Innovation and Change in Professional Education 8

Susan Bridges
Colman McGrath
Tara L. Whitehill *Editors*

Problem-Based Learning in Clinical Education

The Next Generation

Springer

Problem-Based Learning in Clinical Education

Innovation and Change in Professional Education

VOLUME 8

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This book is dedicated to the founding generation of PBL educators and in memory of Howard Barrows.

Howard Barrows: An Appreciation

By all conventional metrics (papers and books published, citation counts, awards received), Howard Barrows was a remarkably influential educator. He was on the faculty of McMaster Medical School from 1970 to 1981 after which he joined the faculty of Southern Illinois University School of Medicine where he retired in 1999 as the Chair of Medical Education. He has had over 400 journal articles and 19 books, received several distinguished awards, including the John P. Hubbard Award by the National Board of Medical Examiners, the Abraham Flexner award for medical education and the Claude Bernard Lectureship from the American Physiological Society. He co-founded *Teaching and Learning in Medicine: An International Journal*. His papers, particularly on problem-based learning and the tutorial process, have been widely cited with several receiving more than 200 citations. What this listing of achievements fails to capture is the essential grace and humility of the person behind it all.

In the summer of 2007, I organized a symposium on Student-Centred Learning at McMaster University and invited Howard to participate. He graciously agreed and his quiet presence made a tremendous impression on all participants. Since then we kept in touch. On several occasions, I invited him to talk to my students, particularly about his invention of the 'simulated patient' approach at the University of Southern California and as the Director of Neuromedicine at the Los Angeles County Hospital. That approach has been adopted globally and used for the training not only of physicians but other health care professionals. The students found him adorable. They just could not believe that someone who had achieved so much could be so modest and unassuming. He was the master facilitator, quiet, effective, sharp and critical. We were working together on a collection of essays to be written by university teachers extolling the excitement and fascination of teaching. This was to be a counter-thrust to the many books and articles bemoaning the decline of university teaching at the expense of research. His essay was entitled 'An Accidental Educator: How an unsuspecting neurologist became enmeshed in the field of medical education and beyond'.

Howard Barrows was very special and when I think of him, Hamlet's remarks about his late father come to mind, 'He was a man, take him for all in all, I shall not look upon his like again'. Problem-based learning has lost a great champion and one of its finest practitioners. I hope that this collection of essays would be read widely as a tribute to a great teacher.

Patangi K. Rangachari

Preface

This work originated in Hong Kong, a territory, like most regions across the globe, currently embarking on widespread reform across both secondary and higher education. Over a decade earlier, clinical programmes at The University of Hong Kong undertook a radical curriculum overhaul and implemented problem-based learning (PBL) curricula. As we in Hong Kong and as colleagues around the globe prepare for further reviews and reforms, it is timely to reflect on practice and to consider the role of PBL in education, in general, but for the purposes of this volume, in clinical education, in particular.

The current research on PBL presented in this volume allows us to not only review practice and draw on collective experience but also reaffirms our commitment to integrated, small-group and inquiry-based learning. Indeed, we argue that the relevance of PBL as an instructional approach is perhaps even more evident today than when first developed over 40 years ago.

In preparing this volume, we have organized the chapters around three key research themes: student learning outcomes in PBL; the role of new learning technologies in PBL; and examining 'inside' the PBL process. Hmelo-Silver and Eberbach's introduction on PBL and modern educational theory provides a clear rationale for PBL as an instructional method and also signals some areas for future research. In our concluding chapter, we reflect on the contribution of the volume to current educational research in the field and close with a proposed agenda for the 'next generation' of PBL research.

Susan Bridges
Colman McGrath
Tara L. Whitehill
July, 2011

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We would like to thank our contributors from across the globe who have shared their practice and undertaken principled research to assist understandings of 'how' PBL is enacted in clinical education. In addition, we wish to thank the series editor and staff at Springer for constructive review and ongoing advice. We would also like to acknowledge The University of Hong Kong Strategic Research Theme 'Sciences of Learning' for funding support towards the preparation of this volume and the invaluable assistance of Ms Rita Suen Po Chu with manuscript preparation.

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Part I
Introduction

Chapter 1
Learning Theories and Problem-Based Learning

Cindy E. Hmelo-Silver and Catherine Eberbach

1.1 Introduction

PBL is a learner-centered instructional method in which students learn through solving ill-structured problems (Barrows, 2000; Hmelo-Silver, 2004; Torp & Sage, 2002). Students work in collaborative groups to identify what they need to learn in order to solve a problem. They engage in self-directed learning and then apply their new knowledge to the problem and reflect on what they learned and the effectiveness of the strategies employed. The teacher acts to facilitate the learning process rather than to provide knowledge. Goals of PBL include helping students develop (1) flexible knowledge, (2) effective problem-solving skills, (3) effective self-directed learning skills, (4) effective collaboration skills, and (5) intrinsic motivation. This chapter discusses the nature of learning in PBL and examines the empirical evidence supporting it. There is considerable research on the first three goals of PBL but little on the last two (Hmelo-Silver, 2004). Moreover, minimal research has been conducted outside medical and gifted education. In this chapter, we explore the goals of PBL and the learning theories that explain how PBL might achieve these goals.

The first goal of PBL, constructing flexible knowledge, goes beyond having students learn simple facts; flexible knowledge integrates information across multiple domains in long-term memory. Such knowledge is coherently organized around deep principles in a domain (Chi, Feltovich, & Glaser, 1981). Moreover, this knowledge needs to be conditionalized, that is, people should understand when and why knowledge is useful. Flexible knowledge develops as people apply their knowledge in a variety of problem situations (CTGV, 1997; Kolodner, 1993).

Helping students develop usable knowledge and skills requires embedding learning in problem-solving contexts (e.g., Gallagher, Stepien, & Rosenthal, 1992; Hmelo, 1998; Hmelo, Holton, & Kolodner, 2000; Perfetto, Bransford, &

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Franks, 1983). Discussing problems in a PBL group (prior to researching learning issues) activates relevant prior knowledge and facilitates the processing of new information (Schmidt, DeGrave, DeVolder, Moust, & Patel, 1989). Students can better construct new knowledge when they can relate it to what they already know.

The second goal of developing effective problem-solving skills refers to the ability to apply appropriate metacognitive and reasoning strategies. Different strategies may be appropriate for different domains and for different problems. For example, hypothetical-deductive reasoning is an appropriate strategy for medical problem solving whereas analogical or case-based reasoning may be appropriate in many design domains such as architecture. Metacognitive skills refer to the executive control processes of planning one's problem solving, monitoring one's progress, and evaluating whether one's goals have been met (Schoenfeld, 1985).

Metacognitive strategies are also important for the third goal of developing lifelong learning skills: being a self-regulated learner (Ertmer & Newby, 1996; Zimmerman, 2002). There are several processes involved. First, learners must have a metacognitive awareness of what they do and do not understand. Second, they must be able to set learning goals for themselves, identifying what they need to learn more about for the problem they are solving. Third, they must be able to plan how to achieve their goals. Finally, as they implement their plan, learners must evaluate whether or not their goals have been attained.

The fourth goal of being a good collaborator means effectively participating in a small group. This encompasses establishing common ground, resolving discrepancies, negotiating the actions that a group is going to take, and coming to an agreement (Barron, 2003). This requires open exchange of ideas and engagement of all group members (Cohen, 1994; Wenger, 1998).

The fifth goal of PBL is to help learners become intrinsically motivated, which occurs when learners work on a task for their own satisfaction, interest, or challenge. Determining what is engaging is easy for medical students; they all share the goal of becoming physicians. Similarly, gifted high school students tend to be highly motivated and have cognitive skills that allow them to confidently tackle complex tasks. Determining appropriate problems for less knowledgeable students requires that problem designers understand what is interesting for a heterogeneous group of students with varying levels of prior knowledge and provides a moderate challenge without being overwhelming (Blumenfeld, Kempler, & Krajcik, 2006).

1.2 Features of PBL

Several features of PBL are important in achieving the goals. These include the overall PBL tutorial process, facilitation, problems themselves, collaboration, self-directed learning, and post-problem reflection. A PBL tutorial session starts by presenting a group of students with minimal information about a

complex problem (Barrows, 2000). From the outset, students must engage in questioning to obtain additional problem information; they may also gather facts by doing experiments or other research (Torp & Sage, 2002). For example, when middle-school children were asked to build artificial lungs, they performed experiments to determine how much air the lungs had to displace (Hmelo et al., 2000). At several points in the problem, students typically pause to reflect on the data they have collected so far, generate questions about that data, and hypothesize about underlying causal mechanisms that might help explain it. The students then identify concepts they need to learn more about in order to solve the problem (i.e., "learning issues"). After considering the problem with their naive knowledge, the students divide and independently research the learning issues they have identified. They then regroup to share what they learned, reconsider their hypotheses and/or generate new hypotheses in light of their new learning, as shown in the cycle (Fig. 1.1). When completing the task, learners reflect on the problem in order to abstract the lessons learned, as well as how they performed in self-directed learning and

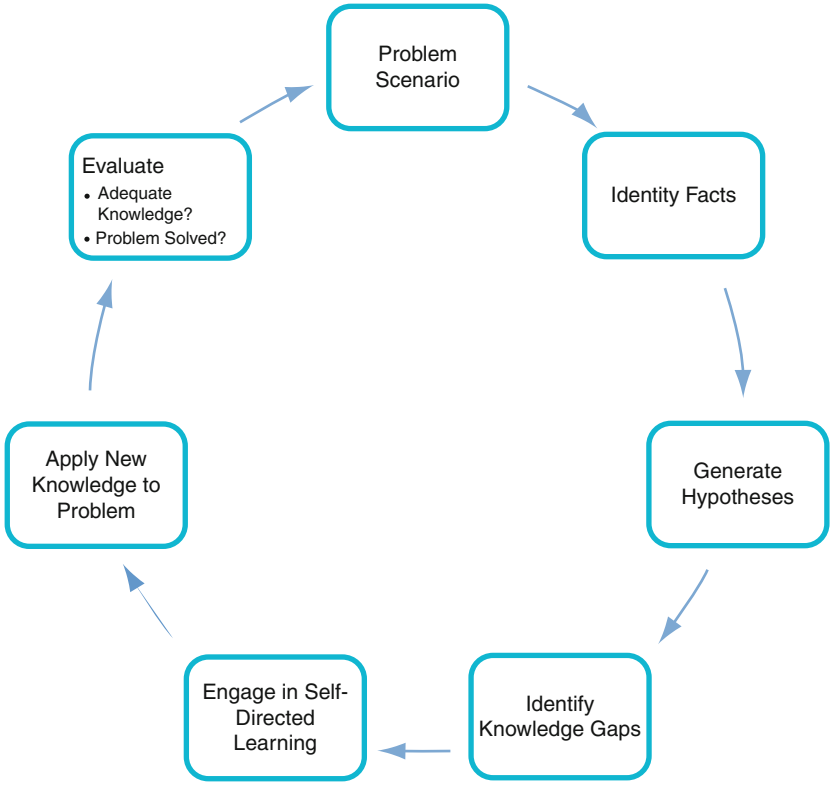

Fig. 1.1 The PBL cycle

collaborative problem solving. They evaluate their understanding of the problem as well as their progress toward a solution.

In the traditional PBL model, students use whiteboards to help scaffold their problem solving (Hmelo-Silver, 2004). The whiteboard may be divided into four columns to help the learners record where they have been and where they are going. The four columns scaffold learning by helping to communicate the PBL process (Hmelo-Silver, 2006) and help structure and guide the group's learning process (Dillenbourg, 2002). The whiteboard serves as a focus for negotiation of the problem for students to co-construct knowledge. The Facts column includes information that the students gather from the problem. The Ideas column serves to keep track of evolving hypotheses about solutions. The students place questions for further study into the Learning Issues column. They use the Action Plan to keep track of plans, problem solving, or finding more information. The use of the whiteboard helps students externalize their problem solving and allows them to focus on more difficult aspects of their task. It provides a model of a systematic approach to problem solving and supports student planning and monitoring as they identify what needs to go up on the board, and later, to consider what needs to be removed. This should enhance students' problem-solving skills (and subsequent transfer of knowledge and skills to new situations).

PBL supports knowledge construction as students activate their prior knowledge in initial discussions (Schmidt et al., 1989). It also supports social construction of knowledge as learners work in small groups using inquiry skills to solve real-world problems (Greeno, Collins, & Resnick, 1996). For example, medical students learn by solving real patient problems using the inquiry skills of medical practice. From a cognitive perspective, organized learning experiences foster students' understanding of concepts through problem-solving activities, but from a situative perspective, social interactions are the source of knowledge construction. This latter perspective acknowledges that social practices support the development of students as capable learners competent in both their disciplinary knowledge and as problem solvers (Lampert, 2001). Before considering the relationship between the goals of PBL and different learning theories, we first consider what we know about several important aspects of PBL: the role of the problem; the role of the facilitator; collaboration; and reflection.

1.2.1 The Role of the Facilitator

Because PBL situates learning in meaningful problems and makes key aspects of expertise visible, it is a good example of the cognitive apprenticeship model (Collins, Brown, & Newman, 1989), where the facilitator plays a key role in modeling the problem-solving and self-directed learning skills needed when self-assessing one's reasoning and understanding. In PBL, the facilitator is an expert learner, modeling good strategies for learning and thinking rather than

providing content knowledge. Facilitators progressively fade their support as students become more experienced with PBL until finally learners adopt the questioning role. The facilitator is responsible both for moving the students through the various stages of PBL and for monitoring the group process – assuring that all students are involved so that they can both externalize their own thinking and comment on each other's thinking (Hmelo-Silver & Barrows, 2006, 2008; Koschmann, Myers, Feltovich, & Barrows, 1994). The PBL facilitator guides the development of higher-order thinking skills by encouraging students (and the group) to justify their thinking, and externalizes self-reflection by directing appropriate questions to individuals. Expert facilitators accomplish these learning and performance goals through the use of a variety of strategies that often involve the use of open-ended and metacognitive questioning (Hmelo-Silver & Barrows, 2008). These strategies build on student thinking and help catalyze and focus discussions in subtle but productive ways.

1.2.2 The Role of the Problem

There are several characteristics of good PBL problems (Barrows & Kelson, 1995; Gallagher et al., 1992; Kolodner, Hmelo, & Narayanan, 1996). In order to promote flexible thinking, problems should be complex, ill structured, and open ended; to support intrinsic motivation, they must also be realistic and connect with learners' experiences. Good problems provide feedback that allows students to evaluate the effectiveness of their knowledge, reasoning, and learning strategies. Such problems foster conjecture and argumentation. Problem solutions should be complex enough to stimulate students' need to know. Good problems help students become engaged right from the beginning and allow them to get started based on their initial understanding. Generative problems often require multidisciplinary solutions. For example, clinical problems might require ideas from physiology, anatomy, and pharmacology. This allows students to see how different kinds of knowledge are useful tools for problem solving.

The ill-structured problems used in PBL can serve as the basis for high levels of problem-relevant collaborative interaction; however, groups may need good facilitation to make this interaction productive (Kapur & Kinzer, 2007; Van Berkel & Schmidt, 2000). Although in studies of PBL the predominant type of ill-structured problem has been diagnosis, other types of problems have been used successfully. Walker and Leary (2009) found the greatest achievement effects were for problems that were classified as design problems and strategic performance problems. A design problem might ask learners to design artificial lungs or an instructional plan. A strategic performance problem might ask learners to act in complex, real-time situations in which they have to employ and adapt tactics as appropriate to situational demands.

1.2.3 Collaborative Learning in PBL

Collaborative problem-solving groups are a key feature of PBL. One assumption of PBL is that the small group structure helps distribute the cognitive load among the members of the group, taking advantage of group members' distributed expertise by allowing the whole group to tackle problems that would normally be too difficult for each individual alone (Pea, 1993; Salomon, 1993). In PBL, students generally divide the learning issues and become "experts" in particular topics. Research suggests that the small group discussions and debate in PBL sessions enhance higher-order thinking and promote shared knowledge construction (Blumenfeld, Marx, Soloway, & Krajcik, 1996; Vye, Goldman, Voss, Hmelo, & Williams, 1997).

In PBL groups, students often work together to construct collaborative explanations, but usually need support to collaborate well. In the traditional PBL model, a facilitator helps accomplish this. In the absence of a dedicated facilitator, several techniques foster productive collaboration including scripted cooperation, reciprocal teaching, guided peer questioning, and the use of student roles (Herrenkohl & Guerra, 1998; King, 1999; O'Donnell, 1999; Palincsar & Herrenkohl, 1999).

1.2.4 Reflection: Supporting Enduring Understanding and Transfer

Reflecting on the relationship between doing and learning is needed to support the construction of extensive and flexible knowledge (Salomon & Perkins, 1989). Reflection is necessary to help learners understand that the tasks are in the service of the questions they have asked, and that these questions arise from the learning goals they have set for themselves (Bereiter & Scardamalia, 1989). Reflection helps students to (1) relate their new knowledge to their prior understanding; (2) purposefully abstract knowledge; and (3) understand how the strategies might be reapplied. PBL incorporates reflection throughout the tutorial process and when completing a problem. Students periodically reflect on the adequacy of their hypothesis list and their own knowledge relative to the problem. On completion of a problem, students reflect on what they have learned, how well they collaborated with the group, and how effective they were as self-directed learners. As students make inferences that tie the general concepts and skills to the specifics of the problem that they are working on, they construct more coherent knowledge (Chi, Bassok, Lewis, Reimann, & Glaser, 1989). The reflection process in PBL is designed to help students make inferences, identify gaps in their thinking, and prepare them to transfer problem-solving strategies, self-directed learning strategies, and knowledge to new situations.

Often groups need help to reflect on their learning (Hmelo-Silver, 2000). A dedicated facilitator can support student reflection but in larger groups, other techniques may be helpful. One approach is the use of structured journals (e.g., Puntambekar & Kolodner, 1998). These kinds of approaches need evidence of their effectiveness before advocating their widespread incorporation into PBL models.

