

**UWL REPOSITORY**  
**repository.uwl.ac.uk**

Ask not only 'What can problem-based learning do for psychology?' but 'What can psychology do for problem-based learning?' A review of the relevance of problem-based learning for psychology teaching and research

Wiggins, Sally, Hammar Chiriac, Eva, Larsson Abbad, Gunvor, Pauli, Regina and Worrell, Marcia (2016) Ask not only 'What can problem-based learning do for psychology?' but 'What can psychology do for problem-based learning?' A review of the relevance of problem-based learning for psychology teaching and research. *Psychology Learning & Teaching*, 15 (2). pp. 136-154. ISSN 1475-7257

<http://dx.doi.org/10.1177/1475725716643270>

This is the Accepted Version of the final output.

UWL repository link: <https://repository.uwl.ac.uk/id/eprint/2625/>

**Alternative formats:** If you require this document in an alternative format, please contact: [open.research@uwl.ac.uk](mailto:open.research@uwl.ac.uk)

**Copyright:**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

**Take down policy:** If you believe that this document breaches copyright, please contact us at [open.research@uwl.ac.uk](mailto:open.research@uwl.ac.uk) providing details, and we will remove access to the work immediately and investigate your claim.

Ask not only ‘what can PBL do for psychology?’ but ‘what can psychology do for PBL?’  
A review of the relevance of problem-based learning for psychology teaching and research

Authors:

Sally Wiggins\*, Eva Hammar Chiriac, Gunvor Larsson Abbad, Regina Pauli, Marcia Worrell.

\*Contact details for corresponding author:

Dr Sally Wiggins, School of Psychological Sciences and Health, University of Strathclyde,  
Graham Hills Building, 40 George Street, Glasgow, G1 1QE. Email:  
[sally.wiggins@strath.ac.uk](mailto:sally.wiggins@strath.ac.uk), Tel: +44 (0)141 548 4461

Ask not only ‘what can PBL do for psychology?’ but ‘what can psychology do for PBL?’  
A review of the relevance of problem-based learning for psychology teaching and research

Abstract

Problem-based learning (PBL) is an internationally recognised pedagogical approach that is implemented within a number of disciplines. The relevance and uptake of PBL in psychology has to date, however, received very limited attention. The aim of this paper is therefore to review published accounts on how PBL is being used to deliver psychology curricula in higher education and to highlight psychological research that offers practical strategies for PBL theory and practice. The paper is divided into three sections. In the first, we discuss the principles of PBL and provide examples of how it can be used within psychology curricula alongside a consideration of its advantages and disadvantages. In the second section, we outline the results of a systematic literature review of published examples of PBL used within psychology undergraduate and postgraduate courses. Finally, in the third section, we examine some of the ways in which psychological research can provide practical guidance for PBL teaching practice. We conclude this paper with some recommendations for future research across all these areas, and call for the further development of PBL curricula in psychology higher education course provision.

Introduction

Problem-based learning (PBL) is more than a pedagogical method (sometimes referred to as a didactic approach). It is an orientation to teaching and learning falling under the broad

umbrella of student-centred, enquiry-based or active learning approaches (Barrett, 2005; Hmelo-Silver, 2004). PBL was pioneered in the 1960s in the Medical School at McMaster University, Canada (Barrows & Tamblyn, 1980) and has since then been developed at Aalborg University (Denmark), Maastricht University (Netherlands) and Newcastle University (Australia), as well as being implemented in a number of disciplines and universities worldwide. The fundamental principle of PBL is to equip students with an investigative approach and to develop a greater sense of responsibility for their learning. As the main processes of PBL are rooted in problem-solving, self-directed learning and group interaction, this places psychology very much at the centre of how PBL works and how it may be understood as a teaching and learning approach. Despite this, there is relatively little reporting of how PBL is used in psychology and how psychology informs PBL in published work (see for example, Dunsmuir & Frederickson, 2014; Kiernan, Murrell & Relf, 2008; Norman & Schmidt, 1992). In view of this, a main objective of this paper is to provide a systematic review of published accounts of the ways in which PBL is being used to deliver psychology curricula in higher education, with a second main objective to illustrate the ways in which psychological research can provide a range of principles and strategies that inform PBL practice. In so doing, our overall aim is to summarise the current developments in each of these areas and to stimulate a more robust engagement with PBL in psychology teaching and learning, and in psychological research. We will begin with an overview of PBL and some examples of how it might be applied to psychology teaching across different settings.

### **1. Problem-based learning in psychology in different settings**

PBL is a student-centred pedagogical approach which places open-ended problems rather than defined curriculum content at the heart of learning (Barrows & Tamblyn, 1980; Hmelo-Silver, 2004). A problem in PBL terms is an issue that is investigated, discussed and analysed, which could take the form of a puzzle, a scenario or a case-study (Barrett, Cashman & Moore, 2011). As there are no fixed and final solutions and numerous ways to solve these problems, students can study the same problem but learn different things from their engagement with them. The problems are used to stimulate the learning of students who are normally required to work collaboratively in small groups in order to identify what is 'unknown' about the problem. Students will then conduct individual research to obtain content information, before returning to the group to collectively devise an appropriate response and a possible and plausible 'solution' to the problem. As students are required to actively take responsibility for

what and how they learn, PBL is not simply another method of teaching and relies on a very different philosophical approach to more tutor-centred pedagogies (Dolmans et al, 2001; Savin-Baden, 2000, 2003). It also necessitates a fundamental revision of the roles of students and teachers respectively. The main goal of PBL is to help students become self-directed learners, who are able to seek out, apply and reflect critically on knowledge, especially as this applies to professional contexts (Hmelo-Silver & Barrows, 2006; Hung et al, 2008). Skills such as these form the bedrock of psychological literacy and employability, which are currently being promoted as examples of good practice when embedded in undergraduate psychology provision across the UK (Cranney & Dunn, 2011).

