development, but it should be acknowledged that it is unlikely that all students may be. Some participants also appreciated the opportunity to reflect on their learning, knowledge gained, and the strategies used. It was suggested that more time for this would be beneficial.

Interestingly, intellectual development was also a challenge, along with uncertainty and burnout. The students within the focus groups were positive towards PBL and delivery, but still found it initially 'traumatising' (participant 3), whilst others were concerned about the lack of revision materials and being wrong. Despite the students indicating their intellectual development when discussing the positive aspects of PBL, they seemingly retreated to a more dualistic perspective (right vs wrong) when challenged, which reflects that students may shift positions within Perry's model (De Martin Silva et al, 2015). A further challenge was burnout, with most admitting to declining motivation towards the end of the module. Motivation has been cited positively (Martin, West & Bill, 2008) and negatively (Benson, 2012) and is likely to be dependent on the student and context.

The students provided several recommendations within the focus groups. A common theme was including some more traditional teaching elements. This may reflect that students can retain uncertainty throughout the module, despite also claiming to be more comfortable about the PBL process and what they need to do. The theme of burnout towards the end of the module, led some students to identify the number of problems as an issue and led some to suggest that having some choice over which ones to write up for assessment or reducing the number of problems would aid motivation. Burnout has generally been more strongly associated with traditional methods (Al-Jehani et al., 2020), but the stage that PBL is introduced may be a factor (Duncan & Lyons, 2008).

Table 1: Themes from the focus groups and relevant quotations.

General Dimension	Themes	Example Quotes
Successes	Group work	P2: We all delegated roles that should be done week to week, so it's a very clear expectation... The group environment is good if you've got the right group.
	Intellectual development	P3: I feel like I've really grown... like being really like, yeah, critical... gathering literature and then being able to apply it to a certain individual, I think that's just really great.
Challenges	Uncertainty	P2: When it comes to like revision, there's nothing really to look back on other than our answers to the questions. P1: And if we've been wrong the whole time, we're going to be wrong for the assessment.
	Intellectual development	P1: I think that some people find it hard where he's not spoon feeding you with information.
	Burnout	P3: I'd lost sort of a bit of momentum after Easter
Recommendations	Content structure and	P4: maybe like a weekly, like a one-hour lecture... just so you have notes to look at.
	Control	P3: (having choice) gives you motivation...

The limitations of this research are that more motivated students likely participated in the focus groups and there was a small sample size. The interpretivist paradigm used means the student experiences are situated within their own context and are potentially more applicable to other UK universities, but this specificity is also a strength. Further work is needed to understand to what extent PBL is transformative regarding intellectual development. Nevertheless, we have identified common themes that other educators can apply to own practice. The results support previous research on the benefits and challenges of PBL and may be meaningful, despite the small sample size.

CONCLUSION: Educators in sports biomechanics seeking to adopt an approach using PBL case studies may find that students describe uncertainty and frustration in the initial stages, although some may also feel empowered and recognise the value in developing skills that may develop them as practitioners. That some students retreat to dualistic ways of thinking may not be surprising, given that fundamental biomechanical concepts, e.g., laws of motion, are presented as such. Empowering students to express opinions on a case study and current literature, modelling strategies for learning and encouraging reflection are methods that can promote intellectual development and students understanding of biomechanics. Educators developing the next generation of biomechanists can be confident that PBL will develop a range of relevant skills but need to be conscious of their students existing intellectual development and be responsive to the reported challenges.

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ACKNOWLEDGEMENTS: We would like to thank the students that participated.