To understand how PBL achieves it goals, we turn to theories of learning. We argue that by understanding these theories, we can better understand how students learn in PBL and use this understanding to determine which features of PBL are most important for particular goals and how PBL might be adapted under different circumstances. Neither information processing nor social constructivist theories alone provides a sufficient account of learning in PBL. Having an understanding of the theoretical foundations of PBL is thus important in designing and facilitating productive PBL experiences.

1.3 Theoretical Foundations

1.3.1 Information Processing Foundations

The earliest explanations of the benefits of PBL were drawn from information processing theory (Schmidt, 1993). From this perspective, a key benefit of PBL is that group discussion helps learners to activate prior knowledge. Schmidt et al. (1989) demonstrated that discussion of a case prior to reading about content served to activate prior knowledge and facilitate processing new information. In addition, PBL discussions provide opportunities for learners to elaborate upon their understanding and connect their new learning to knowledge stored in long-term memory. Beyond these mechanisms, a key idea from information processing is the notion of transfer-appropriate processing, which states that when people learn in a problem-solving context, they should be able to retrieve that information when it is needed (Adams et al., 1988). Spontaneous transfer of knowledge and strategies is generally difficult to achieve, but with increasing practice and expertise, the likelihood of transfer is improved (Novick, 1988; Novick & Holyoak, 1991). Transfer often fails because problem solvers fail to retrieve an appropriate analog. Because in PBL the knowledge is encoded in a problem-solving context, students should be more likely to retrieve that knowledge when faced with future problems, something that is especially important to professional education. In these settings, students are often learning foundational disciplines (e.g., basic sciences for medicine and psychology in teacher education). The goal for learning is often not to learn these disciplines in isolation, but to apply disciplinary knowledge to problem solving. Because PBL students learn domain knowledge (the basic biomedical sciences in the case of medical students), reasoning strategies, and self-directed learning strategies in the context of solving problems, it is reasonable to expect transfer-appropriate processing mechanisms to come into play.

A more general cognitive analysis of PBL suggests that as students are presented with problems, they access prior knowledge, establish a problem space, search for new information to help reach their problem-solving goals, and in the process, they may construct new mental representations or restructure existing representations that include the conditions in which the knowledge might be used (Anderson, 1982). This process involves developing metacognitive awareness of one's progress on both learning and problem solving (Hmelo & Lin, 2000).

As Hmelo-Silver, Chernobilsky, and DaCosta (2004) noted, research in PBL and basic cognitive research show that (1) students who learn knowledge in a problem-solving context such as PBL are more likely to retrieve and transfer their knowledge to new problems; and (2) students who learn reasoning and self-directed learning strategies in a problem-solving context and have extensive practice in applying them are more likely to retrieve and apply these strategies in new problems. Beyond these purely internal cognitive mechanisms, the whiteboard serves as an extension of memory that can reduce cognitive load.

Information processing theory provides some foundations for understanding what students learn, but less about how they learn, particularly in the social context and for that it is important to consider social constructivist and sociocultural foundations of PBL.

1.3.2 Social Constructivist and Sociocultural Foundations

Contemporary learning theories view learning as a fundamentally social activity (Bransford, Brown, & Cocking, 2000; Palincsar, 1998). Social constructivist theories emphasize the importance of learners being actively engaged in their own learning as they engage in meaningful tasks (Collins, 2006). A key aspect of these theories is the notion of scaffolding. There is an extensive body of research on scaffolding learning in problem-based environments (e.g., Collins et al., 1989; Davis & Linn, 2000; Golan, Kyza, Reiser, & Edelson, 2002). Scaffolding in PBL allows learners to engage in complex problems that might otherwise be beyond their present abilities. Scaffolding makes learning more tractable for students by changing complex and difficult tasks in ways that make these tasks accessible, manageable, and within students' zone of proximal development (Rogoff, 1990; Vygotsky, 1978). Quintana et al. (2004) conceived of scaffolding as a key element of cognitive apprenticeship, whereby students become increasingly accomplished problem-solvers given structure and guidance from mentors who scaffold students through coaching, task structuring, and hints, without explicitly giving students the final answers. An important feature of scaffolding is that it supports students' learning of how to do the task as well as why the task should be done that way (Hmelo-Silver, 2006).

Scaffolding is often distributed in the learning environment, across the curriculum materials or educational software, the teachers or facilitators, and the learners themselves (Puntambekar & Hubscher, 2005). Teachers play a

significant role in scaffolding mindful and productive engagement with the task, tools, and peers. They guide students in the learning process pushing them to think deeply and model the kinds of questions that students need to be asking themselves, thus forming a cognitive apprenticeship (Collins et al., 1989, Hmelo-Silver & Barrows, 2006).

PBL is also replete with psychological tools that support student learning and engagement. Sociocultural theories emphasize the role of tools in mediating learning (Engeström, 1993; Kozulin, 1998; Lave & Wenger, 1991). Understanding the role of such tools is central to understanding learning. For example, students in the study reported in Hmelo (1998) were more successful in their problem solving because they could use their science knowledge and the strategies that they developed as tools for their thinking. Psychological tools are

> those symbolic artifacts – signs, symbols, tests, formulae, graphic-symbolic devices – that help individuals master their own 'natural' psychological functions of perception, memory, attention, and so on and serve as a bridge between individual acts of cognition and the symbolic sociocultural prerequisites of these acts (Kozulin, 1998, p. 1).

Tools such as these mediate individual and collaborative activity. In studies of learning processes, the role of several kinds of psychological tools is examined: conceptual tools, such as knowledge, strategies, and language; and representational tools that students construct (and that may be used to scaffold and guide their learning).

Knowledge, strategies, and language help mediate goal-directed activity by helping one make inferences and reason about one's activities. Students use language as a tool to help them construct meaning (Vygotsky, 1978). As Lave and Wenger (1991) pointed out, mastery of language and discourse allows students to progress in becoming participants in communities of practice.

PBL provides many opportunities for students to engage with conceptual tools such as language and domain knowledge. Adequate language practice is essential for being a part of a community of practitioners – a group of people who share goals, ideas, and interests to solve similar problems. Through participation and discussion, practitioners have a chance to appropriate and manipulate newly acquired vocabulary, negotiate word meanings, and interact with other members of the community (Brown et al., 1993). Such discourse is central to the PBL process. As students work in small groups, they have opportunities to share what they have learned and discover what they still need to learn. This kind of talk makes learners' thinking visible to the group, which then allows it to become an object that is open for discussion and revision. This is an ideal environment for students to appropriate the conceptual language of a discipline as they practice it and have a chance to learn from their mistakes.

Besides language, one's knowledge and strategies can serve as important tools for problem solving. In PBL, students appropriate new knowledge and strategies as they engage with problems. This is distinct from acquiring content knowledge because this knowledge carries an instrumental value (Kozulin, 1998). Knowledge is only a tool if "it is appropriated as a generalized instrument

capable of organizing individual cognitive and learning processes in different contexts and in applications to different tasks" (Kozulin, 1998, p. 86). Students in PBL curricula use science concepts and disciplinary reasoning strategies to produce good-quality explanations, which suggests that these concepts and strategies function as psychological tools (Hmelo, 1998; Hmelo-Silver & Barrows, 2008). In addition, the hypothesis-driven strategies that PBL students use in their reasoning also serves to support their self-directed learning because they can use their hypotheses as a way to evaluate the relevance of new information for the problem they are trying to solve (Hmelo & Lin, 2000). For example, a learning issue related to a disease leads students to consider abnormal lab values in a context rather than as an isolated feature such as in this example "...the physiology of the adrenal gland: what are the compounds which it synthesizes, and what are the systemic effects of their release into blood in abnormally elevated levels?" (Hmelo & Lin, 2000, p. 237).

In addition to the conceptual psychological tools, representations can serve as tools for thinking. Different representations afford and constrain social knowledge construction in several ways (Pea, 1993; Roth, 1998). First, representations serve as a shared concrete referent for members of a group and provide a common focus for negotiation. Second, the structure of the representation can guide student discussions (Suthers & Hundhausen, 2001). In PBL, several representational artifacts may be constructed. One representation is the formal structured PBL whiteboard with its facts, ideas, or hypotheses, learning issues, and action plan. This helps guide the discourse to consider certain issues and not others. The whiteboard serves as an external memory for the students – it reminds them of their ideas, both solidified and tentative, as well as hypotheses that they need to test. One ritualized aspect of the PBL tutorial is "cleaning up the boards" (Hmelo-Silver & Barrows, 2006). This occurs at several times, but especially after students have discussed what they learned from the resources they used for self-directed learning. In this event, students evaluate each of their hypotheses, look at how the hypotheses fit with the accumulated data, and how that meshes with what they have brought in from their self-directed learning. The discussions of what hypotheses are still worth considering and which ones are more or less likely lead to substantive discussions that are centered around what needs to be filled in on the whiteboard. Students often discuss how hypotheses should be ranked or when they should be added or deleted. Similar discussions revolve around learning issues (Hmelo-Silver & Barrows, 2006, 2008). The formal whiteboards serve as a space for students to negotiate their ideas. When students mark something as needing to be placed on the whiteboard, it suggests that the group agrees that what is written on the board is worth paying attention to. The use of the whiteboard is a fluid part of the tutorial that supports reasoning, knowledge construction, and self-directed learning as students use it to remind them of what they are considering, what they know, and what they still need to learn. Other representations students may construct are less formal representations such as flow charts, concept maps, and diagrams (see Hmelo-Silver & Barrows, 2006, 2008).

1.4 Discussion

PBL has its theoretical foundations in information processing theory and social constructivist theories. Information processing theory provides an account of the role of prior knowledge and how knowledge is internally structured and restructured through problem solving. Social constructivist and sociocultural theories account for how knowledge is socially constructed and how disciplinary and cultural tools mediate this construction. Although we have described these theories separately, we do not believe that they are mutually exclusive accounts of how learning is accomplished in PBL. These theories serve to explain both individual learning and social knowledge construction. They suggest ways in which PBL is appropriately structured, from initial discussions that activate learners' prior knowledge to the use of language and representations to support learning.

Beyond these theoretical foundations of PBL, there are many questions that are important for elaborating these foundations and warranting the theoretical claims made for the advantages of PBL. One proposed advantage is that students become good collaborators. For clinical professionals, this is particularly important as functioning on a team is important for quality patient care. Although studies of collaboration during PBL tutorial sessions are available (e.g., Hmelo-Silver & Barrows, 2008; Yew & Schmidt, 2009), there is little research on how good-quality collaboration develops and is sustained, both in PBL environments and beyond. Another gap in the research is to understand intrinsic motivation associated with PBL, how to sustain productive dispositions beyond PBL contexts, and how to maintain this problem-solving perspective in lifelong practice (Duschl, Schweingruber, & Shouse, 2007). These are important for creating clinical practitioners who are motivated to be lifelong learners.

Another fertile area for PBL research is to better understand the role of cultural tools in mediating collaborative knowledge construction. In particular, we see technology-rich learning environments as affording possibilities for supporting distributed collaboration and rich problem contexts (e.g., Derry, Hmelo-Silver, Nagarajan, Chernobilsky, & Beitzel, 2006; Lajoie, Lavigne, Guerrera, & Munsie, 2001; Lu, Lajoie, & Wiseman, 2010). Information and communication technology tools are pervasive in clinical education (e.g., Ward, Gordon, Field, & Lehmann, 2001). Many of these are likely to have been developed from an information-processing perspective, with a focus on individual learners. PBL provides opportunities to understand how these technological tools mediate learning in social contexts, using what might be termed the learning sciences approach (e.g., Brown, 1992; Greeno, 2006). The use of technology in a pedagogy that relies heavily on self-directed learning also suggests that we need a situated understanding of how students become critical consumers of all the information that technology puts at their fingertips. The use of technology in PBL raises as many questions as it answers and provides lots of opportunities for future research. What becomes the important question is how this technology can be used in the service of achieving the goals of PBL.

References

Adams, L., Kasserman, J., Yearwood, A., Perfetto, G., Bransford, J., & Franks, J. (1988). The effect of fact versus problem oriented acquisition. *Memory & Cognition, 16*, 167–175.

Anderson, J. R. (1982). The acquisition of cognitive skill. *Psychological Review, 89*, 369–406.

Barron, B. J. S. (2003). When smart groups fail. *Journal of the Learning Sciences, 12*, 307–359.

Barrows, H. S. (2000). *Problem-based learning applied to medical education*. Springfield, IL: Southern Illinois University Press.

Barrows, H. S., & Kelson, A. C. (1995). *Problem-based learning in secondary education and the problem-based learning institute* (Monograph No. 1). Springfield, IL: Problem-Based Learning Institute.

Bereiter, C., & Scardamalia, M. (1989). Intentional learning as a goal of instruction. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 361–392). Hillsdale, NJ: Erlbaum.

Blumenfeld, P. C., Kempler, T. M., & Krajcik, J. S. (2006). Motivation and cognitive engagement in learning environments. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 475–488). New York: Cambridge University Press.

Blumenfeld, P. C., Marx, R. W., Soloway, E., & Krajcik, J. S. (1996). Learning with peers: From small group cooperation to collaborative communities. *Educational Researcher, 25*(8), 37–40.

Bransford, J. D., Brown, A. L., & Cocking, R. (2000). *How people learn*. Washington, DC: National Academy Press.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences, 2*, 141–178.

Brown, A. L., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A., & Campione, J. C. (1993). Distributed expertise in the classroom. In G. Salomon (Ed.), *Distributed cognitions* (pp. 188–228). New York: Cambridge University Press.

Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science, 13*, 145–182.

Chi, M. T. H., Feltovich, P., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science, 5*, 121–152.

Cognition and Technology Group at Vanderbilt. (1997). *The Jasper project: Lessons in curriculum, instruction, assessment, and professional development*. Mahwah, NJ: Erlbaum.

Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64*, 1–35.

Collins, A. (2006). Cognitive apprenticeship. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 47–60). New York: Cambridge University Press.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453–494). Hillsdale, NJ: Erlbaum.

Davis, E. A., & Linn, M. C. (2000). Scaffolding students' knowledge integration: Prompts for reflection in KIE. *International Journal of Science Education, 22*, 819–837.

Derry, S. J., Hmelo-Silver, C. E., Nagarajan, A., Chernobilsky, E., & Beitzel, B. (2006). Cognitive transfer revisited: Can we exploit new media to solve old problems on a large scale? *Journal of Educational Computing Research, 35*, 145–162.

Dillenbourg, P. (2002). Over-scripting CSCL: The risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed.), *Three worlds of CSCL* (pp. 61–91). Heerlen, Netherlands: Open Universitat Nederland.

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (2007). *Taking science to school: Learning and teaching science in grade K-8*. Washington, DC: National Academies Press.

Engeström, Y. (1993). A developmental study of work as a test bench of activity theory: The case of primary care medical practice. In S. Chaiklin & J. Lave (Eds.), *Understanding practice: Perspectives on activity and context* (pp. 64–103). Cambridge: Cambridge University Press.

Ertmer, P. A., & Newby, T. J. (1996). The expert learner: Strategic, self-regulated, and reflective. *Instructional Science, 26*, 1–26.

Gallagher, S. A., Stepien, W. J., & Rosenthal, H. (1992). The effects of problem-based learning on problem-solving. *Gifted Child Quarterly, 36*, 195–200.

Golan, R., Kyza, E. A., Reiser, B. J., & Edelson, D. C. (2002, April). *Scaffolding the task of analyzing animal behavior with the Animal Landlord software*. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Greeno, J. G. (2006). Learning in activity. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 79–96). New York: Cambridge.

Greeno, J. G., Collins, A., & Resnick, L. (1996). Cognition and learning. In D. Berliner & R. Calfee (Eds.), *Handbook of educational psychology* (pp. 15–46). New York: MacMillan.

Herrenkohl, L. R., & Guerra, M. R. (1998). Participant structures, scientific discourse, and student engagement in fourth grade. *Cognition and Instruction, 16*(4), 431–473.

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

Hmelo, C. E., Holton, D., & Kolodner, J. L. (2000). Designing to learn about complex systems. *Journal of the Learning Sciences, 9*, 247–298.

Hmelo, 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* (pp. 227–250). Mahwah, NJ: Erlbaum.

Hmelo-Silver, C. E. (2000). Knowledge recycling: Crisscrossing the landscape of educational psychology in a problem-based learning course for preservice teachers. *Journal on Excellence in College Teaching, 11*, 41–56.

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

Hmelo-Silver, C. E. (2006). Design principles for scaffolding technology-based inquiry. In A. M. O'Donnell, C. E. Hmelo-Silver, & G. Erkens (Eds.), *Collaborative reasoning, learning and technology* (pp. 147–170). Mahwah, NJ: Erlbaum.

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based Learning, 1*, 21–39.

Hmelo-Silver, C. E., & Barrows, H. S. (2008). Facilitating collaborative knowledge building. *Cognition and Instruction, 26*, 48–94.

Hmelo-Silver, C. E., Chernobilsky, E., & DaCosta, M. C. (2004). Psychological tools in problem-based learning. In O. Tan (Ed.), *Enhancing thinking through problem-based learning approaches: International perspectives* (pp. 17–37). Singapore: Thomson Learning.

Kapur, M., & Kinzer, C. K. (2007). Examining the effect of problem type in a synchronous computer-supported collaborative learning (CSCL) environment. *Educational Technology Research and Development, 55*, 439–459.

King, A. (1999). Discourse patterns for mediating peer learning. In A. M. O'Donnell & A. King (Eds.), *Cognitive perspectives on peer learning* (pp. 87–117). Mahwah, NJ: Erlbaum.

Kolodner, J. L. (1993). *Case-based reasoning*. San Mateo, CA: Morgan Kaufmann.

Kolodner, J. L., Hmelo, C. E., & Narayanan, N. H. (1996). Problem-based learning meets case-based reasoning. In D. C. Edelson & E. A. Domeshek (Eds.), *Proceedings of ICLS 96* (pp. 188–195). Charlottesville, VA: AACE.

Koschmann, T. D., Myers, A. C., Feltovich, P. J., & Barrows, H. S. (1994). Using technology to assist in realizing effective learning and instruction: A principled approach to the use of computers in collaborative learning. *Journal of the Learning Sciences, 3*, 225–262.