PBL is often imagined as a single general education strategy, but in reality there are a number of PBL models (Barrows, 1986), as can be illustrated by the Aalborg (Kolmos, Fink and Krogh, 2006), Maastricht seven-step (van Berkel et al, 2010) and open-ended PBL (Boud, 1985; see also Davidson & Howell Major, 2014) models, with the former including project-based PBL. These models differ in terms of whether they require a tutor at every session (Maastricht) or not (Aalborg), whether they involve many short problems (Maastricht) or longer projects (Aalborg, and project-based PBL), and whether there are a series of steps to be followed (Maastricht) in terms of guiding collaborative work in groups. There are also variations in how PBL is integrated into curricula, ranging from PBL approaches underpinning a whole programme of study through to the use of PBL in a single module or session. Savin-Baden (2000), when outlining the different models and modes of PBL notes that the decision over which specific model to use will, in part, be dependent on the discipline within which it will be used. Additionally, those disciplines with more specific and clearly defined core curricula may find it harder to adopt more the open-ended approaches to knowledge acquisition and transfer inherent in PBL. This may pose a particular challenge for disciplines such as psychology, due to its very broad yet tightly defined core curriculum areas, and may account for the relatively low uptake of PBL in this area, which is an issue we will return to later in the paper.

### Two examples of PBL in psychology programmes

Despite perceived barriers to implementing PBL in psychology, it has been successfully used on a number of courses. We provide an illustration of this in the following example based on

Linköping University in Sweden, which adopts a whole programme approach to PBL and Strathclyde University in Scotland where PBL is used in a single module.

The Psychologist programme at Linköping University, Sweden was established in 1995 following a tradition of being effectively used within the medical faculty at that university. The student intake is approximately 50 each year, and students are required to work in small PBL tutorial groups throughout their five years of study. The structure and applied nature of the teaching and learning on this programme provides students with an opportunity to understand a range of theoretical and applied psychological issues. The delivery of the social psychology component of the degree at Linköping provides an example of this, where subject knowledge and applied components are interrelated throughout the course in a way that challenges students to apply their psychological knowledge of groups to their own group processes and practices. This process starts with the students deciding on the membership of their tutorial groups (based on their understanding of the roles and requirements of a group), followed by the acquisition of knowledge about group composition and group working, and finally reflection on various group processes and dynamics.

By contrast, the use of PBL in psychology at the University of Strathclyde, Scotland, takes place within a single module over one 12-week semester, in the context of a psychology programme that typically follows a traditional lecture/tutorial structure. The module is a final year option, led by a single tutor, focussing on developing students' understandings of qualitative research methodologies (see Wiggins & Burns, 2009, for more details). The module intake is limited to 30 students and uses the floating facilitator model (with one tutor moving between student groups) to support students working in small groups in the same classroom. Students taking this course are presented with a set of three problems based on theoretical and practical issues associated with the use of qualitative research methodologies that are progressive in terms of the complexity and level of autonomy required. Given that the students had not previously experienced PBL in their psychology programme, the first week of the class is devoted to introducing the approach and using 'icebreaker' activities. The module is assessed using individual written reports. Table 1 summarises the main differences between the use of PBL across these two institutions.

*Insert table 1 here*

In our example we have demonstrated *how* PBL has been employed in very different ways in two institutions. In the following section we turn to the question of *why* PBL should be adopted on psychology courses by examining available evidence on the benefits of PBL approaches alongside a discussion of some of the associated challenges.

### Benefits and challenges of PBL for psychology teaching

A number of reviews and meta-analyses in this area have aimed to examine the effect of PBL on learning outcomes (Norman and Schmidt, 1992, Colliver, 2000, Dochy, Segers and Van den Bossche, 2003, Hmelo-Silver, 2004, Gijbels, Dochy, Van Den Bossche and Segers, 2005) or have reviewed the evidence on the relationship between tutor characteristics and student learning outcomes (Leary, Walker and Shelton, 2013). Such outcome research has mainly focused on knowledge, skills and the self-reported motivation of the students. There is relatively consistent agreement that while PBL does not necessarily improve current problem-solving or team-working skills, there are benefits with, for example, long-term knowledge retention and the ability to make links between constructs including transfer to new problems and real-world contexts (Hmelo, 1998; Hung et al., 2008; Woods, 1996), enhanced skills for long term self-directed learning, independent planning and organisation (Schmidt et al., 2006) and collaboration and team-working skills (Dolmans et al, 2005).

The use of PBL might also be considered as fundamental to the move towards a skills and employability agenda observed in a number of disciplines. For example, in the UK and US at least, there has been a gradual shift in psychology being a largely knowledge based discipline to one presenting a greater focus on graduate attributes, where ‘psychological literacy’ has been adopted as the conceptual framework for understanding these graduate attributes (McGovern et al, 2010; Trapp et al., 2011). Cranney and Dunn (2011) provide an account of psychological literacy drawing on the attributes psychology graduates are expected to obtain upon completion of their programme of study (see also Karantzas et al, 2013). This encompasses both general psychological literacy dimensions, such as communication, critical thinking and problem solving skills, cultural competence, and self-awareness; as well as the understanding and application of psychological concepts and research practices in real world/professional contexts. PBL approaches are therefore well-suited to developing psychological literacy and employment-related skills due to the emphasis placed on fostering in students effective problem-solving and collaborative skills, flexible thinking styles and by

supporting students to become intrinsically motivated, autonomous, lifelong learners (Hmelo-Silver, 2004).

In addition to the potential advantages of using PBL in psychology curricula, a number of challenges also need to be considered. Hmelo-Silver (2004) notes that most of the research base is informed by medical and high-achieving learner education, raising questions about the extent to which PBL is beneficial for less skilled learners. Furthermore, most of the research on PBL focuses on evaluating outcomes, with very few studies addressing the question of how the processes underpinning PBL can be enhanced to support group work and self-directed learning: that are the critical components of any PBL teaching and learning activity. Individual psychological processes such as academic self-regulation, metacognition, academic self-efficacy and sensitivity in interpersonal contexts may play a significant role in the success or failure of PBL, yet an assumption is made that all students are equally ready to engage in potentially challenging learning activities.

