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**Evaluating the use of problem-based learning
in a new initial teacher education degree**

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Abstract

This paper discusses research conducted to explore student perceptions of problem based learning (PBL) as used in a concurrent degree programme of primary teacher education in Scotland. The research sought to understand the extent to which problem-based learning supported students to make links between educational theory and professional practice. This was of particular interest given that a theory-practice divide is attested to in the literature on initial teacher education. The study concludes that the majority of the students who took part in the research perceive that PBL enables them to make links between theory and practice. However the construction of the PBL scenarios is important in supporting them to do this, as is the reflexive aspect of the PBL approach.

Keywords

Problem based learning; initial teacher education; dialogic learning; enquiry.

Introduction

Since its inception in medical education, problem-based learning (PBL) has been used in various disciplines to encourage higher order thinking about issues that reflect the complexities encountered by practitioners in the field (Mishan, 2011). Its use in higher education is now widespread in medical, dental and legal education (Kwan, 2009) and, increasingly, in teacher education (McPhee, 2002). PBL 'represents a major, complex and widespread change in educational practice within higher education, especially in professional education' (Dolmans et al., 2005: 732). Use of problem-based learning entails presenting subject and/or domain specific scenarios which centre on issues to which students respond. Problems may be presented in various ways, the essential attributes being authenticity and having a complex, ill-structured nature in order to simulate realistic practice situations (see Hmelo-Silver and Eberbach, 2012). From this simulation the processes that contribute to effective professional decision-making can be discussed, enacted and reflected upon (De Simone, 2008).

This paper discusses the use of problem-based learning in a programme of initial teacher education. The MA in Primary Education (MAPE) is an undergraduate four year concurrent programme developed in 2008. It is taught at the University of Glasgow (in the School of Interdisciplinary Studies). Student feedback has regularly shown high levels of satisfaction with teaching and learning on the various constituent elements of the programme, including those taught using PBL. The researchers were concerned to explore MA students' perceptions of PBL and whether or not it enabled them to apply theory to practice. This was an area of particular interest given that the issue of perceived lack of fit between theory and practice in teacher education is well documented in the research literature (De Simone, 2008; Hodson et al., 2012).

Literature review: PBL, policy and practice in initial teacher education

Problem-based learning is a pedagogic approach positioned within constructivist theories of learning

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(Mishan, 2011), and constitutes a range of interventions employing various approaches to pedagogy and content development (Kwan, 2009; Schmidt et al., 2009). PBL approaches aim to provide opportunities for meaningful dialogue and interaction between students while fostering an enquiry-based approach to practice (De Simone, 2008). Individual reflection and social interaction are required since most PBL activities are presented to small groups for discussion (Mishan, 2011, 255). The dialogic and enquiry-based nature of PBL should encourage the mediation of students' intellectual and professional development (Kwan, 2008). Through PBL, students are encouraged to engage in theory-building (Dolmans and Schmidt, 2006: 327), a specific aim being to enable integration of new knowledge with existing understandings and broader experiences (O'Neill et al., 2006). As a result, cognitive conflict may occur, but it is hoped that this will lead to conceptual change (Dolmans and Schmidt, 2006).

Claims for the effectiveness of PBL in enabling theory-building and knowledge integration are important because the literature on teacher education consistently highlights students' difficulties in linking theory with practice (Ure, 2009: 47). Evidence indicates that students believe the academic content of their initial teacher education is of least help in preparing them to teach (Ure, 2009: 27). Indeed, some recent reconceptualisations of teacher education towards school-based training (Ellis, 2010; Griffiths, 2007) have tended to privilege 'practical components to the detriment of theory and analysis' (Hodson et al., 2012: 181). Use of PBL in initial teacher education takes place in a context where the current coalition government in the United Kingdom 'asserts a simplistic depiction of the student teacher developing practical skills in school and subject knowledge in the university' (Hodson et al., 2012: 182). Of course, there is a range of ITE provision in England: partnership between schools and universities takes a variety of forms and new forms of collaboration have been developed (see Furlong et al., 2006). However, there has been a tendency for recent education policy in England to shift towards models of teacher education that distance teacher education from the university components (Menter, 2013; Hodson et al., 2012). Following the Donaldson Report for the Scottish Government (Donaldson, 2010), this tendency is also occurring in Scotland (see Hulme, 2013: 84).