Kozulin, A. (1998). *Psychological tools*. Cambridge, MA: Harvard University Press.

Lajoie, S. P., Lavigne, N. C., Guerrera, C., & Munsie, S. D. (2001). Constructing knowledge in the context of Bio World. *Instructional Science, 29*, 155–186.

Lampert, M. (2001). *Teaching problems and the problems of teaching*. New Haven, CT: Yale University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Boston: Cambridge.

Lu, J., Lajoie, S. P., & Wiseman, J. (2010). Scaffolding problem-based learning with CSCL tools. *International Journal of Computer Supported Collaborative Learning, 5*, 283–298.

Novick, L. R. (1988). Analogical transfer, problem similarity, and expertise. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14*, 510–520.

Novick, L. R., & Holyoak, K. J. (1991). Mathematical problem solving by analogy. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 17*, 398–415.

O'Donnell, A. M. (1999). Structuring dyadic interaction through scripted cooperation. In A. M. O'Donnell & A. King (Eds.), *Cognitive perspectives on peer learning* (pp. 179–196). Mahwah, NJ: Erlbaum.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*, 345–375.

Palincsar, A. S., & Herrenkohl, L. R. (1999). Designing collaborative contexts: Lessons from three research programs. In A. M. O'Donnell & A. King (Eds.), *Cognitive perspectives on peer learning* (pp. 151–178). Mahwah, NJ: Erlbaum.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon & D. Perkins (Eds.), *Distributed cognitions: Psychological and educational considerations* (pp. 47–87). New York: Cambridge University Press.

Perfetto, G. A., Bransford, J. D., & Franks, J. J. (1983). Constraints on access in a problem-solving context. *Memory & Cognition, 11*, 24–31.

Puntambekar, S., & Hubscher, R. (2005). Tools for scaffolding students in a complex learning environment: What have we gained and what have we missed? *Educational Psychologist, 40*(1), 1–12.

Puntambekar, S., & Kolodner, J. (1998). *Distributed scaffolding: Helping students learn in a learning by design environment*. Paper presented at the proceedings of the third International Conference of the Learning Sciences (ICLS '98), Atlanta, GA.

Quintana, C., Reiser, B. J., Davis, E. A., Krajcik, J., Fretz, E., Duncan, R. G., et al. (2004). A scaffolding design framework for software to support science inquiry. *Journal of the Learning Sciences, 13*, 337–386.

Rogoff, B. (1990). *Apprenticeship in thinking*. New York: Oxford.

Roth, W. M. (1998). Inscriptions: Toward a theory of representing as social practice. *Review of Educational Research, 68*, 35–60.

Salomon, G. (1993). No distribution without individual cognition: A dynamic interactional view. In G. Salomon (Ed.), *Distributed cognitions* (pp. 111–138). New York: Cambridge.

Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanisms of a neglected phenomenon. *Educational Psychologist, 24*, 113–142.

Schmidt, H. G. (1993). Foundations of problem-based learning: Some explanatory notes. *Medical Education, 27*, 422–432.

Schmidt, H. G., DeGrave, W. S., DeVolder, M. L., Moust, J. H. C., & Patel, V. L. (1989). Explanatory models in the processing of science text: The role of prior knowledge activation through small group discussion. *Journal of Educational Psychology, 81*, 610–619.

Schoenfeld, A. H. (1985). *Mathematical problem solving*. Orlando, FL: Academic.

Suthers, D., & Hundhausen, C. (2001). Learning by constructing collaborative representations: An empirical comparison of three alternatives. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *Proceedings of the first European conference on computer-supported collaborative learning* (pp. 577–584). Netherlands. Universiteit Maastricht.

Torp, L., & Sage, S. (2002). *Problems as possibilities*. Alexandria, VA: ASCD.

Van Berkel, H. J. M., & Schmidt, H. G. (2000). Motivation to commit oneself as a determinant of achievement in problem-based learning. *Higher Education, 40*, 231–242.

Vye, N. J., Goldman, S. R., Voss, J. F., Hmelo, C., & Williams, S. (1997). Complex math problem-solving by individuals and dyads: When and why are two heads better than one? *Cognition and Instruction, 15*, 435–484.

Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Walker, A. E., & Leary, H. (2009). A problem based learning meta analysis: Differences across problem types, implementation types, disciplines, and assessment levels. *Interdisciplinary Journal of Problem-based Learning, 3*, 12–43.

Ward, J. P. T., Gordon, J., Field, M. J., & Lehmann, H. P. (2001). Communication and information technology in medical education. *Lancet, 357*, 792–796.

Wenger, E. (1998). Communities of practice: Learning as a social system. *Systems Thinker*.

Yew, E. H. J., & Schmidt, H. G. (2009). Evidence for constructive, self-regulatory and collaborative processes in problem-based learning. *Advances in Health Sciences Education, 14*, 251–273.

Zimmerman, B. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice, 41*, 64–71.

Part II
Investigating the Achievement in Student Learning Outcomes in PBL Programmes

Chapter 2
A Backward Glance, the Forward Gaze: Evaluation in Problem-Based Courses

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2.1 Introduction

That evaluation drives learning is an oft-repeated mantra, though what the purpose of that learning is or what it ought to be is debated. Problem-based learning (PBL) provides an opportunity for students to learn more actively, foster self-directed learning and enable a platform for students from which to launch useful, successful careers. In 1989, a new undergraduate science programme in the Life Sciences (the Honours Biology and Pharmacology Co-operative (Co-op) Programme) was set up at McMaster University. Though PBL had been used in professional courses at the university, it had not been used to any great extent in the undergraduate curriculum. This programme used a hybrid curriculum where the pharmacology courses were taught using a PBL approach whereas most of the other courses were taught in the standard lecture-based format. In addition, a cooperative component was included and students were expected to complete three separate work terms in industry, academic centres or in government. The premise was that PBL would provide the skills and the knowledge base that would help them function effectively in the workplace (Rangachari, 1994).

In 1994, the three of us were participants in that programme: KT and RS were students and PKR was their tutor. We published a report where we contrasted the views of students and faculty on specific assessment tools used in the introductory pharmacology course (Rawnsley et al., 1994). There were both process and content objectives. In common with most introductory pharmacology courses, students were expected to learn the general principles of drug action (pharmacokinetics and pharmacodynamics) and apply these to specific domains. Given a problem in pharmacology, students were expected to generate issues, frame learning tasks, seek appropriate information from a variety of sources, critically analyse the information obtained, synthesize it into a coherent framework and share it with their peers. They were also expected to be able to assess their own

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performance as well as those of their peers. Multiple evaluation procedures were developed and these included evaluation of tutorial performance, problem summaries, critical analysis of a published paper, and essays on clinical trials and problem-solving exercises. In the original paper, the tutor described his rationale for using each of the assessment procedures and the students gauged the success or failure of each based on their own learning experiences.

Sixteen years later, we are revisiting those issues. We have chosen to use a conversational approach which we hope will provide a 'thick description' (Geertz, 1973) of what evaluation means to students and teachers.

PKR: Karen, Robert, thanks for joining me on this re-venture. Before we plunge into the discussion, I want each of you to give our readers an update as to how you fared once you graduated from the programme.

KT: Upon graduation, I did a short survey project for you and went on to a 10-year career at Eli Lilly, starting first in data management, moving to clinical trial monitoring, project management and then ending with responsibilities for quality training and business operations. I then moved to London, Ontario where I took on quality assurance management responsibilities with Robarts Clinical Trials which is an academic contract research organization.

RS: After completing the BioPharm programme I was accepted into Medical School at McMaster and completed my clinical training in both Internal Medicine and Gastroenterology. I subsequently accepted a faculty position at McMaster as Assistant Professor of Medicine and I am currently in active practice as a Consultant Gastroenterologist at St. Joseph's Hospital in Hamilton providing both inpatient and outpatient care. During this time I have also been involved in translational research studies examining autonomic functioning in patients with gastrointestinal disease and associated central control mechanisms (Spaziani et al., 2008; Hall et al., 2010). My educational interests include the teaching and clinical supervision of medical students, residents and subspecialty fellows.

PKR: A quick update on my part. I taught that same course till December 2003. I remained as Director of the Programme until that time and then took early retirement to accept a position at the University of Calgary. It was not a wise decision, suggesting that even after years of teaching experience, my ability to size up situations was sorely lacking! Fortunately I had an opportunity to return to my sanctuary. However, I am no longer involved in the Honours Biology-Pharmacology Programme (BioPharm) and in fact do not do much small group teaching any more. My class sizes have grown a bit and I now teach classes that range from 20 to 200. I still try to adapt and modify some of the principles of PBL but that is a challenge.

2.2 Revisit: Assessing Tutorial Performance

PKR: Let us revisit our old paper. In that paper, we considered multiple evaluation procedures that I had used in that introductory course. The rationale was to introduce some sense of fairness and give all students an opportunity to

display their strengths at least in one if not more ways. Just to recap, the ones we discussed were evaluation of tutorial performance, problem write-ups, critical analysis of a published paper, the design of a clinical trial and the Group Triple Jumps. I suggest that in the interests of continuity, we stick to the original sequence and if we have little to say on that item, just move on.

Let us begin with the evaluation of tutorial performance. The rationale was that in PBL process and content were inextricably linked, so what you learned stemmed from how you learned. Responsibility became a crucial issue and we used standard forms to evaluate a student's performance at the end of each tutorial. In my earlier experience with the MD programme, I had felt that this important component was often short-circuited due to time pressures and at least for the introductory course it was vital to formalize these. The categories used were responsibility, information, communication, critical analysis and self-assessment skills. We used the same criteria for both formative and summative evaluations. Interestingly, these were the categories that emerged from the discussions with the first batch of students in the programme. Can you recast your minds to what you felt then and whether any of the skills that you acquired from those procedures have been helpful in your subsequent careers?

KT: I attribute my success in business to my ability to assess my performance and adjust rapidly to the changing environment. I feel strongly that the skills introduced during the tutorial performance evaluations, that were unique to the BioPharm programme, started me on that path. The small (8-student) tutorial provided me with a safe environment to practise these skills and a sounding board to give me the feedback I needed. Being able to receive and provide feedback on performance is an art and I am thankful for the early opportunity to practise this art. To be fair, these early attempts at receiving and providing feedback were not as robust an experience as I later achieved in the workplace. In addition, the overall experience within the tutorial was heavily influenced by the dynamics of the group. Groups that did not get along tended to have a more negative experience than groups that did get along. This was an important lesson that I took with me when starting my career. I realized that if I was to be successful, I needed to join a compatible team.

RS: I found that the skills learned in the tutorial aspect of the BioPharm programme proved to be relevant in my subsequent clinical training and practice. Many of the learning environments in clinical medicine are group based. For example, in preparing for specialty certifications, studying often occurs in small groups serving to complement self-directed or individual learning. Honest feedback at such a stage is important to help focus additional study to allow for successful completion of examinations. 'Group learning' continues to apply even after formal training has been completed. As practicing physicians we continue to meet as a group both at large learning symposia such as conferences or more regularly in the form of small group 'rounds'.

The importance of 'evaluation' also applies in this post-training phase both formally and informally. Formally, physicians apply for and receive credentialing to practise in hospitals. Also many hospitals ask physicians to routinely

evaluate hospital admissions for quality assurance purposes. Informally, the success of a good clinical service depends on the successful interaction of colleagues within a division and among different clinical services sharing opinions, experience as well as new knowledge and techniques.

PKR: Those procedures worked like a charm then. Over the years I have been frustrated in adapting similar approaches to other situations. It is impossible to assess individual learning to the same degree in large classes. I have tried getting students to keep learning logs and document their growth over the duration of the course. The results have been patchy. Some do it extraordinarily well, others find it a chore and jejune. Nowadays, I simply offer it as an option to students as a way of demonstrating their learning. If there is one element in the evaluation process that I find utterly frustrating, it is that. But that would be a topic for a different chapter, one that highlights failure rather than success!

Let me summarize what we have discussed and relate it to observations made by others. There are two issues here – one is the value of feedback, monitoring and formative assessment and the other relates to self-assessment. Though these are linked, they need not necessarily be. Students clearly need to chart their progress so that they can alter their learning strategies to optimize their learning. There is vast literature on this topic and we cannot really explore all the ramifications here. The more important issue is what does all this involve? How well do students perceive and respond? A recent paper by Pokorny and Pickford (2010) explores the complexities involved. Whereas more senior students tried to gauge the basis of the assessments made, more junior ones tried to link comments made to overall performance on summative assessments.

Self-assessment is a crucial element in learning but confusion exists as to what this really means. The problems raised by inconsistencies in the use of that word have been discussed. What we did through ongoing tutorial evaluation would fit into what Eva and Regehr (2008) would call self-monitoring. The students, with the help of their peers and the tutors, were encouraged to think about their progress in relation to the objectives of the course. Thus, issues we discussed were really related to learning strategies and content of the course. Did each student really know how to analyse dose-response curves and estimate pA2s? Did the students identify and consult the most useful resources? Self-reflection is more complex and it is really difficult to get to grips as to what it means to different people and even standardize that. This involves going beyond trying to solve a problem at hand and to invest time and energy in 'understanding' the problem (Eva & Regehr, 2008). These ideas were popularized as two forms of reflection, reflection-in-action and reflection-on-action (Schon, 1983). In the first instance, the practitioners think about their actions while they are doing it. They use the situation to not only test their prior knowledge but also learn from it. Reflection-on-action is often post-hoc and involves thinking about the learning and understanding that has occurred once the actions have taken place. I think that in the discussions that we had at the end of the tutorials we may have done bits of both, but probably did not articulate it explicitly.

2.3 Revisit: Assessing Written Assignments

PKR: Let us move onto Problem Write-ups or summaries. If you recall, we expected each student to hand in a brief summary of what he/she had gleaned from each problem. The rationale was that it provided the student a useful log of the content components of the course and the tutor an opportunity to recognize individual learning.

KT: I have a few comments about the Problem Write-ups. The ability to write succinctly is useful in business. With practice we become better at it. I also find that, over time, I have used this summarizing technique as a study tool to help me understand complicated ideas and concepts. I find that if I can summarize a concept, I can understand it. Upon reflection, there was an additional advantage of the Problem Write-up that was not apparent to me at the time. There were several of my classmates who struggled with the evaluation portion of problem-based learning. Where I most valued my assessment of what I learned, these classmates placed a greater value upon the grade they received from their teacher. These Problem Write-ups gave those classmates a concrete, external benchmark with which they could measure their success.

RS: I felt that the written summaries were a useful learning tool. The ability to succinctly summarize large amounts of information is invaluable in clinical practice. Whether it involves discussing a patient's case by telephone or in a written consultation document, one 'mark' of a good clinician is often this ability to concisely yet thoroughly describe the pertinent aspects of a case: a skill that we continually try to instil in our trainees.

PKR: This, in a sense, harks back to our earlier discussions about feedback and self-monitoring. Again, this particular exercise worked because we anchored it tightly to the objectives of the course and focused on the specific concepts and content that formed part of the core.

Another exercise that I included was the critical analysis of a published paper. My rationale was simple. A crucial component of PBL is the ability to analyse information appropriately. Since much of the information in basic biomedical sciences is published in that format, I wanted students to get experience in that domain. To have a formal evaluation procedure seemed a sensible way of emphasizing the relevance of that skill. So each group was given a short paper in pharmacology and a checklist to help them go through the paper (Rangachari & Mierson, 1995). This was done as a take-home assignment.

KT: It is hard to remember back to the first critical analysis assignment. It is overshadowed by the multitude of papers that I critically analysed every week as part of the PBL programme. This skill has served me well in business and has led me into the quality assurance area where critical analysis is a fundamental requirement.

RS: The critical analysis exercise has had particular relevance for me in the practice of medicine. New evidence is continuously being published and needs to be critically evaluated before it is used clinically. The presented results need

to be carefully considered in the context of methodology and other, often important, limitations. By the same token, the results of robust studies need to be quickly identified and incorporated into practice so as to provide patients with the most up-to-date care.

PKR: Now that I teach larger classes, it is not easy to use that procedure. I have modified it for my first-year biology course, where students get practice in identifying the components of a peer-reviewed paper and learn to write abstracts. But clearly it is not as effective as getting them to really analyse publications in depth. We had two other exercises in the course – one was the design of a clinical trial and the other was a Group Triple Jump exercise. I suggest that we discuss the latter first.

KT: I think, in this case, it makes sense for you to go first and then Rob and I to comment.

PKR: The Group Triple Jump was an exercise that attempted to mimic the scientific process. It was based on the triple jump exercise which had been originally designed by a group of medical students who were in Vic Neufeld's tutorial group many years earlier (Painvin, Neufeld, Norman, Walker, & Whelan, 1979). That was a one-on-one situation where each student was questioned by his/her tutor. Given the larger class sizes in the BioPharm programme, I had to modify the format. All students were given the same problem in a formal exam situation. You were given limited information (a clinical situation, data from an experiment etc.) and asked to provide 1 to 3 possible explanations. Then you were asked to select your best explanation and design an experimental test to confirm or justify your explanation. Finally, you were given more information and asked to reassess your original explanations and tests. When you were students, you noted that this was a valuable exercise. Now that both of you have moved onto different careers, what are you impressions?

KT: Often, I find myself going through the steps of the Triple Jump exercise. I may not have to devise an experiment, but I need to devise a way to test procedures or systems, complete the tests and then research why things did not turn out as planned. This work is usually time sensitive, so this early experience helped prepare me for what I do today.

RS: The Triple Jump exercise mimics the process by which patients are evaluated and treated. It also has similarities to a clinical evaluation tool often referred to as an Objective Structured Clinical Examination (OSCE). In evaluating a patient's presenting clinical problem, one initially obtains information from the patient in both the clinical history and physical examination. From this information, a differential diagnosis is formulated. This is often followed by diagnostic tests or investigations that serve to 'rule out' possibilities on the list of differential diagnoses and to provide objective evidence for the most likely aetiology to help guide management of the problem. Medical learners are often presented in examination environments with a clinical vignette, allowed to then make general hypotheses or a differential diagnosis and then propose avenues of investigation. They are then provided with results and asked to reinterpret this new information in the context of the original clinical

problem in order to propose further diagnosis and management. The Triple Jump exercise as a process has proved to be a relevant examination model for clinical teaching and practice.