PBL requires that students actively work on problems rather than receive specific tutor-driven content, and that a drift across disciplinary boundaries is often a desired or consequent outcome of this process. In order for PBL to be deployed effectively, flexibility over what constitutes 'core' psychological knowledge and the extent to which psychology courses should or could be considered inter-, multi- or even trans-disciplinary is required. It also needs to be recognised that psychology programmes differ internationally in the extent to which they provide a direct route into professional occupations (McCarthy et al, 2012). For example, in Australia and the UK - and in what Reddy and Lantz (2010, p. 56) refer to as the 'BSc career fallacy' - a first followed by a higher degree in psychology provides the basis for employment in an accredited psychology profession (Cranney & Voudouris, 2012; Trapp et al, 2011). In a non-vocational and non-directive undergraduate degree where students can go into many future careers, it can be challenging to focus PBL on specific outcomes. By comparison, the Psychologist programme at Linköping University, combines bachelor and master's levels degrees, studied over a five-year period, which equips students with the requisite skills for professional practice upon completion (Trapp & Upton, 2010). A further challenge concerns fears over a potential 'performance slide' associated with the adoption of PBL pedagogies, in which generic industry-ready skills are assumed to be given priority over depth discipline knowledge (Barnett, 2009; Barnett, Parry & Coate, 2001). A balance

therefore needs to be struck between what counts as appropriate subject knowledge and providing students with adequate skills training in readiness for diverse career destinations.

University ranking schemes and league tables - including published student feedback such as the National Student Survey in the UK – may engender inertia and also resistance from faculty members who fear receiving poor evaluations from students. Resistance may also be met from students, especially those who adopt a consumerist approach to their education which seeks ‘value for money’, often translated as tutor-driven rather than student created input present further obstacles to be tackled.

In very practical terms, the introduction of PBL in psychology courses requires support at an institutional level from senior managers through to faculty members. Buy-in is also required from students who, through previous educational experiences, may associate good teaching and value for money with more traditional tutor-led pedagogies. As we noted earlier, PBL can be utilised in psychology curricula in a variety of ways, ranging from a single session or a stand-alone module, through to a whole programme approach that could be adopted incrementally by those interested in implementing PBL in their psychology curricula. Additional practical guidance for those seeking to develop and use PBL in their teaching is provided elsewhere by Papageorgiou et al., 2015; Schwartz, Mennin & Webb, 2001; van Berkel et al., 2010, see also the PBL clearinghouse at Delaware University: <http://www.udel.edu/inst/clearinghouse/index.html>). In the following section, we report the findings of a systematic literature review that illustrates more broadly how PBL is used in psychology degrees with the aim of supporting the integration of PBL across a greater range of psychology programmes. Having specific examples of how PBL has already been implemented in psychology teaching is important if we are to stimulate further interest in this area.

## **2. Applications of PBL to Psychology**

Earlier we argued that making a transition to PBL requires consideration of a range of factors that are both theoretical and practical (Duch, Groh & Allen, 2001; Paul, 2010; Schwartz, Mennin & Webb, 2001) In this section, we draw together and review published examples of the use of PBL for psychology teaching in higher education. A systematic literature review was conducted in January 2016 to address the following question: *What published evidence is*



*there of problem-based learning being used as a teaching approach in psychology undergraduate and postgraduate curricula in higher education?* This included all forms of problem-based learning (including project-based and inquiry-based learning, but NOT related pedagogies such as case-based learning and scenario-based learning) to ensure that the review was as inclusive as possible. The following databases were searched for all dates up to January 2016: Australian Educational Index, British Education Index, Cochrane Library, Education Abstracts, ERIC, PsycINFO and Web of Science. Combinations of the following search terms were used: inquiry-based learning, learning, pedagogy, problem based learning, project based learning, psychology, teaching. In addition to this, the references of all journal articles included in the review were manually searched to identify any other papers not already captured by the review process, as well as searching Google Scholar to ensure nothing was missed. The inclusion criteria were that articles should refer directly to the use of any form of problem-based learning in teaching psychology in higher education and be written in English. Articles were excluded if they referred to school education or if they referred to a psychology PBL class only as part of a research study but did not go on to discuss this in terms of teaching.

Due to the broad range of associated research terms, thousands of potential papers were identified across the databases listed above. The titles of these were checked to identify all suitable papers, which resulted in a preliminary list of 101 papers. This list was then checked in full to check for suitability of inclusion. A final list of 24 papers was then identified; these are presented in table 2 below.

*Insert table 2 here*

What is immediately noticeable about the list of published examples of PBL being used in psychology teaching is that PBL is mostly used are within a single modules (typically running over one semester and often part of a small part of a module) that is facilitated by only one or two tutors. The majority of the studies also reported using a hybrid approach, integrating PBL sessions with lectures or other structured activities. Some used online means, as either additional support or for the main PBL activity (e.g., Bozic & Williams, 2011; Kiernan et al, 2008). While not all studies noted class sizes, many were around 30 students or less. This was at times due to the intake into psychology degrees being around that number, or because those students were taking an optional module and so were only a proportion of the whole

psychology cohort. The reviewed modules are also typically at institutions where PBL is the minority pedagogical approach. Where PBL is used in psychology bachelor education in universities that adopt PBL across numerous departments (such as Erasmus University Rotterdam, Maastricht University and McMaster University), the literature primarily reports on research that investigates PBL as an approach *per se* rather than as a specific pedagogy for psychology teaching (e.g., de Koning et al, 2014; Wijnia et al, 2014).

There are specific examples of PBL being used in vocational postgraduate psychology courses such as clinical psychology (Kiernan et al, 2008; Nel, 2008; Stedmon et al, 2005), educational (Bozic & Williams, 2011; Chernobilsky et al 2004; Razzak, 2012) and forensic psychology (Hays & Vincent, 2004; Kiernan et al, 2008). As Dunsmuir and Frederickson (2014) note, however, even here there is sparse published work in these areas and these also highlight the surprising lack of PBL reported within psychology curricula. Kiernan and colleagues (2008) argue that this might be due to the tension between the requirements of accrediting bodies (such as the Australian Psychology Accreditation Council or the British Psychological Society) to focus on content knowledge and skills, and the pedagogy of PBL which focuses more on the processes of learning and on interdisciplinarity, as we have noted above.

The reviewed papers support some of the earlier noted learner benefits of PBL. For instance, an improvement in students' critical thinking skills and engagement with their studies has been identified within single psychology courses (Jones, 2013; Karantzas et al., 2013; Muehlenkamp, Weiss, & Hansen, 2015) supporting the review by Dochy et al., (2003). In other studies, the findings have been mixed (Adams & Jordan, 2012; Willis, 2002). The assessment of students' learning might also influence how the effectiveness of PBL is evaluated. Willis (2002), for example, shows that the students' grades in the PBL course were lower at midterm compared to students who took a more traditional course, but at the end of the semester these differences levelled out. Reynolds (1997) also highlights the importance of assessment being aligned with the pedagogical method used, in what Biggs and Tang (2011) describe as constructive alignment. There is also a common challenge with the issue of control when implementing PBL approaches; for the tutors this will relate to the need to let go and for students to take control of their own learning (Reynolds, 1997).