While there may be scant evidence that one model of teacher education is more effective than any other (Ellis, 2010), policy positioning of teaching as predominantly craft-based (Menter, 2013) may exacerbate student ambivalence towards theory (Smith and Hodson, 2010). This is of concern because teacher education in Scotland had moved from a training model of skills acquisition 'towards providing opportunities aimed at promoting sophisticated thinking about teaching and learning' (Patrick et al., 2010: 278). Despite this, students and newly qualified teachers in Scotland have not been necessarily more able to connect theory to practice than those in other countries. O'Brien and Christie's research (2005) indicates that a prevailing culture of regarding teaching as a set of craft-based skills rather than as a theorised profession remains evident in the instructional support received by new teachers via continuing professional development (CPD). This situation perhaps mirrors issues in the broader culture of schools and local authorities (O'Brien and Christie, 2005). However, it has been argued that the practice of generic craft-based skills is not enough to constitute teacher expertise (Shulman, 1986; Diekema et al., 2011; Martyn et al, 2013). Problem-based learning, because it emphasises both scholarship and teaching experience, can support beginning teachers to blend theory with practice (De Simone, 2008: 187) while evolving sophisticated evidence-based strategies to enhance teaching and learning in the classroom.

The development of expert professional knowledge tends to occur when the knowledge is situated and transformative of individual thinking and abilities (Diekema et al., 2011). PBL has the potential to provide opportunities for such transformation, and can act as a 'bridge' between university work and placement experiences (Barrett, 2013). PBL offers the opportunity for students to 'explore and implement ways of enabling students... to work on real-life problems... and to follow through with

the professional action required to resolve these problems' (Barrett, 2013: 532). PBL can also be used to support students to develop the professional 'habits of mind' that encourage the evaluation and synthesis of theory and research necessary to inform practice in an evidence-based profession (Tang et al., 2012: 438).

At its most effective, PBL offers an encouraging space to explore, expand on, and challenge beliefs (Barrett, 2013: 522). Barrett (2013: 533) mentions the importance of threshold concepts to student teachers' learning and links these to the idea of 'liminal space'. Liminal phases in learning occur when there is a process of transition in students' understanding of knowledge and concepts (Wood, 2012). Threshold concepts are those that are difficult and initially 'troublesome' (Meyer and Land, 2005), and are found particularly in learning to teach because teacher education constitutes a 'complex analytical and integrative enterprise' (De Simone, 2008: 187). Even where threshold concepts are openly explored, it can be difficult to modify the initial preconceptions about teaching that students bring into ITE courses (Tang et al., 2012: 436). PBL may help to increase students' tolerance for ambiguity (Landeem et al., 2013: 280) as they make sense of new understandings and how these might be used in the classroom to support pupil learning.

There are caveats to the use of PBL, however. Claims for the effectiveness of PBL can be difficult to support with research evidence (Schmidt et al., 2009). For example, it has been proposed that PBL promotes deep learning through student-centred and self-directed learning processes (Loyens et al., 2013: 23). In contrast, some studies suggest that no significant shifts take place in students' ability to undertake deep learning through using PBL (Loyens et al., 2013). PBL does not seem to enhance acquisition of factual knowledge (Van Blankenstein et al., 2013) but in terms of recall of elaborated knowledge PBL may have some positive influence (Dochy et al., 2003: 545). Challenges identified by Dolmans and Schmidt (2006) from the PBL literature include mini-lecturing rather than student-led learning, dysfunctional group dynamics, lack of content expertise in tutors, overly quiet or overly dominant group participants, disorganised tutorial processes, and student absenteeism.

PBL and the MA in Primary Education

Programmes of initial teacher education in Scotland are broadly similar to those in the rest of the United Kingdom: teachers wishing to practise in primary schools pursue either a one year post-graduate course of initial teacher education, or a four year undergraduate course. In Scotland, initial teacher education is focused on students achieving the Professional Standards for Registration (General Teaching Council for Scotland, 2012). These standards incorporate the Standard for Provisional Registration (gained on successful completion of a teaching award) and The Standard for Full Registration (gained on successful completion of the one year probationary period).

On the MA in Primary Education, students study education as an academic discipline as well as engaging in school experience. They choose academic electives from courses in environmental sustainability, health and social policy, or the humanities. The education elements of the programme are based on substantial inputs in literacy, numeracy, pedagogy, curriculum and assessment, teacher professionalism and the wider contexts for learning. Students also study four modules focused on principles of child development from birth to adolescence. It is in the child development courses that problem-based learning techniques form the core approach to learning and teaching, although PBL is used throughout the education-led components of the degree programme.