PKR: That original exercise has morphed into a Tri-Partite Problem Solving Exercise (TRIPSE). I have adapted it to different situations, to larger classes (numbering 180 plus) and also use it to get students to demonstrate their abilities to transfer learning to a new situation by writing TRIPSES themselves (Rangachari & Nastos, 2010). These TRIPSEs are used for subsequent classes – a sort of legacy!

Do both of you want to discuss the design of a clinical trial? Just to refresh your memories, you were permitted to explore any area of pharmacology that was of particular interest to you and frame a proposal for a clinical trial. You were permitted to invent your own drug for a standard condition or even use a standard drug for an invented condition (Rangachari, 2002). The assessment was based on a clear statement of objectives, logical development of the proposal, clear demonstration that the student recognized the key elements of a clinical trial, appropriate referencing and flair.

KT: Honestly, I don't remember doing this activity. I read and evaluate clinical protocols regularly. That said, after reading our comments about this task, I agree about the need to promote creativity. Being able to think outside the box is a highly sought-after business trait. In quality assurance, I am often asked to provide options to the clinical group when it comes to meeting regulatory requirements. This requires creative thinking!

RS: I recall this exercise well. I chose to study a drug that had recently gone through the process of 'bench to bedside'. It is a drug I often have occasion to use today as it falls under the class of gastrointestinal drugs. I remember obtaining a good appreciation of drug trial methodology during this exercise. I also remember learning about the pathophysiology of nausea and vomiting as a result. Some of the concepts learned there formed the basis of knowledge I now have in the area. For me, this exercise had particular relevance.

PKR: Karen, it is interesting that you mention the ability to think 'outside the box'. However, this is rarely encouraged in most evaluation procedures that are used. Many years ago, Eliot Eisner wrote about educational objectives (or perhaps expected outcomes). One he called instructional is what teachers often refer to as course content. These can be easily framed in behavioural terms. Something like, by the end of this course you would have learned the principles of general pharmacology. You would, for example, be able to contrast graded dose-response and quantal dose-response curves, etc. Expressive objectives in Eisner's view were different and described an educational encounter which gave students licence to explore, defer or focus on issues that are of particular interest to the enquirer (Eisner, 1985). He argued that these could not be really specified in advance as they are evocative rather than prescriptive. In practically all courses that I have designed, I have included expressive outcomes to varying extents. There were, of course, some specifications but these tended to be looser so that students could have ways and means of expressing their imagination and

creativity. For instance, in a course that I currently teach on pharmacology (Therapeutic Drugs: Molecules in the Marketplace), I have students explore drugs from multiple perspectives – makers, users, pushers and watchers. Students can demonstrate their learning through different formats. One year, two groups were exploring adverse drug reactions. One group looked at it from the perspective of a journalist covering an incident that happened to a patient and wrote their report in the form of a story. Another group looked at the same issues and framed a report about changing policies to minimize Adverse Drug Reactions (ADRs) in a hospital setting. I have felt quite strongly that these sorts of activities foster deeper learning. Based on your vantage point, would you say that such exercises may have consolidated your knowledge base?

KT: I think that these types of exercises with their general objectives are aligned with my learning style. I learn best when I find the answers out myself. The process of exploration is what I remember. This process facilitates the retention of details that I would otherwise not be able to recall. The downside of this is that the problem-based courses require substantially more effort than the lecture-based courses. Unfortunately, not all students put the same amount of effort into the PBL courses. It was possible to listen to the discussion, write up the summary and do well in the course. This should have been challenged during the feedback portion of the tutorials, but the feedback tended to be positive, as many of us were unsure of how our feedback would be received. In the grand scheme of life, I don't consider this all that relevant, as self-motivated individuals who put effort into whatever they do, tend to be successful.

RS: I believe the BioPharm programme succeeded in using expressive educational objectives as an application of knowledge learned via instructional components. I believe the combination of both when done with thoughtfulness can be quite effective. Ultimately, expressive learning objectives may have the most relevance in the 'real world' where new areas of knowledge are more likely to be explored in the context of 'projects' or 'rounds' or other similar self-directed learning tasks.

PKR: I want to expand on this notion just a bit. Over 10 years ago, Grant (1999) commented on the incapacitating effects of competence. Her arguments were that some professions such as medicine, law, education and social work were being narrowed to a set of practical skills at the expense of intellect, judgement and independence. She felt that assessing measurable competence may not be able to account for the fact that professionals need to draw upon knowledge in unpredictable and creative ways. These notions were expanded in a more recent paper caustically titled 'Monkey see, monkey do' (Talbot, 2004). Though these comments are focused on medical education, the points made can be generalized to the education of scientists, who, more than others, need to be able to have the flexibility of mind and adaptability to transfer learning to new domains and discover the unknown.

KT: I do see evidence of this in business. The popular training model is to deliver a course via computer-based training that has a testing component at the end. The problem is that these courses and their assessments are presented

as evidence of competence. When employees don't deliver, more resources are applied to the development of the computer-based tool, rather than management support. I have been fortunate to have had management that believed in the importance of having new opportunities as a means of furthering my development.

RS: I believe your comments point to a common challenge in education and evaluation; how does one accurately evaluate a student's competence and is this evaluation relevant in 'real world' applications? This is a dilemma that I believe is not career specific as even the most well thought out teaching and evaluation paradigms have their limitations. One of those limitations undoubtedly relates to how quickly knowledge evolves, making the 'how' of learning, i.e., establishing learning skills, often as important as what is learned. Evaluating this later skill often proves difficult. One hope of any educational endeavour is to accurately identify and promote those students who demonstrate the willingness and effort to learn the necessary fundamental core knowledge; demonstrate proficiency in learning how to apply this knowledge; and demonstrate the flexibility to engage in lifelong learning. How to best provide that opportunity for each individual student will continue to be a work in progress.

PKR: Earlier, you mentioned the survey you designed for the BioPharm programme. It had a number of elements in it, but one set of questions focused on contrasting what students had achieved through a hybrid curriculum. You gave them a list of abilities, skills and outcomes and asked them to rank the degree to which they had attained each item from either the lecture-based or problem-based formats.

2.4 Other Points of View: Analyses of a Questionnaire

PKR: Your class of 1996 was the first to fill this out. Subsequently, I gave the questionnaires to other batches. I explained to each if them what your rationale was and managed to gather data from several cohorts. There were, of course, some problems with gathering the information. It was not really a formal exit survey. Often the surveys were sent to them when they had graduated and many had moved onto other locales. Nevertheless, the data were gathered over a 9-year period from nine cohorts and may have some value for our discussions. Take a look at the results and see if there is anything that surprises you. Since both of you were in the first cohort, would your individual opinions concur with those of the others? (Table 2.1).

KT: Looking at the chart, what stands out to me is the relatively high scores for general and specific knowledge given to the lecture-based format. I know, at the time, I rated the lecture-based format quite high for those items, but, looking back, it is the knowledge that I gained from PBL that I put into practice and built upon. If I were to do the survey again, I would prefer to add a 'usefulness of knowledge' category for which I would rate the lecture-based material as irrelevant.

Table 2.1 Responses to a questionnaire

	Items	Lecture format (Means±SD) $N = 88$	PBL format (Means±SD) $N = 88$
	ABILITIES		
1	Learn on your own	3.09±1.00	4.88±0.33***
2	Contribute as a group member	2.13±1.04	4.81±0.45***
3	Make decisions	2.78±1.13	4.34±0.75***
4	Solve problems	2.79±1.10	4.69±0.49***
5	Gather information	2.89±1.14	4.9±0.28***
6	Analyse information	2.93±1.07	4.73±0.43***
7	Evaluate your own performance	2.35±1.24	4.59±0.57***
8	Work effectively with different personalities	2.25±1.01	4.56±0.62***
9	Function in a high-stress environment	3.67±1.05	4.31±0.67**
	SKILLS		
1	Time management	3.85±1.00	4.5±0.72**
2	Oral communication	2.26±1.02	4.64±0.49***
3	Written communication	3.54±0.96	4.47±0.64***
4	Presentation	2.90±1.01	4.56±0.71***
5	Critical analysis	2.45±1.05	4.67±0.49***
	OTHER		
1	Higher grades	3.81±0.83	4.16±0.81**
2	Higher self-esteem	3.01±1.13	4.06±0.95***
3	Close peer network	2.49±1.13	4.39±0.95***
4	Knowledge in general concepts	3.91±1.04	4.59±0.64**
5	Specific knowledge in a given area	3.73±1.11	4.6±0.57***

Note: differences significant (** $p < 0.01$ *** $p < 0.001$) using a Wilcoxon Sign-Rank Test
Data gathered from nine different batches of students (96, 98, 99, 2000, 2001, 2002, 2003, 2004, 2005)

It is also interesting to view the comments that were supplied with the surveys. Most survey respondents indicated a frustration with the workload of PBL. One survey respondent wrote

> Emphasis should be put on the fact that lecture-based courses are necessary/essential as it would take a super human to complete a solely PBL program.

Despite the workload, most indicated a high degree of satisfaction with the programme, as one respondent indicated:

> I have been challenged beyond any expectation that I could have had and I feel satisfied and fulfilled to have completed the program successfully.

Responders felt confident with their skill-set upon graduation. One respondent wrote

> Some of the most valuable skills to me include oral and written communication and ability to work as a team.

However, there were quite a few who commented on the disparity in work ethics of their classmates:

> I am a hardworking, honest, self-motivated person. Other people are not and just want to cut corners. This is the one major flaw of PBL in undergrad and the main reason why I think the lecture format should not be totally exchanged for PBL... All I can conclude from all my experiences over 3 years in BioPharm is that it has given me guidance, purpose and ambition – who could ask for more?

RS: I think the survey indicates that learners rate PBL quite high in areas that have particular relevance to real-world working environments where communication skills, initiative and working well in groups are of fundamental importance.

2.5 Thoughts on Consequential Validity

PKR: Finally, I would like to draw the diverse threads of this discussion together and discuss what has been termed 'consequential validity' (Kennedy, Chan, Fok, & Yu, 2008; Sambell, Brown, & McDowell, 1997). The term itself has been interpreted in different ways. One way of looking at it is the effect that assessment procedures have in learning and whether the actual consequences are the ones intended. In the past, assessments had been used primarily for purposes of certification. However, it is clear that students learn for exams and thus assessments could have significant effects on learning. Some authors use the term backwash effect to describe the means by which students adjust their learning to the exam situation. If the exam itself is complex, students may alter their learning strategies. So, if an assessment stimulates students towards thinking, then the practice provides a rich learning experience.

In all courses I have designed, including the ones you took, I had two aims, which may or may not have been made clear to the students. The first was to have multiple evaluation procedures so that students had opportunities to demonstrate their strengths in several ways and not be penalized by a single approach. Second, I wanted to provide a rich learning experience and get students to appreciate the complexities involved in practising science. Those were MY intentions. What were the consequences of these assessment procedures on YOUR learning?

KT: In business, it is uncommon to be given exams. Although certification bodies exist, performance assessment is based upon the observations by your peers and supervisors. The assessment procedures in the PBL programme more closely mimic the assessment in business as the PBL assessments are not just assessing knowledge, but providing yet another opportunity to practise useful skills, thereby contributing to ongoing learning. Looking back, it is difficult to say what I would have changed. Part of me would want to see a harsher punishment for those students who didn't put the same effort into the programme. However, at this stage in my life, I am inclined to say that their lack of

effort had a minimal impact on my overall success in the programme and my lifelong learning. I think for a PBL programme to be successful, a rigorous screening process needs to take place. Highly motivated students, who value learning as a process, are desirable for PBL programmes. It is not for everyone. This screening will take resources as there is no easy metric for these qualities.

There is one final comment that I have to make. Throughout this discussion, the emphasis has been on the student's effort in learning. What made this programme possible was the advance planning and facilitation expertise of the teachers. The best teachers direct students, while allowing them to taste failure. I am fortunate that while I attended the PBL programme, I had the best teachers.

RS: I believe where the BioPharm programme succeeded was in providing an educational experience that closely mirrored real-world working environments. By utilizing a tutorial-based component it provided the opportunity to allow students to foster the development of skills highly sought after and valued in the work place such as communication skills and the ability to effectively work within groups. It also allowed for many ways to learn and test the core principles of pharmacology. While I believe it is true that different learning styles may be more or less suited to the mixed didactic and self-directed or PBL structure of the BioPharm programme, I believe it achieved the core goal of training students to have a good core knowledge of topics in pharmacology and biology and allowed for the opportunity to develop highly marketable professional traits such as good interpersonal communication skills and self-directed learning skills. While the success of this particular programme may have been partially dependent on the pre-selection of students likely to excel in such an environment, careful study and analysis of the factors that may have contributed to the experience of students who did not fare as well may prove useful in the future development of such programmes.

2.6 Summing Up: Learning Journeys

PKR: Karen, Rob, we have dealt mainly with the evaluation procedures that were used in the Bio-Pharm courses since trying to revisit our earlier paper. I want you to consider a metaphor for learning and discovery, that of a journey. Buss (2008) wrote a thoughtful essay which started with a quote from Martin Buber that 'All journeys have secret destinations of which the traveller is unaware'. So, all learning results in outcomes, some planned, some unplanned. Can both of you summarize your learning journeys thus far and the unexpected destinations that the PBL approaches have led you to?

KT: As a young child, I learned by experiencing life. When I first entered the school system, I learned by memorizing what I was told to. My university career saw a return to my early childhood learning strategy, following the plan set by my coursework. Now, I take a more active part in planning what I would like to learn and looking for opportunities with which to engage in the process. PBL

provided me with the self-assessment and critical thinking skills necessary to be able to control my future direction.

RS: My educational journey included both traditional didactic and PBL programmes. I ultimately feel fortunate to have been exposed to both approaches. In reflecting back on my formal education, I have come away with an appreciation of the fact that the ultimate goal for any learner is to try and take what worked best from each learning experience and incorporate it into your own ongoing learning strategy.

PKR: Given my age, my learning journey has been longer and more tortuous. PBL entered my lexicon only when I came to McMaster University. I was initially amused and sceptical, but once I saw the process in action, I realized the value of this approach. I have adapted the principles of PBL to different settings and all of this has been a great learning experience. When the system works well, it produces students who have the confidence not only to state what they know but also to provide evidence for their statements. In addition, they have the willingness to admit their ignorance and seek help and advice. In a sense, this harks back to Dewey's (1938/1982) comments about the process of inquiry when he emphsasized that the end point of inquiry was not really knowledge or belief but 'warranted assertibility'. That exquisite term, with its nuanced blend of confidence and humility captures the essence of PBL.

References

Buss, D. (2008). Secret destinations. *Innovations in Education and Teaching International, 45*(3), 303–308.

Dewey, J. (1938/1982). *Logic: The theory of inquiry*. New York: Irvington Publishers.

Eisner, E. W. (1985). *The art of educational evaluation: A personal view*. London and Philadelphia: Falmer Press.

Eva, K. W., & Regehr, G. (2008). "I'll never play professional football" and other fallacies of self-assessment. *The Journal of Continuing Education in the Health Professions, 28*(1), 14–19.

Geertz, C. (1973). Thick description: toward an interpretive theory of culture. In C. Geertz (Ed.), *The interpretation of cultures: selected essays* (pp. 3–30). New York: Basic Books.

Grant, J. (1999). The incapacitating effects of competence: A critique. *Advances in Health Science Education, 4*(3), 271–277.

Hall, G. B., Kamath, M. V., Collins, S., Ganguli, S., Spaziani, R., Miranda, K. L., et al. (2010). Heightened central affective response to visceral sensations of pain and discomfort in IBS. *Neurogastroenterology and Motility, 22*(3), 276.

Kennedy, K. J., Chan, J. K. S., Fok, P. K., & Yu, W. M. (2008). Forms of assessment and their potential for enhancing learning: Conceptual and cultural issues. *Educational Research for Policy and Practice, 7*(3), 197–207.

Painvin, C., Neufeld, V. R., Norman, G. R., Walker, I., & Whelan, G. (1979). The "triple jump exercise" – a structured measure of problem solving and self-directed learning. *Annual Conference on Research in Medical Education, 18*, 73–77.

Pokorny, H., & Pickford, P. (2010). Complexity, cues and relationships: Student perceptions of feedback. *Active Learning in Higher Education, 11*(1), 21–30.

Rangachari, P. K. (1994). Quality education for undergraduates in pharmacology: A Canadian experiment. *Trends in Pharmacological Sciences, 15*(7), 211–214.

Rangachari, P. K. (2002). Student-designed clinical trials: Evaluating self-directed learning in pharmacology. *Naunyn-Schmiedeberg's Archives of Pharmacology, 366*(1), 44–47.

Rangachari, P. K., & Mierson, S. (1995). A checklist to help students analyze published articles in basic medical sciences. *The American Journal of Physiology, 268*(6 Pt 3), S21–S25.

Rangachari, P. K., & Nastos, S. (2010). Legacy TRIPSE (Tri-Partite Problem-Solving Exercises): Fostering student engagement and learning in large classes. *The FASEB Journal, 24*, 633.1.

Rawnsley, K., Spaziani, R., & Rangachari, P. K. (1994). Evaluation in a problem-based course: Contrasting views of student and teacher. *Probe, 2*, 9–14.

Sambell, K., Brown, S., & McDowell, L. (1997). "But is it fair?": An exploratory study of student perceptions of the consequential validity of assessment. *Studies in Educational Evaluation, 23*(4), 349–371.

Schon, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Spaziani, R., Bayati, A., Redmond, K., Bajaj, H. S., Mazzadi, S., Bienenstock, J., et al. (2008). Vagal dysfunction in Irritable Bowel Syndrome; Assessed by colorectal distension and baroreceptor sensitivity. *Neurogastroenterology and Motility, 20*(4), 336–342.