In addition to the reviewed articles featured here, other articles were identified not included in the review because as they did not fit the inclusion criteria worth noting for their relevance to the broader aims of this paper relate to potential of PBL for clinical psychology (Baillie et al, 2011; Huey, 2001), educational psychology (Dunsmuir & Frederickson, 2014; Jordan & Porath, 2006) and forensic psychology (Day & Tytler, 2012). There were also articles which drew on the use of PBL in psychology courses for primarily research purposes, notably: Dahlgren (2002, 2003; Linköping University, Sweden), de Koning et al (2012; Erasmus University Rotterdam, Netherlands), Van den Hurk (2006; Maastricht University, Netherlands), Wijnia et al (2014; Erasmus University Rotterdam, Netherlands), and also Contreras et al (2013; University of Jaen, Spain).

In summary, there are promising published examples of PBL being used in psychology higher education teaching, at both undergraduate and postgraduate level. Some of these publications provide details on the structure of classes and the specific form of PBL being used. Readers will hopefully be inspired by these examples to consider how they might develop their own teaching practice in this area. Those who have been using PBL in psychology teaching are encouraged to publish their own reports, in order for tutors at other institutions to see examples of PBL in use in psychology teaching. Much more work is needed, for example, to show the specific benefits of PBL in psychology teaching (as opposed to other pedagogical approaches), to consider how PBL might help to rejuvenate psychology curricula and how psychology tutors might seek training in PBL facilitation and curriculum management.

### **3. Applications of psychology to PBL**

#### *Outcome research from a psychological perspective*

In this final section, we consider the ways in which psychological research can make a significant contribution to the development of strategies for PBL. While the core principles of PBL are to promote greater student autonomy and responsibility for their learning and to develop their ability to apply problem solving skills across a range of contexts, we have noted that there is a great deal of variation in the way that PBL approaches are operationalized across different institutional contexts. This variation means that it is difficult to make any meaningful comparisons across contexts when evaluating the effectiveness of PBL. This is further compounded when notions of effectiveness are reduced to simplified outcome measures such as student performance on summative assessment tasks. When factors such as

the type of PBL model, type of problems used, differences between facilitators and students, resourcing for PBL and workload are taken into account, it is difficult to measure precisely what is having an effect on student performance and in what ways (Hung, 2011). Additionally, Belland (2009) has noted that reliability and validity are not routinely reported across many of the meta-analyses and systematic reviews conducted in this area, which further throws into question the extent to which a focus on outcome measures is a desirable way of assessing the utility of PBL approaches, or whether this is even possible. The emphasis placed on short-term summative assessments as outcome measures may also miss the point, as PBL offers an entirely different approach to learning that embeds long-term skills rather than emphasising short-term knowledge gains. Furthermore, assessment-focused outcome research which compares different pedagogies makes an assumption that these pedagogies are enacted in the classroom and perceived by students in comparable ways and also in the ways intended. As indicated above, this assumption may not hold where PBL is used with more varied groups of students.

Karantzas et al's (2013) paper exemplifies the type of outcome-oriented research which can serve to transcend the issues raised above from a psychological research perspective. They report the development of a short scale aiming to directly assess critical analysis and problem solving skills in order to estimate the effect of PBL on student learning; thus bypassing reliance on performance in summative assessment tasks or simple 'liking' measures. The effect of PBL on student learning is thus measured in terms of perceived opportunities for engagement with the process as it was intended. In our own research we have taken a similar approach assessing in the first instance the extent to which students agree that the principles of PBL have been apparent in the classroom (Pauli, Raymond-Barker and Worrell, 2016). The focus of this research was students-as-partners (SaP) pedagogies (which includes PBL but is a broader construct). Like Karantzas et al (2013), we developed a scale to measure self-report of SaP experience in an effort to avoid the assumption that all students experience a given pedagogy in the same way. Secondly, in common with Karantzas et al (2013), we focused on broader and more long-term outcomes than student performance in assessment tasks, such as graduate and employability skills. An important finding in our own research was that students who were more favourably disposed to these pedagogies were more likely to benefit from them in terms of skills acquired (Pauli et al., 2016). From a perspective of examining the utility of PBL in psychology, it is suggested that outcomes worthy of evaluation include the

development of psychological literacy (Trapp et al, 2011), psychology graduate skills and long-term effects in terms of usefulness for employment (Pauli et al, 2016).

### *Development of self-directed learning*

Another area in which psychological research could make a contribution to PBL practice is in the area of self-directed learning. This can be understood as a design feature of the learning environment as well as a learner characteristic, where the latter refers to students' preparedness to initiate a learning task and take control of the learning issues (Loyens et al., 2008). Self-regulated learning, on the other hand, is often treated as a learner characteristic involving goal-directed, active and engaged learning, intrinsic motivation and efficient use of behavioural and meta-cognitive strategies which is associated with high academic achievement (Zimmerman, 1990), that is, as an individual trait rather than a PBL process. In PBL practice it is assumed that self-regulated students should be capable of self-directed learning and therefore not depend on tutors to supply them with the 'correct' knowledge for addressing a problem. Handing responsibility for selecting appropriate knowledge over to students is one of the issues that concerns those tutors and students who are critical of PBL (Camp, 2001). As noted above, there is evidence that not all students may be equally prepared to take this on (Pauli et al, 2016). There is also some evidence that self-regulation and individuals' preparedness for self-direction in learning are developmental processes (Silén & Uhlin, 2008; van den Hurk, 2006; Zimmerman et al, 1996), however, the evidence pointing towards the extent to which PBL actively fosters this development is more mixed, indicating that how PBL is implemented (e.g. group size) and how it is understood and enacted by tutors and students is critically important to the extent to which it impacts on the development of learning skills (Lloyd-Jones & Hak, 2004). This raises two specific issues which would warrant more detailed psychological and pedagogical research. Firstly, how can diverse student groups be prepared for active learning pedagogies to derive maximum benefit, and secondly, how can we understand individual differences in learner characteristics as impacting on the acceptability and benefit of PBL pedagogy?