The use of problem-based learning is designed to enable students to make strong and immediate connections between the theoretical aspects of learning and professional practice in the classroom. Prior to each two hour seminar, students are encouraged to undertake professional reading and research. A seminar begins with students chosen from the class presenting their critical review of literature on the topic for the week. This is followed by a lecture input from the class tutor lasting

around 40 minutes to highlight some of the key issues around the topic area. Students are then given scenarios for discussion and analysis. These scenarios are created by staff drawing from their prior experiences in teaching, and from research literature. Tutors depersonalise, anonymise and fictionalise scenario content. They then refer to the process as engaging with issues-based learning (rather than problem-based learning). This term is used in order to avoid any sense that pupils, parents or school staff should be viewed as problems. Students are encouraged to connect with issues and to see their responses to these issues as being focused on how they can create effective learning environments for their pupils.

Research design, methods and limitations

The research set out to explore the following research questions:

1. To what extent do students perceive PBL to be an effective teaching and learning approach when compared with other approaches?
2. Do students perceive that use of PBL helps them to apply professional theory to professional practice?
3. What are the advantages and disadvantages of PBL as a learning and teaching method?

To gather data, a questionnaire was administered to all students in the MA programme (N=103). Participation in the research was voluntary. The questionnaire was completed with no researcher or lecturer present, and the following returns were made: Year 4 – 12 (86%); Year 3 – 9 (38%); Year 2 – 15 (48%); Year 1 – 17 (50%). The total response was n= 53 (51.4% of the student cohort). For questions 1-8, respondents were asked to choose one category from a 5 point bipolar (Likert) scale (rated from strongly agree to strongly disagree). Frequency scales are most appropriate when respondent opinion or perception is the focus of the data collection (Rattray and Jones, 2007) as was the case in this study. Further data were then gathered using free text boxes.

To contextualise the empirical data, an integrative literature review (Daley et al., 2010) was carried out to explore existing theory and research regarding problem-based learning in higher education. The review of literature was conducted following the schematic offered in Sylvester et al. (2013) for the searching, mapping, clarification, and appraisal of literature in order to identify which texts were of relevance to the study. A qualitative analytic approach was then used in the reading of relevant texts to identify the conceptual framework which supported the initial categorization of theories and issues (see Rocco & Plakhotnik, 2009: 121).

Ethical clearance for the research was given by the School of Interdisciplinary Studies. The research was designed and carried out following the ethical guidelines published by the British Educational Research Association (BERA, 2011) and the University ethics policy. Participants were included only once informed consent had been gained. Participant anonymity was guaranteed as far as possible, the only identifying characteristics being the naming of the degree programme in publications arising from the research and the identification of the year group to enable comparison of perceptions across years one to four.

Given that the study is small-scale and based on the perceptions of a cohort of students on one degree programme, no claims to generalisability can be made. In addition, the research focuses on one instrument only: this gives rise to methodological limitations in terms of triangulation of data. While we have confidence in the rigour of the research instrument and therefore the validity of the data generated (particularly in light of the richness of the qualitative data obtained), this does limit the nature of the research claims. Further study is intended to enable fuller understanding of student perceptions of PBL on this programme as well as exploration of the dialogic elements of student interactions during PBL sessions.

Discussion of findings

Analysis of frequency distributions from the Likert scale responses indicates that students perceived that:

- PBL had helped them to understand important points during sessions (88%: Strongly agree/Agree);
- PBL sessions had helped them to feel motivated during the course (81%: Strongly agree/Agree);
- Working with other students in the group sessions was enjoyable (96%), (although 9% indicated that group work could be distracting).

Specific aspects of student perceptions were identified through thematic analysis of the qualitative data. The data analysis will be presented around three themes: perceptions of PBL effectiveness; theory and practice alignment; and perceived challenges associated with the use of PBL.

Perceptions of PBL effectiveness

The first research question explored the extent to which students perceive PBL to be an effective teaching and learning approach. Respondents outlined a range of teaching and learning areas where effectiveness was evidenced. They indicated that PBL was effective in fostering specific abilities such as: a flexible approach to problem-solving and the 'ability to explore alternative routes and solutions' (*year 1 student*); group working and collaborative learning skills; communicative abilities; developing a professional vocabulary; creative and independent thinking; organisational abilities; and reflective skills. In addition, students highlighted the effectiveness of PBL in terms of encouraging critical thinking, reading and academic research. One first year student stated that PBL 'encourages you to explore, take risks and investigate with different methods'.

Year 1 students noted a broad set of interpersonal and affective skills as being developed by PBL. For example, they highlighted the positive effects of PBL on their confidence, engagement and resilience, particularly in 'dealing with unfamiliar situations' (*year 1*) and in developing 'empathy for others' (*year 1*). Years two to four tended to highlight the development of a cluster of skills related to problem-solving and being able to provide deep rather than surface explanations. The development of such skills is a core aim of problem-based learning, so these responses perhaps should not come as a surprise. Hmelo-Silver and Eberbach (2012) note that PBL can be particularly effective in supporting students to apply appropriate metacognitive and reasoning skills to professional learning. It will be interesting to explore further why students in years two to four highlighted a fairly attenuated set of skills focused on enquiry and research, whereas the first year students highlighted a broader range with less consensus among individuals as to which skills were supported.