Talbot, M. (2004). Monkey see, monkey do: A critique of the competency model in graduate medical education. *Medical Education, 38*, 587–592.

Chapter 3
Comparisons in Basic Science Learning Outcomes Between Students in PBL and Traditional Dental Curricula at the Same Dental School

Charles F. Shuler

3.1 Introduction

The terms "assessment" and "evaluation" are often used as synonyms when speaking about a curriculum, but they can be defined more precisely based on their use in the educational literature (Stufflebeam, Madaus, & Kellaghan, 2002). "Assessment" refers to methods used to determine the performance of individual students. "Evaluation" is used to refer to methods that determine the performance of the curriculum or program as a whole. Thus both student assessment and program evaluation are fundamental components essential for any curriculum. Unfortunately, these important aspects are often left until the very late stages of any curriculum revision and at those stages there is often a lack of faculty/staff energy to develop detailed approaches. Consequently the development of assessment and evaluation strategies is not afforded the same level of consideration as the content topics in the curriculum. Some form of program evaluation outcome is likely to have identified a weakness or deficiency that triggered the curriculum revision, so a strategy to insure that the new curriculum functions as designed to overcome that weakness/deficiency needs to be implemented. Activities such as detailed outcomes assessment approaches monitoring specified metrics, both internal and external, as well as external review through accreditation processes, often provide valuable contributions to program evaluation. In-depth reviews of dental curricula by the Institute of Medicine also identified several areas that should be addressed in dental curriculum revisions (Field, 1995). Ultimately, outcomes generated from external evaluation metrics may be the most valuable to enable comparison between similar programs at different institutions or major changes in curricular approach at the same institution; however few external metrics suitable for these types of comparison exist. The American Dental Association National Board Dental Examination (NBDE) Part 1 is an example of an external metric

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that can be used since the exam assesses dental students on their basic science content knowledge at all schools of dentistry in the United States (Joint Commission on National Dental Examinations, 2010).

One difficulty in comparing curricula at the same school is that most often when a major curriculum change occurs, the entire student body adopts the change. This means that program evaluations of the new curriculum can only be made either with respect to historical outcomes with the previous curriculum or with other schools using a different structure. There are few examples of comparisons of different curricular organizations at the same dental school at the same time with identical curricular learning objectives (Shuler & Fincham, 1998). Comparisons do exist in the medical literature between outcomes with different pedagogy (Baca, Mennin, Kaufman, & Moore-West, 1990; Saunders, McIntosh, McPherson, & Engel, 1990; Richards et al., 1996). The evolution of curricular change at the University of Southern California School of Dentistry (USCSD) provided an opportunity to compare historical outcomes, outcomes with different pedagogies with parallel tracks of students, and outcomes once a new pedagogy was implemented school-wide (Fincham et al., 1997; Fincham & Shuler, 2001).

One factor that is critical to program-evaluation strategies is the impact of pedagogy on learning. The approach used to help the students learn the content in the curriculum can have a major impact on developing the skills necessary to use the content in clinical situations. In *How People Learn* (Knowles, Holton, & Swanson, 2005) there is a careful review of learning styles and approaches that are effective for student achievement. Inquiry-based learning styles, like problem-based learning (PBL), have the benefit of providing students with an approach that is applicable to future situations in patient diagnosis and treatment (Barrows & Tamblyn, 1980). A clinician in practice must be able to recognize the limits of their knowledge, determine new information required, and develop a strategy for accessing and evaluating new information. In a traditional lecture-based curriculum the students are given the material, told to remember it, but not challenged to assess their own competence in the area. Even more importantly, assessment of student learning outcomes is generally limited to specific factual recall rather than application of knowledge. PBL provides a framework for curriculum achievement that resembles their eventual practice environment (Fig. 3.1). In practice a patient will present with a set of information that can be determined – the facts, i.e., chief complaint, history of present illness, past medical history, clinical examination, etc. Using all these facts the clinician will come to some conclusions that generate a differential diagnosis, which represents ideas/hypotheses for the nature of the patient's presentation. The clinician will often require additional information from radiographs, laboratory tests, and professional consultations that represents learning needs required to fully evaluate the patient's signs and symptoms. Obtaining this information provides additional facts for the case so that a final diagnosis can be reached and the appropriate treatment recommended. The PBL process is equivalent to the evaluation of a patient so that students

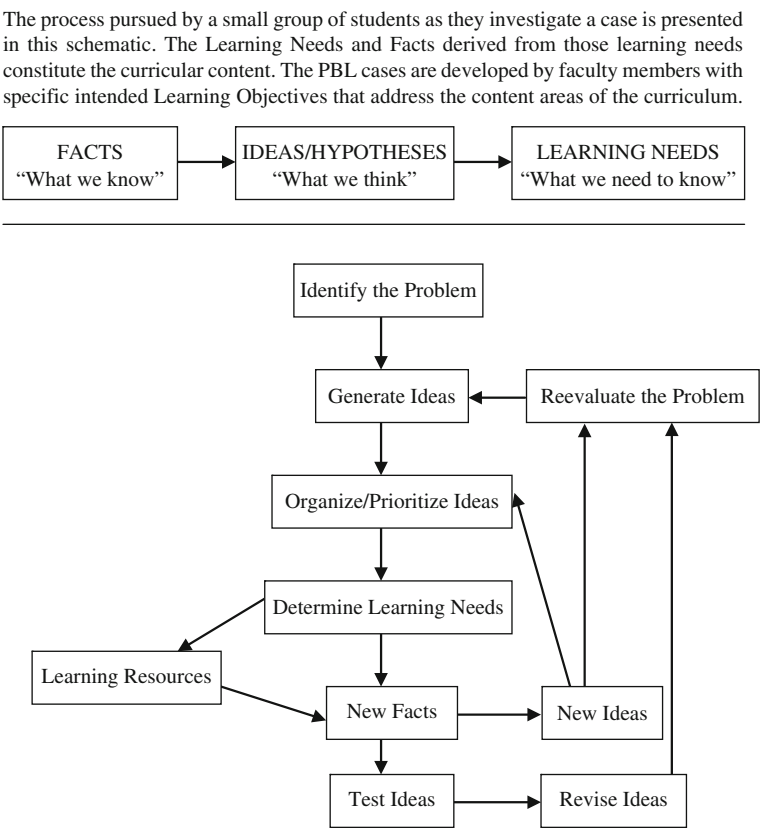

Fig. 3.1 Process of learning with a problem-based pedagogy at USCSD

learning by this method are developing skill sets applicable in the future when they encounter patient presentations they have not previously seen. This educational structure provides a foundation for critical thinking about new situations encountered during patient care. The approach also permits students to apply the knowledge they have gained in a clinically relevant fashion to build a framework of information applicable to patient care.

An active, student-centered learning approach is often opposed by faculty members who feel that students will only be able to learn if they are "told" the content by an expert. This leads to the conundrum of "teaching vs. learning." If the expert teachers "tell" the student the facts, yet the students perform at low levels on standardized examinations, then what conclusions should be made about the effectiveness of the curricular design? Learning with the ability to apply the information in subsequent clinical settings is truly the desired outcome. Evidence shows that the principles of adult learning require active

engagement in the learning process in order to achieve the desired educational outcomes (Knowles et al., 2005; Bransford et al., 2000). PBL is organized to support the evidence on effective adult learning approaches (Norman & Schmidt, 1992). In order to address the concerns of critics, program evaluation of curricula using different pedagogies based on outcome metrics generated from external processes is critically important. This chapter compares student achievement on an external, standardized examination of the basic sciences considered foundational for dental clinicians. The comparison is between two groups of students at the same school, with the same curricular learning objectives but following either a problem-based or a traditional, lecture-based pedagogy.

3.2 Methods

In 1995 a transition in leadership occurred at the Center for Craniofacial Molecular Biology (CCMB) of the University of Southern California School of Dentistry (USCSD). The faculty of CCMB had a retreat to plan for the future, and the dean, Howard Landesman, attended. Dean Landesman challenged the CCMB faculty members to become more involved in teaching the basic sciences to the dental students. He made this request based on his review of the performance of the USC dental students on the NBDE Part 1 examination. Dean Landesman had concluded that their performance fell below the desired level based on comparisons between the USC students and other dental students in the United States (Table 3.1 1988–1995). He was also impressed by the recommendations in the recent publication (1995) of the IOM report on dental education that provided some ideas with respect to curricular modification (Field, 1995). The CCMB faculty considered his request and came to the conclusion that it would be preferable to develop an alternative means to present the curriculum content rather than trying to change student outcomes by participating in the currently offered basic science courses. A PBL parallel track pilot program was initiated in 1995. It had the same curricular learning objectives as the traditional dental curriculum but differed with respect to the primary pedagogy (Fincham et al., 1997; Fincham & Shuler, 2001). The development and evolution of this curricular structure has been reported in several previous publications that also cite other examples of PBL incorporation in dental education (Fincham et al., 1997; Fincham & Shuler, 2001; Rich, Keim, &

Table 3.1 NBDE Part 1

Year	88	89	90	91	92	93	94	95	96	97	98
School	81.6	82.4	80.8	81.4	80.6	80.3	82.3	81.2	80	79.9	82.5
National	83.9	83.5	83.7	84.1	83.5	84.1	84.6	83.9	84.2	84.1	84.6
Quintile	5	5	5	5	5	5	5	5	5	5	5
Failure %	10	11	16	18	20	27	28	35	33	37	21

Shuler, 2005; Dalrymple, Wuenschell, & Shuler, 2006; Shuler, 2001, 2002). The style of PBL learning used in the USCSD program is depicted in Fig. 3.1. University approval of the PBL pilot was dependent on the program representing an educational "track" that was defined as identical educational outcomes but with the use of different methods to present the curricular content. Thus the learning objectives for both the PBL dental education and the traditional curriculum did not differ. All the specified learning objectives documented in the 1994 USCSD accreditation documentation were included in the PBL cases incorporated in the curriculum.

The educational achievements of the students were compared based on the overall performance of groups of students on the NBDE Part 1. That examination is prepared by the Joint Commission on National Dental Examinations of the American Dental Association (Joint Commission on National Dental Examinations, 2010). The examination focuses on the foundational basic sciences and assesses students based on their responses to questions in biochemistry, physiology, anatomy, histology, microbiology, pathology, dental anatomy and occlusion. Passing the examination is a required element for licensure in the United States. The NBDE Part 1 has gone through some changes over time in the way that exams are scored and results are reported, so the material used in the comparisons presented in this chapter are the aggregate overall averages and the quintile ranking of those scores for an entire group of dental students either PBL or Traditional. The quintile ranking of the performance of a group of students is an accurate comparator for achievement between the different pedagogies. The NDBE Part 1 consists of discipline-specific examinations that use multiple-choice questions to test the specified content areas. The NDBE Part 1 has a group of test constructors who review and update exam items and continue to review the content areas assessed. During the period reviewed in this chapter, the NDBE Part 1 remained similar in content areas and test construction.

The development of the PBL pilot program allowed the achievement of the students on NBDE Part 1 to be compared between the PBL and traditional students between 1997 and 2002. In 2001 the USCSD decided to implement the PBL curriculum for all the dental students. This means that there are three curricular time periods that can be used for analysis in this chapter. Period 1 represents the period before the first PBL pilot class took the NBDE Part 1 examination and extends from 1988 to 1996. Period 2 represents the period when PBL pilot students and traditional students were both taking the same NBDE Part 1 examination and occurred between 1997 and 2002. Period 3 represents when PBL was adopted school-wide for all dental students and extends from 2003 until the present. However, in this chapter, 2006 is the final comparison point that was available to this author. The examination results used in this analysis were those generated from the July NBDE Part 1 by students taking the examination for the first time. The numbers of students in each cohort changed over time. Up to 1995 the traditional DDS class had grown to 132 students per year, a number that was consistent until the last traditional

class that had 118. The initial PBL pilot class enrolled 12 students and during the 6 years of the pilot program the number grew to 24. When PBL was implemented school-wide, the class size was 144. Since the value used to compare the performance by students in different pedagogies is an overall group average score, the numbers in each cohort are not listed. Statistical analysis of the results from 1997 (Shuler & Fincham, 1998) indicated that the group sizes were sufficient for statistical comparison.

3.3 Results

The historical performance of the dental students at USCSD can be observed to be in the lowest quintile (5th) between 1988 and 1996 (Table 3.1), which is prior to the first students in the PBL pilot taking the exam. These historical results were one of the factors that led Dean Howard Landesman in 1995 to encourage the CCMB faculty members to become more involved in the dental student basic science education. The results through 1998 were shared broadly with faculty members at a curriculum retreat in December 1998 (Table 3.1) and at that retreat the performance of the first two pilot PBL classes was also shared (Fig. 3.2). In reviewing these scores, a frequent comment from some faculty members to justify the level of achievement was "we don't teach to the boards," yet no other external metric was available to compare student performance. The first PBL pilot group consisted of students who were accepted from the waiting list for entry to the USCSD. They were the first group of pilot students whose performance on the NBDE Part 1 could be compared to their peers in the

The NBDE Part 1 scores are reported to each school with a ranking in quintiles. Each quintile has 20% of the schools taking the examination included. The first quintile includes the schools with the highest overall averages on the examination. The fifth quintile includes the schools with the lowest overall averages.

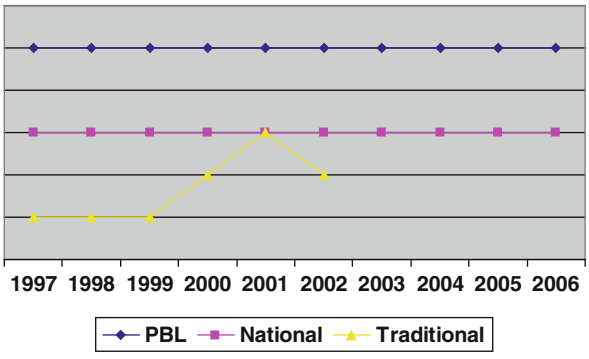

Fig. 3.2 Comparison of quintile ranking between PBL and traditional

traditional curriculum. That comparison between the PBL pilot group and their traditional peers based on the 1997 NBDE Part 1 examination has been previously reported (Shuler & Fincham, 1998). Following the initial pilot program, class students were required to be suitable for admission to the traditional DDS curriculum and thereafter chose to go through an additional admission process for the PBL program. Throughout the process they had the option to participate in either the traditional or PBL track. Once they entered school they were to remain in the track they chose prior to the beginning of their education until they completed the program of dental education.

Six NBDE Part 1 exams were taken by both PBL pilot students and traditional students (Fig. 3.2). In all 6 years the PBL pilot average scores ranked in the highest quintile of achievement. In all 6 years all of the students in the PBL pilot program completed the July NBDE Part 1 examination. The traditional scores did improve between 2000 and 2002, reaching the national mean level in 2001. There was a difference in the numbers of traditional students taking the July NBDE Part 1 in those years as students were only certified to take the examination when they had achieved either a specific grade point average in their basic science curriculum or achieved at a defined level on a series of mock board exams. The result during 2000–2002 was that a subset of the traditional class first took the NBDE Part 1 at a date later than July.

The USCSD classes that had all students enrolled in a curriculum using PBL as the primary pedagogy began taking NBDE Part 1 in July 2003. The results for the first four all PBL classes, 2003–2006, are also presented in Fig. 3.2. These students continued to complete the NBDE Part 1 examination with average scores in the highest quintile.

3.4 Discussion

An important factor in an analysis of student performance on examinations is the students' motivation to achieve at the highest levels. If students view the exam simply as a hurdle to cross prior to entering dental practice, then the motivation may be to simply pass the exam. The attitude toward performance on the NBDE Part 1 may also be related to the faculty attitudes toward the value of the examination, which the students learn and model. Thus, it is hard to determine whether the previous low achievement levels on NBDE Part 1 from 1988 to 1996 were reflective of student knowledge, student motivation, or faculty attitudes with respect to the examination. In any case, once the scores were presented at the 1998 faculty curriculum retreat, there was considerable concern that the scores reflected a weakness in the curriculum. Additionally, the achievement level was noted during an accreditation site visit also raising questions on the effectiveness of the curriculum. There is considerable debate within dental education regarding the NBDE Part 1 and whether it is dictating the content of dental curricula; however, the exam has been and remains a

requirement for dental graduates to obtain their licenses to practice dentistry (Neumann & MacNeil, 2009). The NBDE Part 1 is a student assessment measure since individual students generate the scores, however, the overall school-wide averages on this assessment measure do represent an external metric suitable for use as a program evaluation outcome.

The effect of pedagogy on student outcomes on standardized examinations has been evaluated in medical education (Baca et al., 1990). These studies reported that the achievement on standardized exams did not improve for students in a PBL curriculum. Importantly many of the medical schools adopting PBL as a primary pedagogy were schools that already had a high achievement level on standardized examinations and thus there was not much room for improvement. In the present case, the achievement levels prior to the introduction of PBL were in the lowest quintile and students in the PBL curriculum had a significantly improved level of achievement on the NBDE Part 1. The other factors, previously noted, for student performance on the NBDE Part 1 are difficult to quantify and evaluate in overall achievement, but certainly contribute to the school-wide achievement outcomes.

One aspect of PBL student achievement on standardized examinations is the categorization of knowledge in ways that facilitate responses on the examinations. The integrated nature of PBL results in the absence of compartmentalization of knowledge in disciplinary ways (i.e. biochemistry or physiology). It has been suggested that the absence of this traditional compartmentalization could hinder a PBL student's recall of content knowledge in examinations organized by the traditional disciplines. However there is some evidence that the small group helps integrate knowledge that may be initially categorized in a disciplinary format (Patel et al., 2004). This did not appear to be the outcome with students in either the PBL pilot or the school-wide PBL at USCSD. This could be due to the lack of a need for a knowledge structure organized on the disciplinary structure, or that when students prepared specifically for the board examinations they were able to reorganize their knowledge in ways that facilitated responses on the examination. Organization of knowledge and critical thinking are importantly linked (Hendrickson et al., 2009).