### *Research on group processes in PBL*

The final area that we will consider, in terms of how psychological research might inform PBL practice, is that of group processes. Following concerns that there was little research into PBL student group interaction - what has been termed the 'black box' of PBL (Hak & Maguire, 2000) - accompanied by the lack of conclusive evidence of whether PBL works or

not (Svinicki, 2007), there has been a focus in recent years on the processes of facilitation, group work and learning in PBL. It is argued that what is needed is not an answer to whether PBL works, but rather *how* it works, and in which circumstances (Dolmans et al., 2005). As such, social psychological research offers unique insights here into both group processes and student interaction within tutorials. Hammar Chiriac (2008) noted that studies on tutorials typically focus on how the following factors influence learning: (a) the nature and role of the problems used; (b) cognitive process; (c) motivational influence and; (d) tutors. So where group dynamics are regarded as a prerequisite for learning in PBL, there is still ambiguity and a need for increased understanding of group dynamics in tutorials (Azer, 2009; Hammar Chiriac, 2008, 2011). An important difference between tutorial groups and traditional group work in education is that the dynamic interplay between students is regarded as a part of the task and a core element of learning in PBL (Cockrell, Caplow & Donaldson, 2000; Hammar Chiriac, 2008) and that group dynamics change in and during tutorial sessions.

Some of the research that has been conducted into group interaction in PBL tutorials focuses on the importance of the tutorial formation stage on subsequent working practices (Hempel & Jern, 2001). Important aspects such as the group contract and how to negotiate a tutor role are topics of interest for a successful tutorial development (Azer, 2009; Hammar Chiriac & Rosander, 2010; Hempel & Jern, 2001). The importance of different types of tasks on the interactional dynamics operate in the tutorial groups (Hammar Chiriac, 2008), as well as the tutor's impact on group work and other process has also been addressed (Azer, 2005, 2009, Silén 2006). This work draws heavily on intra-group processes in social psychology. For instance, a group's structure (or in this case a PBL tutorial structure) can be described as a kind of network of roles, status, composition, resources and frames that organise the group, with the students acting as a key element in all of this. Understanding the psychological relevance of the tutorial processes - all the intra- and inter-personal actions - can enable us to examine issues such as cohesion, norms, communication, collective defence, group pressure, influence and conformity.

Other social psychological work has also begun to examine student interaction in PBL tutorials. This work typically examines the discursive practices within tutorials using video-recorded data (e.g. Barrett, 2010; Clouston, 2007; Imafuku et al, 2014; Jin et al, 2015; Koschmann, Glenn & Conlee, 1997) as well as the ways in which students retrospectively rate the quality of tutorials via questionnaires (e.g. Visschers-Pleijers et al, 2005, 2006) and the

amount of time spent on different kinds of interaction during the tutorials (Vischers-Pleijers et al, 2005, 2006). Research in this area examines the use of online technologies in PBL tutorials, for example, when and how students make use of mobile phones in tutorial settings (Authors, under review; Jin et al, 2015). By focusing in detail on the conversational and interactional practices through which students work together and collaboratively construct knowledge, for example, we can gain a greater insight into the processes as much as the outcomes of learning in PBL settings.

### Conclusion

In conclusion, this paper is both a review of how PBL has been (and could be) used in psychology curricula in higher education, and a call to arms to encourage further psychologically informed research into PBL processes. It is also to show how this, in turn, could benefit PBL practice in any discipline. The literature review has shown that despite the broader prevalence of PBL in higher education, there are still very few published reports of its use in psychology bachelor or masters courses. Those who do use PBL in psychology higher education are therefore urged to make available reports on issues such as problems used for specific psychology classes, tutor training or guidelines for class structures. Such information would be invaluable to those seeking to make the transition to PBL in one or more of their psychology classes. The message from the limited literature available in this area is clear: PBL is a valued and useful tool for teaching and learning in psychology.

This leads us back to an issue we raised in the introduction: that PBL works best when broaching interdisciplinary problems, and may face resistance by those who seek to police and maintain strict disciplinary boundaries. One way to tackle this issue might be to treat psychology *itself* as a blend of many sub-disciplines, so PBL problems could require students to learn across areas that are often separated in curricula, such as individual differences and social psychology, or developmental and neuropsychology. This small step might enable teaching staff to develop PBL problems that still adhere to regulations set out by accrediting bodies (in that students must cover specific topic and sub-discipline areas) while at the same time, allowing the flexibility in which PBL learning can thrive.

There is much for psychology to gain from using PBL approaches to learning, and most of the benefits of PBL witnessed in other disciplines may apply equally well to psychology. Moreover, it may also assist psychology courses in bridging the ever-widening

gulf between theoretical and applied psychology; between those who study it simply as a subject they are interested in, and those who study it and go on to pursue a professional pathway in psychology. PBL shifts the focus from learning facts, theories and methods in neatly arranged, but often de-contextualised situations, to learning that can be meaningfully and readily applied in specific contexts.

While PBL could arguably be put to much greater use in psychology teaching, we have highlighted some of the ways in which psychological research has been - and might still be - put to greater use within PBL research. It has been noted that PBL is itself based on a range of psychological principles (Norman & Schmidt, 1992), yet the potential of psychological research to have an impact on both the theoretical and practical developments of PBL is to be fully realised. We have briefly covered just three areas here - problem-solving, self-directed learning and group processes – that are central to the way in which PBL works as a pedagogy. Psychological research, however, has the potential to contribute more fully to understandings of how PBL works theoretically (i.e., to have a fuller understanding of how it works, and in what settings) and practically (i.e., to inform teaching and learning practice, providing guidance for PBL tutors and students). We look forward, therefore, to a greater collaboration between PBL and psychology, and to the potential for both endeavours.

### References

Authors. (under review). ‘Are you still with us?’ Managing group togetherness and mobile phones in PBL settings. *International Journal of Problem Based Learning*

Albanese, M. A., & Mitchell, S. (1993). Problem-based learning: a review of literature on its outcomes and implementation issues. *Academic medicine*, 68(1), 52-81.

Adams, M. & Jordan, M. (2012). Taking a problem-based learning approach to teaching ecopsychology. *Ecopsychology*, 4(2), 87-93.

Azer, S. (2005). Challenges facing PBL tutors: 12 tips for successful group facilitation. *Medical Teacher*, 27(8), 676-681.

Azer, S. (2009) What makes a great lecture? Use of lectures in a hybrid PBL curriculum. *The Kaohsiung journal of medical sciences*, 25(3), 109-115.