The responses from the MA students did not focus on PBL as encouraging the learning of factual knowledge: some students highlighted lectures as a better method for this. Research by Van Blankenstein et al. (2013) suggests that PBL has no positive impact on the acquisition of knowledge: what it can do is to promote activation of prior knowledge acquired through other means (Yew et al., 2011), while encouraging a holistic approach to the application of knowledge in professional contexts (see Groves, 2005). The range of independent and interpersonal skills that the MA students highlight as being developed through PBL may indicate the development of nonlinear rather than linear and rote patterns of learning. Nonlinear learning is characterised by interactivity, interdependence and responsiveness to new information, discussion and feedback (Mennin, 2007: 307). Testing this aspect in order to move beyond tentative indicators will require further research with the student cohort.

Theory and practice alignment

Research question two focused on the extent to which students perceive PBL as being useful in helping them to apply professional theory to professional practice. A consistent theme that ran through the responses for question 3 (on skills development and PBL) was that the scenarios were regarded as useful contexts in which academic theory and professional practice might be linked:

- *'It helps you to see yourself as a real teacher and think about what you would do rather than just reading about what we are learning and not its application to schools'. (Year 3).*
- *'I think it allows you to put your theory into practice – gives you opportunities to discuss theorists in a teaching context'. (Year 4)*
- *'[PBL] helps develop strong links between theory and practice'. (Year 4)*
- *'[PBL] makes you think of ways to use the knowledge you have gained'. (Year 1)*
- *'[PBL gives] confidence and ability to build strategies to improve learning'. (Year 1)*

Explicit statements on the link between theory and practice were more evident in comments from students in years 2-4 than in those from first year students. In terms of how theory had related to practice, students in years 2-4 outlined that it had helped develop: knowledge of classroom practices and how to see learning from a pupil's point of view; understanding of individual pupil needs and how to support children's learning; knowledge about school structures and management issues; and the ability to embed their own learning in classroom practice.

The more a PBL scenario presented what students perceived to be strong and relevant issues, the more they tended to rate it as being effective in terms of supporting theory-practice alignment. Scenarios which had a significant impact were those focused on (fictional) pupils requiring additional support for learning (Down's Syndrome, Autism spectrum disorders, partial sightedness, and high ability). The child protection scenario was also noted as having had impact. First year students were affected particularly by this aspect of the teacher's work: many of them were unaware of the stressful and important nature of issues relating to child protection.

The scenario writing requires careful crafting to ensure that issues are discussed in a way that highlights the open-endedness of responses and mirrors the complexities inherent in teaching situations. However, there is a danger that PBL may lead to a focus on 'solving' immediate problems to generate 'quick, self-sufficient solutions' (Schechter, 2010: 151) rather than supporting long-term strategising. Schechter argues that this occurs because PBL tends to 'perpetuate hypothetico-deductive reasoning' towards the end of efficient, stable 'solutions' (Schechter, 2010: 152). In our experience, this danger can be mitigated by effective tutor-student interactions to move students away from regarding the scenario content as a presentation of problems to be solved, towards seeing the issues presented as indicative of complex individual and social contexts for learning. Effective teaching – and effective teacher education – represents the meshing of sophisticated pedagogic understandings and skills (De Simone, 2008). Inasmuch as this makes learning to teach a difficult endeavour, it also affords opportunities for rich discussion about the nature of learning and teaching and of the student's role in supporting children to learn. Problem-based learning can support such rich conversations because of 'its emphasis on both scholarship and teaching practice' (De Simone, 2008: 187), and because it allows for mediation of intellectual development through enquiry and discussion (see Kwan, 2008).

Challenges

The third research question explored the perceived advantages and disadvantages of PBL. A significant number of advantages was listed, but when analysed these were found to cluster around: support to put theory into practice, developing professional skills such as organisation and team-working, support to develop research-led approaches to learning, and critical thinking/analysis.

Despite clear overall support for PBL, there were important challenges associated with its use. One challenge centred on the variable abilities of lecturers to lead and analyse the PBL discussions. This was a significant feature of the comments from students in year two, but was not raised by students in years one, three or four. Tutor skills are crucial to the effectiveness of PBL (Martyn et al., 2013: 2). The quality of student learning during PBL depends on rich instructional scaffolding (Schmidt et al., 2009) within which it is important for tutors to use open-ended metacognitive questions (Yew et al., 2011). Tutors should 'balance and integrate' facilitation with content expertise and input in order to maximise the effectiveness of PBL as a learning strategy (Cunningham et al., 2006: 259).