The outcomes that the use of PBL as a pedagogy are meant to achieve are not necessarily linked to performance on standardized examinations. The development of critical thinking skills and the development of a knowledge framework more accessible in the treatment of patients are not outcomes measured on standardized examinations. In several studies (Schmidt et al., 1996; Mennin et al., 1996) the strength of PBL was not observed until later stages of a professional education when patient examination and diagnosis was an important factor. In medicine, it has been found that students completing a PBL medical education exhibited superior levels of achievement in their residency programs (Richards et al., 1996). One important objective of students completing a PBL curriculum is a commitment to lifelong learning through the generation of patient-based questions leading to new knowledge. This objective is much more difficult to measure since it relates to the ways in which clinicians

actually practice with their patients. It is likely that these outcomes may only be exhibited several years after graduation when PBL graduates demonstrate a commitment to evidence-based clinical practice. So the question remains: why would students in a PBL curriculum perform at a higher level than their traditional peers? Is there something in the PBL structure that enhances retention of basic science content? The answer may lie in the importance of knowledge application in a PBL-based curriculum.

In the cycle of learning, application of knowledge becomes critical for the learner to embed the importance of a piece of content. In a traditional curriculum, a faculty expert tells a student that a piece of information is important and should be remembered. However, the actual value of that piece of information is not demonstrated to the student through application. In PBL, the student discovers the limits of his/her knowledge and determines what pieces of information are necessary to advance his/her investigation of a patient's signs and symptoms. Once the content item is learned by the student, it is immediately reinforced by application to the case under study to better understand the nature of the signs and symptoms. Every patient sign or symptom is the result of some change in a basic science property. Consequently, application to the case has a strong reinforcement outcome and embeds the content in a framework that is directly relevant to the student's future health care career. The application of the content is further reinforced by the reflection embedded in PBL to determine whether sufficient material has been mastered to adequately explain the nature of the signs and symptoms. The results of this study indicate that direct linkage of application and reflection to the mastery of basic science content in a PBL curriculum lead to longer-term retention in meaningful knowledge frameworks.

Evidenced-based patient care is becoming the standard for clinical treatment. Treatments are based on addressing the signs and symptoms of a patient and ultimately restoring the underlying basic sciences to a normal level. Evidence-based dentistry (EBD) will require dental clinicians to understand and evaluate new advances. A clinician in practice will need to review the scientific basis of a new finding and evaluate the utility in the care of his/her patients. This requires specific skills that may be lacking in traditional lecture-based curricula. Many clinicians are quite uncomfortable with literature reporting new findings and with research accomplishments in general (Hannes et al., 2008; McGlone et al., 2001). This may be due to the fact that research and clinical practice are not seen to be comparable resulting in the situation that clinicians do not have a framework for finding and evaluating scientific literature. It can be argued, however, that the treatment of every patient is an experiment and that clinical care has many parallels with scientific investigation (Fig. 3.3). Both a diagnosis and a research hypothesis are statements of what you believe to be true and they are both subsequently tested either in the clinic or the research laboratory.

The features of a scientific research protocol are compared to the sequence of events in patient care to demonstrate that patient care is a form of scientific investigation and that it is critical to approach patient care with a scientific mindset.

Scientific Research compared to Clinical Care		
Research Protocol		Patient Care
Research Question	=	Chief Complaint
Background & significance	=	HPI, PMH, exam, radiographs
Hypothesis	=	Diagnosis
Specific Aims	=	Treatment Objectives
Research Plan	=	Treatment Plan
Data Generation	=	Patient Outcomes
Data Analysis	=	Long Term Follow-up

Fig. 3.3 Scientific research compared to clinical care

3.5 Conclusion

The skills required to learn in a PBL curriculum integrate the necessary requirements for scientific literature identification and evaluation. The ability to learn a basic science and understand the relevance to patient care provides a solid basis for the future lifelong learning necessary to provide evidence-based treatments. The evidence that PBL students achieve at a high level on standardized examinations of basic science content represents an important first step toward evidence-based care. Future studies will need to be done to determine if the principles mastered in a PBL curriculum continue to be embedded in the graduates' health care practice and lead to improvements in health outcomes.

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References

Baca, E., Mennin, S. P., Kaufman, A., & Moore-West, M. (1990). Comparison between a problem-based, community-oriented track and a traditional track within one medical school. In Z. M. Norman, H. G. Schmidt, & E. S. Essat (Eds.), *Innovation in medical education* (pp. 9–26). New York: Springer.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience and school*. Washington, DC: National Academy Press.

Dalrymple, K. R., Wuenschell, C., & Shuler, C. F. (2006). Development and implementation of a comprehensive faculty development program in PBL core skills. *Journal of Dental Education, 70*(9), 948–955.

Field, M. J. (Ed.). (1995). *Dental education at the crossroads: Challenges and change*. Washington, DC: Institute of Medicine, National Academy Press.

Fincham, A. G., Baehner, R., Chai Y., Crowe, D. L., Fincham, C., Iskander, M., et al. (1997). Problem-based learning at the University of Southern California School of Dentistry. *Journal of Dental Education, 61*(5), 417–425.

Fincham, A. G., & Shuler, C. F. (2001). The changing face of dental education: The impact of PBL. *Journal of Dental Education, 65*(5), 406–421.

Hannes, K., Norre, D., Goedjuys, J., Naert, I., & Aertgeerts, B. (2008). Obstacles to implementing evidence-based dentistry: A focus group-based study. *Journal of Dental Education, 72*(6), 736–744.

Hendrickson, W. D., Andrieu, S. C., Chadwick, D. G., Chmar, J. E., Cole, J. R., George, M. C., et al. (2009). Educational strategies associated with development of problem-solving, critical thinking and self-directed learning. In ADEA CCI (Ed.), *Beyond the crossroads: Change and innovation in dental education* (pp. 24–35). Washington, DC: ADEA.

Joint Commission on National Dental Examinations. (2010). National Board Dental Examination Part 1 2011 Guide. *American Dental Association*. Retrieved from http://www.ada.org/sections/educationAndCareers/pdfs/nbde01_examinee_guide.pdf

Knowles, M. S., Holton, E. F., & Swanson, R. A. (2005). *The adult learner*. San Diego: Elsevier.

McGlone, P., Watt, R., & Sheiham, A. (2001). Evidence-based dentistry: An overview of the challenges in changing professional practice. *British Dental Journal, 190*(12), 636–639.

Mennin, S. P., Kalishman, S., Friedman, M., Pathak, D., & Snyder, J. (1996). A survey of graduate in practice from the University of New Mexico's conventional and community-oriented, problem-based tracks. *Academic Medicine, 71*, 1079–1089.

Neumann, L. M., & MacNeil, R. L. (2009). Revisiting the National Board Dental Examination. In ADEA CCI (Ed.), *Beyond the crossroads: Change and innovation in dental education* (pp. 136–147). Washington, DC: ADEA.

Norman, G. R., & Schmidt, H. G. (1992). The psychological basis of problem-based learning: A review of the evidence. *Academic Medicine, 67*, 557–565.

Patel, V. L., Arocha, J. F., Branch, T., & Karlin, D. R. (2004). Relationship between small group problem-solving activity and lectures in health science curricula. *Journal of Dental Education, 68*(10), 1058–1080.

Rich, S. K., Keim, R. G., & Shuler, C. F. (2005). Problem-based learning versus a traditional educational methodology: A comparison of preclinical and clinical periodontics performance. *Journal of Dental Education, 69*(6), 649–662.

Richards, B. F., Ober, K. P., Cariaga-Lo, L., Camp, M. G., Philp, J., McFarlane, M., et al. (1996). Ratings of students' performance in a third year clinical clerkship: Comparison between problem-based and lecture-based curricula. *Academic Medicine, 71*, 187–189.

Saunders, N. A., McIntosh, J., McPherson, J., & Engel, C. E. (1990). A comparison between University of Newcastle and University of Sydney final-year students: Knowledge and

competence. In Z. M. Norman, H. G. Schmidt, & E. S. Essat (Eds.), *Innovation in medical education* (pp. 50–54). New York: Springer.

Schmidt, H. G., Machiels-Bongaerts, M., Herman, H., ten Cate, T. J., Venekamp, R., & Boshuizen, H. P. (1996). The development of diagnostic competence: Comparison of a problem-based, an integrated and a conventional medical curriculum. *Academic Medicine, 71*, 658–664.

Shuler, C. F. (2001). Keeping the curriculum current with research and problem-based learning. *Journal of the American College of Dentists, 68*(3), 20–24.

Shuler, C. F. (2002). Application of problem-based learning to clinical dental education. *Journal of the California Dental Association, 30*(6), 435–437, 440–443.

Shuler, C. F., & Fincham, A. G. (1998). Comparative achievement on National Dental Board Examination Part 1 between dental students in problem-based learning and traditional educational track. *Journal of Dental Education, 62*(9), 666–670.

Stufflebeam, D. L., Madaus, G. F., & Kellaghan, T. (Eds.). (2002). *Evaluation models: Viewpoints on educational and human services evaluation*. Boston: Kluwer.

Chapter 4
Experiences from Two Swedish Speech and Language Pathology Education Programmes Using Different Approaches to Problem-Based Learning

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4.1 Introduction

In many programmes within higher education, including speech language pathology (SLP) education, students are expected to develop collaborative skills alongside acquisition of theoretical knowledge. Many educational practices use instructional approaches such as problem-based learning (PBL), in which collaborative learning plays an important role. It has also been demonstrated that the learning environment, such as interactions between students themselves as well as between students and staff, is beneficial both for learning outcomes and academic career success (Vermeulen & Schmidt, 2008). Previous research has shown differences in professional skills between PBL and non-PBL graduates (Prince, van Eijs, Boshuizen, van der Vleuten, & Scherpbier, 2005). Those differences mainly concern general competencies such as organizational skills and teamwork. However, regarding general academic competencies, e.g. academic writing, there were no significant differences between PBL graduates and non-PBL graduates (Schmidt, Vermeulen & van der Molen, 2006). The topic of the present chapter is the relationship between the use of PBL as a pedagogical philosophy and the professional outcome, mainly regarding general competencies. The work is unique, since there are no previous studies focusing specifically on this topic in SLP programmes. A study with new data collection has been carried out in order to cover this topic within the present chapter. The overall purpose of the study was to evaluate SLP graduates' opinions on how well prepared they feel for professional life.

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4.1.1 What Is Problem-Based Learning?

The SLP programmes at two Swedish universities have chosen PBL as the prime pedagogical approach. In PBL, real-life problems become the context in which students learn academic content as well as professional skills (Biggs, 2003). Although PBL is one of the best-described methods of interactive learning (Smits, Verbeek, & de Buisonjé, 2002), there is still confusion about what PBL really is. It has been claimed to be more effective than traditional methods (Dolmans & Schmidt, 1994) and also more nurturing and enjoyable (Albanese & Mitchell, 1993). An attempt to define useful "ground rules" was made by Maudsley (1999) by means of a literature review. Five rules were formulated, stating that PBL is both method and philosophy, it aims at efficient acquisition of knowledge, it builds on prior knowledge, it achieves its goals via small-group work and it applies to problem solving as knowledge becomes more accessible (Maudsley, 1999, p. 184). PBL is based on several theoretical traditions, originating from the pragmatic model (Dewey, 1911), evolving through cognitive psychology (Piaget, 1952), and phenomenography (Marton, Hounsell, & Entwistle, 1984) to the more recent theories of social constructivism (Säljö, 1997). It has been claimed that PBL represents the shift from teaching to learning, and the methods of PBL emphasize students' active learning (Boud & Feletti, 1999). Essential features of PBL are learning in context, deepening of knowledge through discussion and self-directed learning.

One of the most fundamental ideas of PBL is that learning is organized in tutorial groups where the students actively discuss problems based on real-life situations (Fyrénius, Bergdal, & Silén, 2005). In the group there is also a tutor and the role of the tutor is rather to facilitate learning than to transfer knowledge. The tutor's focus is mainly on the learning process of the group and he/she does not necessarily have specific knowledge of the topic. Despite the importance of work in tutorial groups, traditional lectures are often a component in undergraduate medical education, also in SLP education. The use of lectures alongside PBL was investigated in a study by Fyrénius, Bergdal and Silén (2005). The authors found that lectures may be supporting students with expertise if teachers are aware of the drawbacks of lectures, e.g. passiveness of the audience and the risk of students becoming cue seekers. However, it is emphasized that to be advantageous from a learning perspective and in line with the notions of PBL, the lecture must be interactive and the students should be encouraged to take an active part in contextualizing the content of the lecture (Fyrénius et al., 2005, p. 65).

4.1.2 The Concept of Competence

In the research reports on competencies, many different definitions are used. The concept of competence is relevant from different perspectives, which may be roughly divided into three main fields: the educational perspective, the

labour market perspective and the human resource perspective (Van Loo & Semeijn, 2004, p. 332). The present chapter mainly takes on an educational perspective, where competencies are viewed as composites of knowledge, skills and attitudes, often referred to as the holistic perspective (Hager & Gillis, 1995). Previous research has demonstrated that graduate surveys form a valid method to measure such competence (Van Loo & Semeijn, 2004).

The importance of general competencies in medical education has been emphasized by Batalden, Leach, Swing, Dreyfus and Dreyfus (2002). They specify certain general competencies of special importance in medical education, e.g. practice-based learning and improvement, interpersonal skills and communication and system-based practice. General competencies are mainly related to interdisciplinary work and reasoning skills in general, whereas specific competencies refer to a set of core competencies unique to each profession and related to the clinical populations met within the profession (Greiner & Knebel, 2003). It has also been shown that the student's perceived competence is related to confidence. However, both competence and confidence are complex terms, and the authors conclude that self-evaluations should not be used "to judge the accuracy of an individual's capability" (Stewart et al., 2000). Nevertheless, self-evaluations have been frequently used and proven appropriate to study the individual perception of one's competence (Prince et al., 2005; Schmidt et al., 2006; Vermeulen & Schmidt, 2008).

4.1.3 Evaluations of PBL Curricula

The effectiveness and outcomes of PBL have been investigated in a number of studies in medical education (Albanese & Mitchell, 1993; Berkson, 1993; Dolmans & Schmidt, 1994; Smits et al., 2002; Vernon & Blake, 1993; Visschers-Pleijers, Dolmans, Wolfhagen, & Van Der Vleuten, 2004). In a literature review, it was demonstrated that PBL graduates perform as well or better in clinical examinations as graduates with traditional education (Albanese & Mitchell, 1993). However, PBL students scored lower on basic sciences and also viewed themselves as less prepared in basic sciences than traditionally trained students. These findings concur with a more recent study (Schmidt et al., 2006), where it was shown that graduates from PBL programmes rated themselves as more competent than graduates from non-PBL programmes regarding interpersonal skills, problem solving and self-directed learning, but slightly less competent as regards medical knowledge. On the other hand, Vernon and Blake (1993) found that students exposed to PBL and traditional methods did not differ on tests of factual knowledge. Their results also indicated that PBL was superior compared to more traditional programmes as regards students' programme evaluations. The authors concluded that the comparative value of PBL was supported by data on areas such as faculty attitudes, student mood and academic process variables (Vernon & Blake, 1993). These findings get further support from an evaluation of Swedish medical education programmes, where PBL-graduates

reported better skills in communication, cooperation and leadership than non-PBL graduates (Grundutbildningsenkäten, 2006).

Although reviews of undergraduate medical education support the effectiveness of PBL, there was limited evidence that PBL in continuing medical education increased students' performance (Smits et al., 2002). However, there was some evidence that students were more satisfied with PBL than with traditional educational methods. Berkson (1993) stated that PBL graduates did not differ from traditionally taught graduates. The author also argued that PBL can be stressful and that it is "unrealistically costly" (Berkson, 1993, p. 85). The prediction in the paper was that the differences between PBL programmes and traditional programmes would decrease, since the traditional educational institutions would become more aware of pedagogical philosophies and would encourage interactivity, and the PBL programmes would add more structure into the curricula.

Different factors influence both student satisfaction and learning outcomes. It has been demonstrated that theoretical content and social aspects of academic life have great impact on student satisfaction (García-Aracil, 2009). In PBL, the influence of the discussions in the tutorial groups is an increasingly important factor over the educational years (Dolmans & Schmidt, 1994). It is also suggested that students in a PBL curriculum become more self-directed learners over their curriculum years. The impact of course objectives was investigated in a study by Abrandt Dahlgren (2000) and the results showed that the use of course objectives in the learning process varied according to how they were formulated. It was also shown that PBL can be adopted differently according to intrinsic factors of the future professional field (Abrandt Dahlgren, 2000).

To sum up, the central concepts of PBL are real-life problems, self-directed learning and learning in interaction. The concept of competence is complex, and needs to be assessed from different perspectives. Evaluations of PBL show diverging results regarding graduates' specific competencies, but there seems to be rather solid support for PBL enhancing students' satisfaction of the social aspects of their studies. The aim of the present study was to evaluate opinions of Swedish SLP graduates on both specific and general competences. In addition, comparisons between a curriculum using PBL only and a curriculum using PBL in combination with more traditional methods were made.

4.2 Method

4.2.1 Participating Programmes

Postgraduate students from the two Swedish PBL-driven SLP education programmes participated in the study. Although both programmes use PBL as a pedagogical philosophy and method, the application of PBL differs between the two universities. One of the programmes has been running since 1971 and PBL was implemented in 1989. The other programme started in 2003 and it has used PBL as a pedagogical philosophy since the beginning. In the latter

programme, PBL is used from the first semester and all courses are carried out within the PBL framework. The tutorial groups meet twice a week and during the first two semesters the tutor is present during both tutorial meetings. From semester three to six the tutor is present once a week. During the seventh semester the groups meet without the tutor and in the eighth and last semester there are no tutorial groups, since the students work on their master's thesis. PBL is used throughout the whole faculty, which makes the learning environment as a whole very student centred. There are also two courses that are integrated with all programmes at the medical faculty. Within these courses, the students work in tutorial groups with mixed members from the different programmes, e.g. students in medicine, occupational therapy, physiotherapy and nursing. The other SLP programme may be described as a semi-PBL programme, since the first year is taught within a traditional framework and PBL is not introduced until the third semester. The tutorial groups meet once a week, always with the tutor present (from semester three to semester seven). The eighth semester is devoted to the master's thesis. In sum, the main difference in the implementation of PBL between the two programmes is the extent to which PBL is applied. In the younger programme, PBL is used throughout the education, i.e. also in basic courses such as linguistics and psychology. In the semi-PBL programme, PBL is introduced in the second year and is only used in medical courses where scenarios mainly consist of cases with speech and/or language diagnoses.