- Baillie, A., Proudfoot, H., Knight, R., Peters, L., Sweller, J., Schwartz, S. & Pachana, N. (2011). Teaching methods to complement competencies in reducing the “junkyard” curriculum in clinical psychology. *Australian Psychologist*, 46(2), 90-100.
- Ball, C. & Pelco, L. (2006). Teaching research methods to undergraduate psychology students using an active cooperative learning approach. *International Journal of Teaching and Learning in Higher Education*, 17(2), 147-154.
- Barnett, R. (2009). Knowing and becoming in the higher education curriculum. *Studies in Higher Education*, 34, 429-440.
- Barnett, R., Parry, G. & Coate, K. (2001). Conceptualising curriculum change. *Teaching in Higher Education*, 6(4), 435-449.
- Barrett, T. (2005). Understanding problem based learning. In Barrett, T., MacLabhrainn, I., & Fallon, H. (Eds.), *Handbook of Enquiry & Problem Based Learning. Irish case studies and international perspectives* (pp. 13–25). All Ireland Society for Higher Education (AISHE), Dublin.
- Barrett, T. (2010). The problem-based learning process as finding and being in flow. *Innovations in Education and Teaching international*, 47(2), 165-174.
- Barrett, T., Cashman, D. & Moore, S. (2011). Designing problems and triggers in different media: Challenging all students. In T. Barrett & S. Moore (Eds.) *New approaches to problem based learning: Revitalising your practice in higher education*. (pp. 18-35). London: Routledge.
- Barrows, H. S. (1986). A taxonomy of problem-based learning. *Medical Education*, 20, 481–486.
- Barrows, H. S. & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.

- Biggs, J. & Tang, C. (2011). *Teaching for quality learning at university: what the student does (4th ed.)*. Maidenhead: Open University Press.
- Boud, D. J. (Ed.). (1985). *Problem-based learning in education for the professions*. Sydney: Herdsa.
- Bozic, N. & Williams, N. (2011). Online problem-based and enquiry-based learning in the training of educational psychologists. *Educational Psychology in Practice*, 27(4), 353-364.
- Brown and King (2000). Constructivist pedagogy and how we learn: Educational psychology meets international studies. *International Studies Perspectives*, 1(3), 245-254.
- Camp, G. (2001). But what if they leave with misinformation? In P. Schwartz, S. Mennin, & G. Webb (2001). *Problem-based learning: Case studies, experience and practice*. (pp. 40-44). London: Routledge.
- Chernobilsky, E., DaCosta, M. C., & Hmelo-Silver, C. E. (2004). Learning to talk the educational psychology talk through a problem-based course. *Instructional Science*, 32(4), 319-356.
- Clouston, T. J. (2007). Exploring methods of analysing talk in problem- based learning tutorials. *Journal of Further and Higher Education*, 31(2), 183-193.
- Cockrell, K. S., Caplow, J. A. H., & Donaldson, J. F. (2000). A context for learning: Collaborative groups in the problem-based learning environment. *The Review of Higher Education*, 23(3), 347-363.
- Colliver J. (2000). Effectiveness of problem based learning curricula. *Academic Medicine*, 75, 259- 66.
- Connor-Greene, P. A. (2002). Problem-based service learning: The evolution of a team project. *Teaching of Psychology*, 29(3), 193-197

Contreras, L., Rodriguez-Espartal, N., Augusto Landa, J.M. & Lopez-Zafra, E. (2013). Studying social psychology at the university: The effect of a problem-based learning class. *International Conference of Education, Research and Innovation*, November 2013, Seville, Spain.

Cranney, J. & Dunn, D.S. (2011) (Eds.). *The psychologically literate citizen: Foundations and global perspectives*. Oxford: Oxford University Press.

Cranney, J. & Voudouris, N.J. (2012). Psychology education and training in Australia: Shaping the future. In S. McCarthy, K.L. Dickson, J. Cranney, A. Trapp & V. Karandashev (2012). *Teaching psychology around the world: Volume 3*. (pp. 2-14) Newcastle: Cambridge Scholars Publishing.

Dahlgren, M. A., & Dahlgren, L. O. (2002). Portraits of PBL: Students' experiences of the characteristics of problem-based learning in physiotherapy, computer engineering and psychology. *Instructional Science*, 30(2), 111-127.

Dahlgren, M. A. (2003). PBL through the looking-glass: Comparing applications in computer engineering, psychology and physiotherapy. *Learning*, 19(5), 672-681.

Davidson, N. & Howell Major, C. (2014) Boundary Crossing: Cooperative Learning, Collaborative learning and Problem-based Learning. *Journal on Excellence in College Teaching*, 25(3&4), 7-55.

Day, A. & Tytler, R. (2012). Professional training in applied psychology: Towards a signature pedagogy for forensic psychology training. *Australian Psychologist*, 47(3), 183-189.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Springer Science & Business Media.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational psychologist*, 26(3-4), 325-346.

de Koning, B. B., Loyens, S. M., Rikers, R. M., Smeets, G., & van der Molen, H. T. (2014). Impact of binding study advice on study behavior and pre-university education qualification factors in a problem-based psychology bachelor program. *Studies in Higher Education, 39*(5), 835-847.

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: a meta-analysis. *Learning and instruction: the journal of the European Association for Research on Learning and Instruction, 13*(5), 533-568.

Dolmans, D. & Schmidt, H. (2010). The problem-based learning process. In van Berkel, H., Scherpbier, A., Hillen, H. & van der Vleuten, C. (Eds). *Lessons from problem-based learning*. Pp. 13-20. Oxford: Oxford University Press.

Dolmans, D., Wolfhagen, I., van der Vleuten, C., & Wijnen, W. (2001). Solving problems with group work in problem-based learning: Hold on to the philosophy. *Medical Education, 35*, 884-889.

Dolmans, D., de Grave, W., Wolfhagen, I. & van der Vleuten, C. (2005). Problem-based learning: Future challenges for educational practice and research. *Medical Education, 39*(7), 732-741.

Duch, B.J., Groh, S.E. & Allen, D.E. (2001). Why problem-based learning? A case study of institutional change in undergraduate education. In B.J. Duch, S.E. Groh & D.E. Allen (Eds.) *The power of problem-based learning: A practical "how to" for teaching undergraduate courses in any discipline*. Sterling, Virginia: Stylus.

