0669

'Strengthening the link': Student teachers' knowledge of biomechanical principles of movement and its application to teaching

Will Katene, Victoria Stiles
University of Exeter, Exeter, Devon, United Kingdom

Background

Student teachers start their Postgraduate Certificate in Education (PGCE) Physical Education (PE) courses with a multiplicity of sports-related undergraduate degrees, which makes it difficult to ensure that they have adequate subject knowledge to teach all areas of activity of the National Curriculum for Physical Education (NCPE) (Reeves, 1993; OFSTED, 1999; Capel & Katene, 2000). In addition, the theoretical or scientific nature of many sport-related degrees does not prepare them for the practical teaching of PE in secondary schools. Raymond (2006) reported that there was limited evidence of both PE student teachers and PE teachers making explicit reference to principles underpinning movement skills/actions in their planning and teaching in schools (Raymond, 2006). Given the concerns regarding student teachers' limited subject knowledge in a range of practical activities comprising the NCPE, one solution worth exploring is strengthening the link between student teachers' theoretical or scientific knowledge (gleaned from their first degree) and its application to the teaching of a range of physical activities within the PE curriculum, specifically, student teachers' knowledge of biomechanical principles of movement.

Biomechanics involves the application of mechanical principles (involving elements of mathematics and physics) to biological systems for the purposes of improving sports performance and reducing the risk of injury (Bartlett, 1997). Knowledge of biomechanical principles will help prepare the PE teacher to teach effective motor skills and sports techniques, prevent injury and evaluate the effect of exercise and physical activity on the human structure (Wells & Luttgens, 1976; Hamill & Knutzen, 2003). Skilled qualitative analysis involves the teacher or coach observing performance and providing immediate feedback to the pupil/player without the need for sophisticated observational and numerical methods of assessment. Making the link between biomechanical principles (theory) and application of these principles (practice); or as Knudson (2007) states, turning 'science into coaching', is an important skill to master (OFSTED, 1999; Raymond, 2006). Currently, there is no evidence to suggest that PGCE PE courses offer student teachers (who may not have studied biomechanics at degree level) the opportunity to improve their subject knowledge through applying biomechanical principles of movement to practical teaching situations.

Research Questions

The present study examined the effectiveness of a Principles of Movement (PoM) module designed to improve and strengthen the link between student teachers' knowledge and understanding of biomechanical principles and its application to the teaching of a range of physical activities comprising the NCPE. It was hypothesised that student teachers' knowledge and application would improve at the end of the four-week PoM module.

Methods

A test consisting of 15 questions eliciting respondents' knowledge of biomechanical principles of movement and its application to physical activities was created based on a diagnostic test previously used by Dixon (2005) and interpretive styled questions (recall and application of relevant conceptual information to a particular problem/setting without involving mathematical procedures) described by Galbraith and Haines (2000).

The test was administered on two separate occasions (pre and post module), to 54 student teachers undertaking a one-year PGCE PE Course at one university in the southwest of England. Mean test

scores were calculated for pre and post-module assessments. Paired t-tests were used to determine whether changes in mean test scores were significant between pre and post module assessments ($p<0.05$).

Normal informed consent and ethical procedures were followed and conformed to the guidelines of the University with which the study took place.

The PoM module consisted of a one-hour introductory lecture outlining some key biomechanical principles underpinning sports performance (e.g. angle of release, release/take-off velocities, stability, centre of gravity, kinematic/kinetic chain, angular-linear motion relationship, moment of inertia and angular momentum). In groups of two or three (peer collaboration), student teachers then self-selected and prepared a teaching task (with tutorial support) over the following week and delivered their 10-minute teaching episode in either week 3 or 4 on at least four occasions to a rotating group of learners. The teaching task required selected principles of movement to be outlined and taught with respect to either one or two sporting techniques.

Frame

The form of peer collaboration used to deliver this module, is defined as an instructional practice which brings two or more student teachers and their expertise together to acquire, construct, apply and reflect critically on new knowledge, skills and instructional practices to meet the diverse needs of learners (Katene, 2009). In the context of Initial Teacher Education (ITE), numerous studies, particularly from a Vygotskian perspective, have demonstrated the favourable role of peer collaboration in acquiring, understanding and applying new knowledge and skills (for example, Neubert & McAllister, 1993; Williams, 1996; Katene & Faulkner, 2003). Peer collaboration is rooted largely, although not exclusively, on Vygotsky's (1978) social constructivist theory of learning which argues that individuals are introduced to new patterns of thought and new understandings by interacting and engaging through dialogue with others.

Research findings

An analysis of pre and post-module test scores found that the short four-week PoM module enabled student teachers to significantly increase their test score (mean improvement of 6.8 %, ± 7.8, $p<0.05$). Specifically, 74% of students (40/54) showed a positive increase in their overall test score. This was considered to reflect an improvement in student teachers' application of subject knowledge, specifically, principles of movement.

The aims of the PoM module have been achieved, however, some areas are in need of further and sustained improvement. For example, administering an additional test at the end of the PGCE year would assess the sustainability of the improved test score seen here in this pre and post-module assessment. Implications for student teachers and teacher educators are also discussed, for example, the question of whether university tutors should share their knowledge and understanding of the subject/biomechanical principles of movement to all school-based and university-based teacher educators. This could be achieved through a one-day workshop in order for these principles of movement to be discussed, understood and integrated fully into ITE PE courses. This exploratory study will form the basis for the development of a larger scale evaluative study.

References

Bartlett, R. (1997). Sports Biomechanics. Reducing Injury and Improving Performance. London: E & FN Spon.

Capel, S. and Katene, W. (2000). Secondary PGCE PE students' perceptions of their subject knowledge. European Physical Education Review 6(1), 46-70.

Dixon, S. (2005). Diagnostic assessment of preparedness of level one sports science students for biomechanics modules. International Journal of Mathematical Education in Science and Technology 36(1), 49-63.

Galbraith, P. and Haines, C. (2000). Conceptual mis(understandings) of beginning undergraduates, International Journal of Mathematical Education in Science and Technology 31(5), 651-678.

Hamill, J. and Knutzen, K.M. (2003). Biomechanical basis of human movement. London: Williams and Wilkins.

Katene, W.H, and Faulkner, G.E.J. (2003). Peer teaching: A case for collaborative learning between trainee teachers. British Journal of Teaching in Physical education, 34(3), 45-47.

Katene, W.H. (2009). Two heads are better than one: Collaborative learning and teaching in initial teacher education. Paper presented at the ECER (European Conference on Educational Research) Annual Conference, University of Vienna, Austria.

Knudson, D. (2007). Qualitative biomechanical principles for application in coaching. Sports Biomechanics 6(1), 109-118.

Neubert, G.A. and McAllister, E.A. (1993). Peer coaching in preservice education. Teacher Education Quarterly 3: 77-84.

OFSTED (Office for Standards in Education) (1999). Secondary initial teacher training: Secondary subject inspections 1996-98 overview report. London: HMSO.

Raymond, C. (2006). Keynote. Presented at the Physical Education Initial Teacher Training (PE ITT) Network Conference, Northampton, UK.

Reeves, S. (1993). National curriculum council in association with CATE and SEAC subject specific conferences on the national curriculum and initial teacher training (secondary). Spring term 1993, Bulletin of Physical Education 29(2), 53-58.

Vygotsky, L. (1978). Mind and society. Cambridge, MA: Harvard University Press.

Wells, K. and Luttgens, K. (1976). Kinesiology: Scientific basis of human motion. Toronto: Saunders.

Williams, A. (1996). Teaching physical education: A guide for mentors and students. London: David Fulton.