4.2.2 Material

A comprehensive questionnaire, focusing on perceived professional skills in relation to education, was constructed in order to capture general and specific competencies that are relevant for clinical SLP. The questionnaire was inspired by the alumni questionnaire used for physicians (Thomé & Arstam, 2001). Questions of general character are similar to questions in other questionnaires previously used to evaluate students' perceptions of graduate competencies (Armgard, Fasth, & Nelsson, 2002). The programme-specific questions for SLP were formulated through discussions with the teaching colleagues at the two participating universities. The questions comprised both aspects of specific competencies regarding the different diagnostic fields of SLP, as well as general competencies regarding reasoning skills, critical thinking, teamwork, etc. This design was chosen in order to assess more than one aspect of competence, since the concept is complex. The participants were also asked about their overall satisfaction with their education (see Appendix A for a complete translation of the questionnaire). In addition, questions on perceived demands in working life regarding the general competencies were asked. The answers were given on a categorical scale with five or six alternatives from nonexistent/very inadequate or very insufficient, to very satisfying, depending on the nature of the question.

The questionnaire was distributed by regular mail to 80 former SLP students from the two universities. The identity of the participants was kept anonymous

to the researchers. One reminding letter was sent out to all participants, since the identity of those who already had answered was unknown.

4.2.3 Respondents

A total of 55 students (69%) completed the questionnaire, 25 and 30 from the two participating programmes respectively. The total number of SLP students graduating every year in Sweden is about 120, so the number of participants in the present study must be considered rather high.

4.2.4 Analysis

The results are analysed in three ways: first by descriptive statistics in terms of degree of student satisfaction expressed in percent; second by analytical statistics with student's t-test; and third by qualitative analysis of students' comments.

4.3 Results

4.3.1 Specific Competencies

Regarding specific competencies, more than 50% of the students rated their competence as "satisfied" or better, except for graduates from the university where PBL is used throughout the programme regarding dyslexia management (Fig. 4.1). There are some very slight differences between the different groups of students, so that the semi-PBL students rated their education regarding dyslexia and stuttering higher and the competencies regarding cleft lip and palate lower than the PBL throughout students.

4.3.2 General Competencies

For the general competencies, the proportion of graduates rating their competencies as "satisfied" or better was 65% (Fig. 4.2). For the students who had used PBL throughout the programme the proportion was 100% for all competencies except the overall satisfaction with PBL. For the semi-PBL graduates the proportion of satisfied graduates was around 80% for most of the general competencies.

The questionnaire also included a question about the extent to which the examinations of the programme focused on knowledge needed as a professional SLP. The proportion of graduates rating that the examinations focused on relevant knowledge to some or a great extent was 88%. There was no significant difference between the two compared programmes regarding this question.

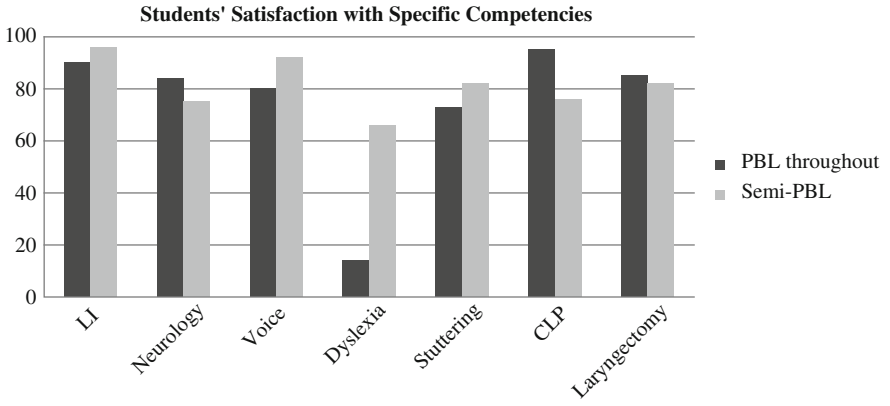

Fig. 4.1 Proportion of students rating their specific competence level as "satisfied" or higher in percentage, across the compared programmes
Note: LI language impairment, *CLP* cleft lip and palate

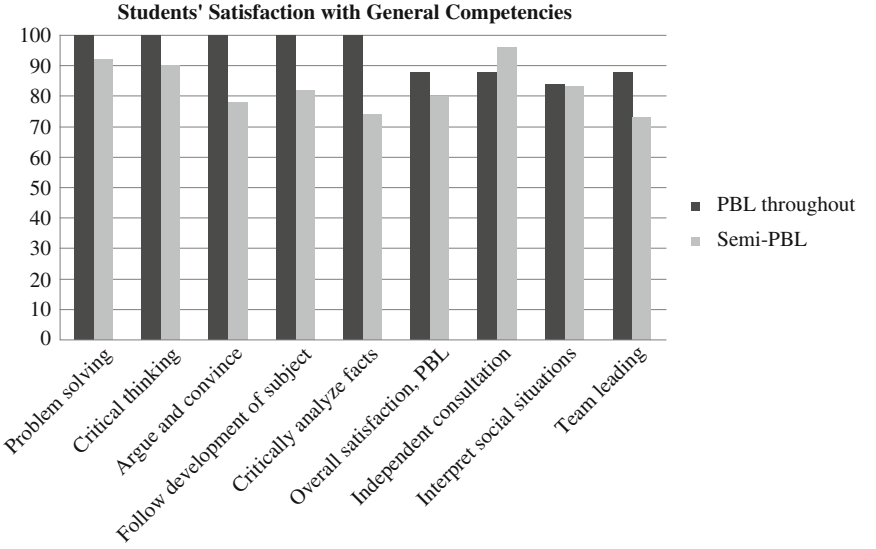

Fig. 4.2 Proportion of students rating their general competence level as "satisfied" or higher in percentage, across the compared programmes

4.3.3 Differences Between the Programmes Regarding Specific Competencies

In order to analyse data in further detail and also to determine statistical significance, a statistical analysis with student's t-test was performed. This

analysis showed that for specific competences there were no significant differences regarding neuro-logopedics, voice disorders, stuttering or laryngectomy. As regards language impairment (LI) and dyslexia the graduates from the semi-PBL programme rated their competences significantly higher than the graduates who had used PBL throughout the programme ($p < 0.01$) while the latter graduates rated their competences regarding cleft lip and palate significantly higher than the semi-PBL graduates ($p < 0.01$).

4.3.4 Differences Between the Programmes Regarding General Competencies

According to statistical analysis, it was demonstrated that graduates from the PBL throughout programme rated their general competence significantly higher for most of the questions ($p < 0.01$). However, there was no significant difference between graduates from the two programmes regarding the overall satisfaction with PBL, the ability to perform independent consultations or the ability to interpret social situations.

4.3.5 Relationship Between Demands and Competence

An analysis of the relationship between perceived demands in working life, and perceived competence regarding the general competencies, revealed that the participants rated their competence as exceeding the demands of working life for all questions (Fig. 4.3).

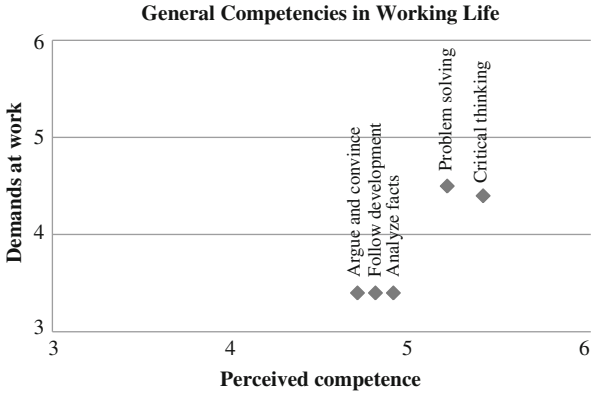

Fig. 4.3 Relationship between perception of demands in working life and perception of competence, as regards general competencies, 3 = average level of demands/competence; 4 = above average demands/competence; 5 = high demands/competence; 6 = very high demands/competence

Qualitative analysis of comments in the questionnaires revealed that 27 respondents (49%) found that the discussion in the study group was the most beneficial aspect of PBL in their education. The ability to seek and evaluate information was also considered important in the learning process, which was commented by 11 (20%) of the respondents. The main drawback of PBL, as commented by the participants in the present study, was availability of relevant literature. Another criticism by 3 participants (5%) was that PBL was time consuming for the students.

4.4 Discussion

The aim of the present study was to evaluate opinions of Swedish graduates of SLP programmes on both specific and general competencies and to compare two programmes of SLP with different applications of the PBL approach. The concept of competence is complex, and in order to take the educational, holistic perspective (Hager & Gillis, 1995), the questionnaire used in the present study was designed to capture both specific and general competencies. The results show that the participants are rather satisfied with their education. However, all groups of students are more satisfied regarding general rather than specific competencies. This is in accordance with previous research where it has been found that students graduating from a PBL curriculum gave high ratings on programme evaluations regarding faculty attitudes and academic process variables (Vernon & Blake, 1993; Smits et al., 2002). The research on the effectiveness of PBL as regards specific competencies show somewhat contradicting results; there is evidence both of students being less apt in basic sciences (Albanese & Mitchell, 1993; Schmidt et al., 2006), and of graduates performing as well or better on tests of factual knowledge (Vernon & Blake, 1993) than did traditionally educated students. However, in a recent exploratory study, Ebert and Kohnert (2010) demonstrated that among the most important factors in speech and language treatments are more general competencies, such as behaviours like collaboration and communication, personal traits like creativity, empathy and tolerance as well as acquisitions like attitudes and experience. This may indicate that the general competencies are more important to the clinical work than the specific competencies. The present study did not include comparison to a traditional programme without PBL, nevertheless it provides indications supporting the notion that PBL graduates feel confident also regarding specific competencies, although less than for general competencies. The comments from the respondents in the present study do not contain frustration or expression of stress, which has been reported in previous research (Berkson, 1993).

Graduates from the PBL throughout programme rated their general competences significantly higher than the graduates from the semi-PBL programme. This difference may be explained by the fact that the programme as a whole is carried out according to the PBL methodology. In that programme, great emphasis is placed on the learning progress from the start during the first course

in integration with other programmes at the medical faculty. Thus, the PBL methodology is introduced in a very comprehensive way. It is reasonable to assume that PBL would promote general competencies, since the ground rules of PBL apply to problem solving (Maudsley, 1999) and build on learning in interaction, self-directed learning and learning from real-life situations. Previous research has also demonstrated that students from PBL programmes perform better or as well in real-life-like clinical examinations (Albanese & Mitchell, 1993). Thus, it is not surprising that graduates who have had more experience of PBL rate their general competencies higher than the graduates who have not used PBL throughout the curriculum.

When relating the perception of general competencies to perceived demands in working life, the results demonstrate that the perception of competence exceeds the perception of demands for all general competencies assessed in the present study. This may be an expression of the graduates' confidence, but the concept of confidence is also related to courage and self-esteem (Stewart et al., 2000), so the relationship is not simple or straightforward. It is also interesting to note that the perception of demands regarding general competencies such as "critically analysing facts" and "problem solving" is rather low. The complexity of the concept of competence as well as the participants' interpretation of the questions may have contributed to this result. This result is also interesting from an employer's perspective, since it may indicate that there are possibilities for the employer to expect more from the employee, not only in production but also regarding analysis and critical thinking.

As regards specific competencies, the difference between the two compared programmes is less salient and for four out of seven aspects there were no significant differences between the programmes. For two aspects, the graduates from the semi-PBL programme rated their competence significantly higher than the graduates who had used PBL throughout the programme, while this group rated their competence significantly higher than the semi-PBL group regarding one aspect. Altogether, this indicates that the extent to which PBL is used did not affect students' perceptions of their specific competencies.

Different factors drive learning in PBL as in all pedagogical methods. One of the most fundamental ideas of PBL is the interactional learning within the tutorial groups (Biggs, 2003). This is also shown in the present study, where 50% of the respondents stressed the importance of the tutorial groups for their learning process. The fact that the SLP educations in both programmes use lectures to support the work in the tutorial groups may also contribute to the overall high satisfaction rate, both for specific and for general competencies, among the respondents. In Berkson's (1993) study, it was emphasized that to optimize the learning possibilities curricula using PBL should add more structure than suggested within the original ideas of the method. The role of lectures was also discussed by Fyrénius et al. (2005), where the authors concluded that interactive lectures are beneficial for student learning. In both programmes, the character of the lectures varies. Most lectures are interactive, but some lectures are more traditional, noninteractive ones.

4.5 Conclusion

PBL has been identified as one efficient way to facilitate the development of SLP students' abilities to meet the demands of self-directed learning in everyday worklife, here referred to as general competencies. Moreover, it has been shown that the use of PBL throughout the programme is beneficial to the perception of general competencies. It was also demonstrated that students from both the PBL throughout and the semi-PBL curricula rated themselves high on many specific competencies. The results also point out the importance of evaluation of educational programmes both in terms of general and specific competencies. In future research it would be valuable to make a comprehensive enquiry of Swedish SLP education, including curricula using pedagogical methods other than PBL. It would also be of interest to interview the participants to complement the written questionnaires.

References

Abrandt Dahlgren, M. (2000). Portraits of PBL: Course objectives and students' study strategies in computer engineering, psychology and physiotherapy. *Instructional Science, 28*, 309–329.

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.

Armgard, B., Fasth, E., & Nelsson, O. (2002). Humanistiska studier och arbetslivet. Uppföljning av studenter efter avslutad utbildning. [Humanity studies and working life. Follow-up of students after completing education]. *Rapport nr, 217*. Lund University.

Batalden, P., Leach, D., Swing, S., Dreyfus, H., & Dreyfus, S. (2002). General competences and accreditation in graduate medical education. *Health Affairs, 21*(5), 103–111.

Berkson, L. (1993). Problem-based learning: Have the expectations been met? *Academic Medicine, 68*(10), 79–88.

Biggs, J. (2003). *Teaching for quality learning at university*. Maidenhead: Open University Press.

Boud, D., & Feletti, G. (Eds.). (1999). *The challenge of problem-based learning* (2nd ed.). London: Kogan Page.

Dewey, J. (1911). *How we think*. New York. Prometheus Books.

Dolmans, D. H. J. M., & Schmidt, H. G. (1994). What drives the student in problem-based learning? *Medical Education, 28*, 372–380.

Ebert, K. D., & Kohnert, K. (2010). Common factors in speech-language treatment: An exploratory study of effective clinicians. *Journal of Communication Disorders, 43*, 133–147.

Fyrénius, A., Bergdal, B., & Silén, C. (2005). Lectures in problem-based learning – Why, when and how? An example of interactive lecturing that stimulates meaningful learning. *Medical Teacher, 27*(1), 61–65.

García-Aracil, A. (2009). European graduates' level of satisfaction with higher education. *Higher Education, 57*, 1–21.

Greiner, A. C., & Knebel, E. (Eds.). (2003). *Health professions education: A bridge to quality*. Washington, DC: National Academy Press.

Grundutbildningsenkäten, (2006). [The graduate education questionnaire]. Sveriges Läkarförbund.

Hager, P., & Gillis, S. (1995). Assessment at higher levels. In W. C. Hall (Ed.), *Key aspects of competency-based assessment* (pp. 59–72). Adelaide: National Center for Vocational Education Research Ltd.

Marton, F., Hounsell, D., & Entwistle, N. (Eds.). (1984). *The experience of learning*. Edinburgh: Scottish Academic Press.

Maudsley, G. (1999). Do we all mean the same thing by "Problem-based Learning"? A review of the concepts and a formulation of the ground rules. *Academic Medicine, 74*(2), 178–185.

Piaget, J. (1952). *The origins of intelligence in children*. Connecticut: International Universities Press, Inc.

Prince, K. J. A. H., van Eijs, P. W. L. J., Boshuizen, H. P. A., van der Vleuten, C. P. M., & Scherpbier, A. J. J. A. (2005). General competencies of problem-based learning (PBL) and non-PBL graduates. *Medical Education, 39*, 394–401.

Säljö, R. (1997). *Learning and discourse: A sociocultural Perspective*. Leicester, UK: British Psychological Society.

Schmidt, H. G., Vermeulen, L., & van der Molen, H. T. (2006). Long term effects of problem-based learning: A comparison of competencies acquired by graduates of a problem-based and a conventional medical school. *Medical Education, 40*, 562–567.

Smits, P. B. A., Verbeek, J. H. A. M., & de Buisonjé, C. D. (2002). Problem based learning in continuing medical education: A review of controlled evaluation studies. *British Medical Journal, 324*, 153–156.

Stewart, J., O'Halloran, C., Barton, J. R., Singleton, S. J., Harrigan, P., & Spencer, J. (2000). Clarifying the concepts of confidence and competence to produce appropriate self-evaluation measurement scales. *Medical Education, 34*, 903–909.

Thomé, G., & Arstam, A. (2001). *Når läkarutbildningen de resultat som yrkeslivet förväntar? En alumniundersökning* [Does the medical education reach the expectation of the working life? An alumni questionnaire]. Lund University: The Division of Medical Pedagogy.

Van Loo, J., & Semeijn, J. (2004). Defining and measuring competences: An application to graduate surveys. *Quality and Quantity, 38*, 331–349.

Vermeulen, L., & Schmidt, H. G. (2008). Learning environment, learning process, academic outcomes and career success of university graduates. *Studies in Higher Education, 33*(4), 431–451.

Vernon, D. T. A., & Blake, R. L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. *Academic Medicine, 68*(7), 550–563.