Dunsmuir, S. & Frederickson, N. (2014) Problem-based learning in professional training: Experiences of school psychology trainers in the United Kingdom. *Training and Education in Professional Psychology, 8*(2), 127-135.

Elder, A. D. (2015). Using a Brief Form of Problem-Based Learning in a Research Methods Class: Perspectives of Instructor and Students, *Journal of University Teaching & Learning Practice, 12*(1), 8.

- Freire, P. (1972). Education: domestication or liberation? *Prospects*, 2(2), 173-181.
- Gijbels, D., Dochy, F., Van Den Bossche, P. & Segers, M. (2005). Effects of problem-based learning: A meta-analysis from the angle of assessment, *Review of Educational Research*, 75, 127-61.
- Guiller, J., Durndell, A., Ross, A. & Thomson, K. (2004). Issues surrounding use of online discussion groups on traditional undergraduate modules. *Psychology Learning and Teaching*, 6(2), 130-138.
- Hak, T. & Maguire, P. (2000). Group process: The black box of studies on problem-based learning. *Academic medicine: Journal of the association of American medical colleges*. Vol. 75 (7), 769-772.
- Hammar Chiriac, E. (2008) A scheme for understanding group processes in problem-based learning. *Higher Education*, 55, 505– 518.
- Hammar Chiriac, E. (2011). *Research on Group Work in Education*. NY: Nova Science Publishers, Inc.
- Hammar Chiriac, E., & Rosander, M. (2010). Sharing your Nuts – Teacher Collaboration in Groups as a Means for Competence. *International Journal of University Teaching and Faculty Development*, 2, 89–102.
- Harland, T. (2003). Vygotsky's zone of proximal development and problem-based learning: Linking a theoretical concept with practice through action research. *Teaching in higher education*, 8(2), 263-272.
- Hays, J. & Vincent. J. (2004). Students' evaluation of problem-based learning in graduate psychology courses. *Teaching of Psychology*., 31(2), 104-106.
- Hempel, A., & Jern, S. (2001). Developmental perspectives on tutorial groups as projects groups. In S. Jern & E. Olsson (Eds.), *Studies of Groups and Change. Proceedings from a*

conference on group and social psychology, Lund University, May 2000 (pp.112–124). Lund University: Socialhögskolan.

Hmelo, C.E. (1998). Problem-based learning: Effects on the early acquisition of cognitive skill in medicine. *Journal of Learning Science*, 7(2), 173-208.

Hmelo-Silver, C. E. & Lin, X. (2000). Becoming self-directed learners: Strategy development in problem-based learning. In D. Evensen & C.E. Hmelo (Eds), *Problem-based learning: A research perspective on learning interactions*. London: Routledge.

Hmelo-Silver, C. (2004) Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235–266.

Hmelo-Silver, C. & Barrows, H. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based learning*, 1(1), 5-22.

Hmelo-Silver, C., Duncan, R.G. & Chinn, C. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller and Clark (2006). *Educational Psychologist*, 42(2), 99-107.

Hung, W., Jonassen, D. H., & Liu, R. (2008). Problem-based learning. *Handbook of research on educational communications and technology*, 3, 485-506.

Imafuku, R., Kataoka, R., Mayahara, M. Suzuki, H. & Saiki, T. (2014). Students' experiences in interdisciplinary problem-based learning: A discourse analysis of group interaction. *The Interdisciplinary Journal of Problem-based learning*, 8(2), 3-13.

Jin, J., Bridges, S., Botelho, M. & Chan, L.K. (2015). Online searching in PBL tutorials. *The Interdisciplinary Journal of Problem-based learning*, 9(1), 96-108.

Jones, S. (2013). Using problem-based learning for the acquisition of psychological knowledge and understanding. *Psychology Teaching Review*, 19(2), 38-48.

- Jordan, E. A., & Porath, M. (2006). *Educational psychology: A problem-based approach*. Allyn & Bacon.
- Karantzas, G., Avery, M., Macfarlane, S., Mussap, A., Tooley, G., Hazelwood, Q., Fitness, J. (2013). Enhancing critical analysis and problem-solving skills in undergraduate psychology: An evaluation of a collaborative learning and problem-based learning approach. *Australian Journal of Psychology*, 65(1), 38-45.
- Karpiak, C. (2011). Assessment of problem-based learning in the undergraduate statistics course. *Teaching of Psychology*, 38(4), 251-254.
- Kiernan, M., Murrell, E. & Relf, S. (2008). Professional education of psychologists using online problem-based learning methods: Experience at Charles Sturt university. *Australian Psychologist*, 43(4), 286-292.
- Knowles, M. S. (1968). Andragogy, not pedagogy. *Adult leadership*, 16(10), 350-352.
- Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of management learning & education*, 4(2), 193-212.
- Kolmos, A., Fink, F.K. & Krogh, L. (2006). *The Aalborg PBL model*. Aalborg: Aalborg University Press.
- Koschmann, T., Glenn, P., & Conlee, M. (1997). Analyzing the emergence of a learning issue in a problem-based learning meeting.
- Kreiner, D.S. (2009). Problem-based group activities for teaching sensation and perception. *Teaching of Psychology*, 36(4), 253-256.
- Lloyd-Jones, G. & Hak, T. (2004). Self-directed learning and student pragmatism. *Advances in Health Sciences Education*, 9, 61-73.

Loyens, S. M., & Gijbels, D. (2008). Understanding the effects of constructivist learning environments: Introducing a multi-directional approach. *Instructional science*, 36(5-6), 351-357.

Loyens, S.M.M., Magda, J. & Rikers, R.M. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review*, 20, 411-427.

McCarthy, S., Dickson, K.L., Cranney, J., Trapp, A. & Karandashev, V. (2012). *Teaching psychology around the world: Volume 3*. Newcastle: Cambridge Scholars Publishing.

McGovern, T.V., Corey, L.A., Cranney, J., Dixon, Jr., W.E., Holmes, J.D., Kuebli, J.E., Ritchey, K., Smith, R.A. & Walker, S. (2010). Psychological literate citizens. In D. Halpern (Ed.), *Undergraduate education in psychology: Blueprint for the discipline's future* (pp. 9-27). Washington, DC.: American Psychological Association.