Another perceived challenge attracting significant comment included the time consuming aspect of PBL, with the amount of time and effort put in 'not always [being] acknowledged' (*year 1*) or 'appreciated or evaluated' (*year 1*) in class or assessments. Another first year commented that 'time demands equate to lazy last minute efforts'. The issue of time was a significant feature of comments from year one students, but was not raised as a particular issue in the other year groups. In addition, the variable quality of group interactions was highlighted by students in years two and four, especially if groups became 'dysfunctional' (*year 2*). For example, the inability of some students to work constructively or in a concentrated manner in discussion groups was a consistent aspect of the responses:

- *'some do not contribute to discussions' (Year 2)*
- *'some people dominate situations' (year 4)*
- *'sometimes fellow classmates can be distracted into chatting rather than staying on-topic' (year 4).*

This was not raised as an issue by students in year three, who mentioned fewer challenges with PBL as a method than did the other year groups. Kumar and Refaei (2013) note that some students might be reluctant to take an active role in group work because they expect university courses to use didactic forms of learning. Others may have difficulty identifying issues from PBL scenarios, or may analyse the scenarios without moving beyond simplistic assumptions (Kumar and Refaei, 2013).

Issues identified with group functioning in this study accord with those highlighted in the literature (see Dolmans and Schmidt, 2006), and attest to the importance of effective group interaction. During PBL activities, knowledge is co-constructed and 'distributed in the social system' through group working (Tang et al., 2012: 437). Rowan et al. (2009: 218) discuss the issue of student perceptions of learning quality in PBL to be dependent on the group: frustration results if individual contributions are perceived by some group members to be of poor quality. Mennin (2007: 306) considers each PBL group as a complex system. There may be a tendency in higher education for tutors to practice group work without sufficient attention to the complexities of group interactions and the sophisticated social skills sometimes required to negotiate challenging group dynamics. In addition, Dolmans and Schmidt (2006: 330) mention that it can be problematic if students appear to be actively involved during group discussions but are contributing only on a surface level. A further issue can arise if all learners are at the same level with limited or no expert input. In this case, discussions during PBL will not be as effective as they could be with fuller scaffolding and expert input into debates (Dolmans and Schmidt, 2006: 217).

Some MA students also stated that scenarios could be unrealistic, or too generic, and could fail to introduce new knowledge. Further challenges were perceived to be that PBL 'works against spontaneity' (*year 1*), and can be repetitive or used too much (*year 2*). As Reynolds and Hancock (2010) state, lectures do not always facilitate creative thinking and problem-solving in students, but it must also be acknowledged that sole use of PBL for course delivery can be limiting. Kwan (2008) argues that using PBL as the only or main method of teaching is too constraining for students who

need to access a range of learning approaches and methods in order to have a holistic and effective learning experience. Rowan et al. (2009: 217) advocate a balance on courses between PBL and lectures.

Rowan et al. (2009) also note the importance of the practice environment aligning with the critical approach taken in university: it is crucial that time and space is given for the questioning and enquiry approaches used in PBL to be continued while on placement (Rowan et al., 2009: 219). One reason for the perceived success of the PBL on this programme may relate to the careful matching of course content to the nature of the school-based placements. A feedback loop (see Barker and Pinard, 2014: 3) is enabled on the programme because the tutors who teach the course have both subject and pedagogic expertise and are the same tutors who visit the students while they are on placement. Feedback is therefore more likely to focus on dialogues about learning and professional enactment designed to enhance future learning. There is thus an iterative dimension (Barker and Pinard, 2014) to the teaching and learning between the university and school contexts that enables students to reflect on their placement experiences during PBL sessions, and to reflect while on placement on the knowledge gained from university components.

Conclusion

Evidence from this small scale study indicates that PBL can support students to relate theory gained during university components to school-based periods of practice. PBL was perceived as an effective method of teaching and learning by the student participants. However, the study is limited by its scale and by the reliance on self-reporting of perceptions, with the result that further research is needed to enhance knowledge of the ways in which students engage with PBL. The next stage of the project will invite students to take part in focus groups to explore in depth their perceptions of PBL and the ways in which it supports (or does not support) learning. In addition, permission will be sought to digitally record discussions during PBL sessions to enable discourse analysis of student/student and student/tutor interactions (see Woodward-Kron and Remedios, 2007; Barrett, 2013). In this way fuller understanding will be gained of the ways in which PBL influences students' professional development.

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