Muehlenkamp, J.J., Weiss, N. & Hansen, M. (2015). Problem-based learning for introductory psychology: Preliminary supporting evidence. *Scholarship of Teaching and Learning in Psychology*, 1(2), 125-136.

Nel, P. W., Keville, S., Ford, D., McCarney, R., Jeffrey, S., Adams, S., & Uprichard, S. (2008). Close encounters of the uncertain kind: Reflections on doing problem-based learning (PBL) for the first time. *Reflective Practice*, 9(2), 197-206.

Norman, G. R., & Schmidt, H. G. (1992). The psychological basis of problem-based learning: A review of the evidence. *Academic medicine*, 67(9), 557-65.

Norton, L. (2004). Using assessment criteria as learning criteria: A case study in psychology. *Assessment & Evaluation in Higher Education*, 29(6), 687-702.

Pachana, N. A., Sofronoff, K. V., & O'Brien, M. (2008). Focus on clinical psychology postgraduate training: Taking the curriculum into the next decade. *Australian Psychologist*, 43(4), 219-221.



Papageorgiou, A., McCrorie, P., Georgiades, S. & Perdikogianni, M. (2015). *Psychology for psychologists: A problem-based approach to undergraduate psychology teaching*. London: Palgrave.

Paul, M. (2010). How to organise the transition from a traditional curriculum to a PBL curriculum. (pp. 143-150). In H. van Berkel, A. Scherpbier, H. Hillen & C. van der Vleuten (Eds.). *Lessons from problem-based learning*. Oxford: Oxford University Press.

Pauli, R., Raymond-Barker, B & Worrell, M (2016) The impact of pedagogies of partnership on the student learning experience in UK higher education: A psychological perspective, Higher Education Academy, York.

Razzak, N.A. (2012). Problem-based learning in the educational psychology classroom: Bahraini teacher candidates' experience. *International Journal of Teaching and Learning in Higher Education*, 24(2), 134-143.

Reddy, P. & Lantz, C. (2010). Myths, maths and madness: Misconceptions around psychology. In D. Upton & A. Trapp (Eds.) *Teaching Psychology in Higher Education*. pp. 54-81. BPS Blackwell.

Reynolds, F. (1997). Studying psychology at degree level: Would problem-based learning enhance students' experiences? *Studies in Higher Education*, 22(3), 263-275.

Rodriguez-Espartal, N., Lopez-Zafra, E., Contreras, L. & Augusto, J.M. (2013). Developing a scale to assess a problem-based learning experience. *International Conference of Education, Research and Innovation*, November 2013, Seville, Spain.

Savin-Baden, M. (2000). *Problem-based learning in higher education: Untold stories*. Buckingham: Open University press.

Savin-Baden, M. (2003). Disciplinary differences or modes of curriculum practice? Who promised to deliver what in problem-based learning? *Biochemistry and Molecular Biology Education*, 31(5), 338-343.

Schmidt, H. G. (1983). Problem- based learning: rationale and description. *Medical education*, 17(1), 11-16.

Schmidt, H. G., Loyens, S. M., Van Gog, T., & Paas, F. (2007). Problem-based learning is compatible with human cognitive architecture: Commentary on Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, 42(2), 91-97.

Searight, H. & Searight, B. (2009). Implementing problem-based learning in an undergraduate psychology course. *InSight: A journal of scholarly teaching*, 4, 69-76.

Silén, C. (2006). The tutor's approach in base groups (PBL). *Higher Education*, 51, 373–385.

Silén, C., & Uhlin, L. (2008). Self-directed learning—a learning issue for students and faculty! *Teaching in Higher Education*, 13(4), 461-475.

Stedmon, J., Wood, J., Curle, C., Haslam, C. (2005) Development of PBL in the training of clinical psychologists. *Psychology Learning and Teaching*, 5(1), 52-60.

Schwartz, P., Mennin, S. & Webb, G. (2001). *Problem-based learning: Case studies, experience and practice*. London: Routledge.

Svinicki, M. D. (2007). Moving beyond “it worked”: The ongoing evolution of research on problem-based learning in medical education. *Educational Psychology Review*, 19(1), 49-61.

Trapp, A. & Upton, D. (2010). Individual differences: Psychology in the European community. pp. 1-21. In D.Upton & A.Trapp (Eds.) *Teaching Psychology in Higher Education*. BPS Blackwell.

Trapp, A., Banister, P., Ellis, J., Latto, R., Miell, D., Upton, D. (2011). The future of undergraduate psychology in the UK. *The Higher Education Academy Psychology Network publication*.

van Berkel, H., Scherpbier, A., Hillen, H. & van der Vleuten, C. (Eds). *Lessons from problem-based learning*. Oxford: Oxford University Press.

van den Hurk, M. (2006). The relation between self-regulated strategies and individual study time, prepared participation and achievement in a problem-based curriculum. *Active Learning In Higher Education*, 7(2), 155-169.

Vischers-Pleijers, A., Dolmans, D. Wolhagen, I. & van der Vleuten, C. (2005) Student perspectives on learning-oriented interactions in the tutorial group. *Advances in Health Sciences Education*, 10, 23-35.

Vischers-Pleijers, A., Dolmans, D., de Leng, B., Wolhagen, I. & van der Vleuten, C. (2006) Analysis of verbal interactions in tutorial groups: A process study. *Medical Education*, 40(2), 129-137.

Wiggins, S., & Burns, V. (2009). Research methods in practice: The development of problem-based learning materials for teaching qualitative research methods to undergraduate students. *Psychology Learning & Teaching*, 8(1), 29-33.

Wijnia, L., Loyens, S.M.M., Deros, E., Koendjie, N.S. & Schmidt, H.G. (2014). Predicting educational success and attrition in problem-based learning: do first impressions count? *Studies in Higher Education*, 39(6), 967-982.

Willis, A. S. (2002). Problem-based learning in a general psychology course. *The Journal of General Education*, 51(4), 282-292.

Yandall, L.R. & Giordano, P.J. (2008). Exploring the use of problem-based learning in psychology courses. In S.A. Meyers & J.R. Stowell (Eds.), *Essays from excellence in teaching: 2008* (Vol. 8, pp. 8-12).

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, 25(1), 3-17.

Zimmerman, B. J., Bonner, S. & Kovach, R. (1996). *Developing self-regulated learners: Beyond achievement to self-efficacy*. Washington, DC, US: American Psychological Association.