Visschers-Pleijers, A. J. S. F., Dolmans, D. H. J. M., Wolfhagen, I. H. A. P., & Van Der Vleuten, C. P. M. (2004). Exploration of a method to analyze group interactions in problem-based learning. *Medical Teacher, 26*(5), 471–478.

Chapter 5
The Influence of Two PBL Curricular Contexts on First-Year Students' Understandings of PBL, Approaches to Learning and Outcomes

Tracey Winning, Vicki Skinner, Angela Kinnell, Grant Townsend, Gunnel Svensäter, Madeleine Rohlin, and Julia Davies

5.1 Introduction

The rationale for adopting PBL in health professions education is to prepare students for practice as clinicians. In contemporary contexts, PBL curricula are oriented toward students learning discipline-specific ways of thinking and acting (Barrows, 2000; Hmelo-Silver, 2004). The crucial aspect of PBL, as opposed to other forms of learning and teaching, is that the PBL problem focuses and drives learning (Barrows, 1986; Charlin, Mann, & Hansen, 1998). This means that knowledge and skills are learned through and oriented toward application to authentic problems of the field. Outcomes that are possible with PBL can include a usable and integrated (i.e., cross-disciplinary) knowledge base that is embedded in both context and problem-investigation processes; a systematic approach to analyzing problems and developing and testing hypotheses; the ability to monitor and manage personal learning needs; the ability to work and learn effectively in and as a team; enhanced motivation to learn; and enculturation into the ways and values of the discipline (Barrows, 2000; Hmelo-Silver, 2004).

PBL outcomes are generally attributed to its constructivist theoretical basis. Constructivism as a theory of learning is founded on the premise that learners are actively involved in constructing their own knowledge through engagement with the world (Palincsar, 1998; Savery & Duffy, 1995; Schmidt, 1993). Constructivist principles provide a rationale for how PBL is implemented. However, although PBL has clear theoretical design principles, it cannot be assumed that these are understood and adopted by students. Therefore, researchers have asked if students understand the constructivist design of learning in PBL (Dochy, Segers, van den Bossche, & Struyven, 2005). Dochy and colleagues (2005) reported that students identified key design aspects of PBL as enhancing

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their learning, namely key activities in which they participate, the PBL group, and task. Three recent studies comparing students from PBL and conventional curricula showed that PBL students' ratings on Likert scale surveys were more consistent with certain constructivist learning principles, e.g., learning in groups and application of learning in relevant contexts (Gijbels, van de Watering, Dochy, & van den Bossche, 2006; Loyens, Rikers, & Schmidt, 2006; Lycke, Grøttum, & Strømsø, 2006). These investigations addressed the important issue of students' understandings in relation to PBL and its constructivist basis. However, they did not link students' perceptions of the PBL context with their learning approaches and/or outcomes (Biggs, 2003; Prosser & Trigwell, 1999; Ramsden, 2003).

Student approaches to learning (SAL) theory (Biggs, 2003; Prosser & Trigwell, 1999; Ramsden, 2003) explains how students' understanding of the learning context influences how they approach their learning, which in turn influences the quality of their learning outcomes. SAL theory proposes that students' approaches to learning are constituted from their prior experiences, their conceptions of learning and the discipline or profession, their motivations for learning, their perceptions of the learning context and what is required of them in various learning tasks/assessment, and the learning processes (strategies and methods) that they adopt (Biggs, 2003; Prosser & Trigwell, 1999; Ramsden, 2003). Therefore, an SAL approach can shed light on what students think PBL is about and whether they might adopt a deep or surface approach to their learning. Deep and surface approaches in turn have been reported to be associated with a variable quality of outcomes (Biggs, 2003; Prosser & Trigwell, 1999; Ramsden, 2003).

Studies of PBL from an SAL perspective have shown that students' perceptions and learning are not always congruent with theoretical or curricular design of PBL. In two Australian studies, the responses of very few undergraduate second- and third-year nursing or fourth-year pharmacy students matched the intended nature and purpose of PBL in their respective programs (Duke, Forbes, Hunter, & Prosser, 1998; Ellis, Goodyear, Brillant, & Prosser, 2008). These papers reported that the majority of students' perceptions of PBL varied from what the curriculum planners had intended (Duke et al., 1998; Ellis et al., 2008). These SAL studies also showed that the majority of students adopted reproduction or surface-type approaches to learning, which were associated with lower level or fragmented conceptions of PBL, i.e., they did not identify a clear link between the PBL problem and the overall aim of recognizing the deeper principles of the topics covered (Duke et al., 1998; Ellis et al., 2008). The study by Ellis and colleagues also demonstrated an association between deep approaches, cohesive conception (i.e., students linked the PBL learning activities to core disciplinary concepts), and higher achievement. Another study of students' experiences of PBL (Abrandt Dahlgren & Dahlgren, 2002) demonstrated differences between disciplines which reflected variations in the implementation of PBL, particularly with respect to the structure of the courses and delineation of course objectives, as well as

reflecting the different academic cultures of the disciplines (physiotherapy, psychology, and computer engineering).

These various studies of PBL curricular outcomes highlight a key issue in interpreting and applying outcomes from PBL programs: specifically, variation in the interpretation of PBL and its subsequent implementation, leading to variations in the intended student experiences and outcomes. To better understand how and why PBL works and when it does not (Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005) we aimed to clarify how our contexts and implementation of PBL influence the development of our students' understanding of PBL, their approaches and outcomes, particularly for first-year students, as previous studies generally had focused on later-year levels. Specifically, the aim of this study was to investigate first-year students' understandings of PBL and to examine the learning approaches and outcomes of these students at the beginning and end of the first semester of first year in two different curricular contexts. It is expected that the outcomes of these analyses will enable us to optimize our students' learning outcomes from their first semester.

5.2 Method

5.2.1 Curricular Contexts

The Faculty of Odontology, Malmö University, Sweden and School of Dentistry, The University of Adelaide, Australia were logical collaborators in this study as both curricula were well established (Rohlin, Petersson, & Svensater, 1998: implemented in 1990; Townsend, Winning, Wetherell, & Mullins, 1997: implemented in 1993). The Malmö curriculum is integrated and is characterized by consecutive courses that address major themes and include PBL sessions and related learning activities (Rohlin et al., 1998) (see Table 5.1). As a point of difference, the Adelaide curriculum is a hybrid PBL curriculum consisting of four parallel courses with a combination of PBL sessions and other learning activities across the different courses (Townsend et al., 1997). Both curricula provide early clinical experience for students. We analyzed our curricular contexts using key features of PBL curricula derived from the literature (Barrows, 2000; Charlin et al., 1998). These included organizational aspects of the curriculum, student induction, characteristics of the problems or cases, tutor role, and feedback and assessment processes. In summary, there were many common aspects across the two curricula in terms of induction of students to PBL, problem selection, purpose, presentation, format, and processes, as well as scope and format of course outcomes, resources students used, and assessment format (Table 5.1). The key differences related to the level of integration, length of PBL cases, timetabling of non-contact time for completing research, and number of assessment tasks across the program (Table 5.1).

Table 5.1 Summary of key similarities and differences between the Malmö and Adelaide first-year dentistry curricular contexts, first semester

Similarities (Barrows, 2000; Charlin et al., 1998)	Differences
Scope of course outcomes: Content included introduction to normal structure and function of the oral cavity, including oral mucosa, periodontium, saliva, teeth, and oral microbiology; group process and self-directed learning skills and systematic processes for problem investigation.	**Level of integration:** There were only two consecutive courses at Malmö, resulting in all learning activities in each week being related to the weekly/fortnightly case. At Adelaide there were four concurrent courses, with various classes across these courses that related to the weekly case. At Adelaide, PBL analysis steps were matched to parallel clinical steps.
Induction of students to PBL: Case(s) used to address PBL processes, group processes, introduction to dentistry, and the course(s).	**Length of PBL cases:** Several cases at Malmö were reviewed over 2 weeks, with 2 × 3 h sessions where students discussed the progress they had made on their learning issue research with the group and facilitator feedback was provided on the scope, detail, and links with their initial hypotheses.
Problem selection, purpose, presentation, format, processes, group size, resources used, and facilitator experience and roles: Patient situations were selected by staff to provide opportunities to learn in context and integrate content. Cases were presented as text or video with images and were analyzed using a modified 7-step process (Schmidt, 1989) to identify learning goals. Students worked in groups of 8–9 and were provided with a list of recommended resources from which they selected their own resources. Facilitators were a mix of content experts with a focus on being skilled in PBL processes. They assisted students in relating cases across the course(s); guided process and asked questions, sought clarification and elaboration; focused on application of learning to case; provided feedback.	**Length of semester and contact time:** At Malmö, there were only 16 h/week for 17 weeks of classes in comparison with 25 h/week for 13 weeks in Adelaide. In each week in Malmö there were four, mostly consecutive, half-day sessions in the timetable for researching learning goals which contrasted with Adelaide, where only one half day/week was in the timetable for research with another half day for research in 7 out of 12 weeks when classes were scheduled.
Feedback and assessment: Formative: PBL participation and discussion of learning goals Summative: Questions based on cases that involved demonstration of PBL processes, i.e., case analysis and application of learning to explain problems.	**Number of assessment tasks:** There were more formative and summative tasks across the program in Adelaide related to the four concurrent courses that students completed.

5.2.2 Participants

Participants in this study were first-year dental students at Malmö University (MU) and the University of Adelaide (UA). Details of the participants are presented in Table 5.2.

5.2.3 Materials

5.2.3.1 Open-Ended Survey and Analysis

Students responded to an open-ended question about what they would say to a friend regarding what PBL is about. The question was written in English and translated to Swedish by one of the bilingual authors (first language: English) and then reviewed by two other bilingual authors (first language: Swedish). All responses were de-identified and transcribed. Swedish students' responses were translated by one of the bilingual authors (first language: English) based on conceptual analysis, i.e., not a direct or literal word-for-word translation (Chang, Chau, & Holroyd, 1999). A randomly selected subset (30%) of these open-ended surveys were also independently translated by the two other bilingual authors familiar with the content (first language: Swedish) (Irvine et al., 2007). The two independent English translations were compared for equivalence by English-speaking authors. Minor wording changes were made to 63% of the responses, which mostly related to the use of "one" versus "you" and did not alter the meaning and subsequent coding of these data.

Students' responses to the open-ended question were analyzed using a thematic approach (Liamputtong & Ezzy, 2005) with codes that were closely based on the students' words or "grounded" in the data (Strauss & Corbin, 1994). From each data set a list of themes was created; these represented broad content areas within students' responses. Within each theme, a set of codes was created that was based on key words or phrases that students had used to refer to the thematic content. The themes and codes were compared and contrasted across data sets to produce a final set of themes and codes (Table 5.3). This approach

Table 5.2 Characteristics of the Malmö and Adelaide cohorts

	Malmö[a]	Adelaide
Number of enrolled students	99	72
Response rate	80 (81%)	58 (81%)
Analysis rate	60 (61%)	52 (72%)
Mean participant age (se)[b]	21.96 (0.45)	20.1 (0.26)
Female participants[c]	41 (68%)	25 (48%)

[a] Combined data for 2007 and 2008 cohorts
[b] The Malmö cohort were significantly older than the Adelaide cohort ($p < 0.05$)
[c] For enrolled students, 60 and 54% were females at Malmö and Adelaide, respectively

Table 5.3 Codes related to the theme: "PBL Activities"

Code	Explanation of code
Case/problem	The stimulus material or starting point
Real	Descriptor applied to the case/problem: "real," from "real life," "reality"
Group	Reference to working in a group
Solve	Reference to solving the problem/case, problem solving
Information	Reference to looking for or finding information
ID problem(s)[a]	Reference to identifying problems represented by the stimulus material (i.e., distinguishes the case from the problem)
Problem steps[a]	Reference to using a set of steps or a systematic process to investigate the case/problem or learning goals and hypotheses
Basic	Simple description, e.g., discuss in a group
Elaborated[a]	Explanation or rationale provided, e.g., discuss in a group to . . .

[a] Code mostly associated with end-of-semester responses

kept the themes and codes closely aligned with students' own words and facilitated interpretation and comparison of pre- and post-responses across cohorts and within students.

5.2.3.2 Revised Two-Factor Study Process Questionnaire (R-SPQ-2F)

The R-SPQ-2F (Biggs, Kember, & Leung, 2001) was used to categorize students' responses at the commencement and end of first semester into deep or surface approaches to their learning. It consists of 20 items, rated by participants on a five-point Likert scale (1: Never or only rarely true of me, 5: Almost or always true of me). At the beginning of the semester, students were asked to respond to the statements in relation to a subject that was important to them. At the end of the semester, they were asked to respond in relation to courses that involved PBL. For the Swedish participants, the R-SPQ-2F was translated using the same process as the open-ended survey.

Responses were summarized into deep (DA) and surface approach (SA) scores. Cronbach's α values for the 2-factor model at both sites ranged from 0.63 to 0.77 for the DA scale and 0.68 to 0.85 for the SA scale. These scales were considered reliable as they are comparable to the values reported by Biggs et al. (2001): DA $\alpha = 0.73$ and SA $\alpha = 0.64$ and were within an acceptable range for reliability assessments (Schmitt, 1996).

5.2.3.3 Examination Results

The examination performances of participating students at MU and UA at the end of the first semester were collected. Based on the structure and grading of the assessments at both sites (see Table 5.4), all students were classified as having obtained either a high pass (P1), low pass (P2), or fail (F).

Table 5.4 Classification of performance on assessment

	P1	P2	F
Malmö[a]	Passed all five sections	Passed four sections	Failed more than one section
Adelaide	Credit or above (>65)	Pass (50–64)	Fail (<50)

[a] Non-graded pass or fail were used at Malmö University

5.2.4 Procedure

At both sites, the initial data were collected at the beginning of a class prior to any induction to PBL, i.e., there were no explicit class-based discussions or handouts about PBL, its goals, rationale, processes, or outcomes before the initial data collection. Information about PBL was available to students at Malmö and Adelaide through the faculty or school website or discussions with previous/current students. At Malmö, a brief introduction to PBL was presented on the afternoon prior to data collection, with the main focus being on the difference between a conventional and PBL approach to learning, highlighting the student's role/responsibility in learning and linking theory and practice. The project was explained by the authors and consent obtained from students by staff not involved in teaching or assessing students. Students then completed both the open-ended and R-SPQ-2F surveys. Both surveys were completed again by students in the last week of first semester, before final exams. Responses from non-consenting students were discarded.

5.2.5 Quantitative Data Analysis

Data from all cohorts were coded to de-identify students and matched across the data sets. Only data that were complete and matched across all sets for each student were analyzed. Age differences between participants and non-participants across cohorts were compared using a two-way analysis of variance (ANOVA). Two-way repeated measures ANOVA was used to compare DA and SA scores between testing occasions. Where interactions were found between any of the factors, the effect of individual factors, specifically beginning and end-of-semester responses within DA or SA, were analyzed separately using paired t-tests. To enable analysis of associations at the end of the semester between students' understandings of PBL, learning approaches, and assessment performance, students' responses were categorized as indicated in Table 5.4. Associations between gender and performance for those who participated or not, and students' understandings of PBL, approaches, and performance were analyzed using χ^2 tests. Categories were collapsed (refer Table 5.5) due to the small number of subjects in some categories. The level of significance for all analyses was set at $p < 0.05$.

Table 5.5 Categories for PBL understandings, learning approaches, and performance

PBL understandings[a]	R-SPQ-2F: DA/SA[a]	Performance[a]
Basic/simple descriptions of problem solving or information generation	DA $>$ 30[b] & SA $\leq$ 30	P1
Key aspects of the rationale for PBL or professional context	DA $\leq$ 30 & SA $>$ 30; DA & SA $\leq$ 30; DA $>$ 30 & SA $>$ 30	P2/F

[a] Categories were collapsed into two groups for each dataset due to the small number of students in some categories

[b] The cut-off for these scores was derived from deep (DA) and surface approach (SA) scores reported in the literature (Leung, Mok, & Wong, 2008; Balasooriya, Toohey, & Hughes, 2009a)

5.3 Results

5.3.1 Participant and Non-participant Results

There were no significant differences between participants and non-participants, including those with missing data, in terms of age and gender except for the Malmö cohort where significantly more participants were female. The mean age of both Adelaide participants and non-participants was significantly lower than for Malmö participants and non-participants ($p < 0.05$). There were no significant differences in performance on examinations between participants and non-participants.

5.3.2 Open-Ended Survey

5.3.2.1 Commencement of First Semester, First Year

PBL Activities and Outcomes

In response to the question "*What do you think PBL is about?*" the majority of Malmö students (approx. 70% from both cohorts) gave simple descriptions of PBL activities. They described PBL as *problem solving* related to a *case* or *problem*, which involved *finding information*. About half of these students referred to *group-work* or *discussing in a group*. Several described the case or problem as *real* or *realistic*. The goal of PBL in these simple accounts was to find solutions or information, and the outcome was answers and content knowledge, e.g.,

> **MU23**. The problem represents the starting point for the student to look for information regarding the problem and to try and find a solution.

The majority of Adelaide students (approx. 80%) also gave simple descriptions of PBL focussing on "... solving the case or problem" (AU4) or "... learning through solving problems" (AU38). About one-third of these also

referred to the authenticity of the problem, using terms like *real-life*, *dental*, or *clinical*. Only four Malmö students and four Adelaide students provided more detailed explanations of PBL activities, which included the role of the group in supporting learning or learning being focussed by research questions or involving hypothesis testing, e.g.,

> **MU47**. PBL: You start from a case which you form to a problem. By asking questions about the problem you can then go on with the case and investigate it with literature etc. Afterwards the problem can be examined again and you gain a deeper understanding. PBL works well in a group context where you can help each other with feedback and ideas. When the problem is solved you have been through a learning process where you knew nothing from the start and then gained a deeper understanding.

Five Malmö students listed PBL skills outcomes, such as learning "... to find different ways of looking at problems" (MU14) and "... to find necessary information on one's own, to adopt a critical stance" (MU18). In Adelaide, 12 students identified skill development, such as *life-long learning* (AU7), *critical thinking* (AU46), *communication skills* (AU22), and training "... to work alone or in a team independently" (AU17). In addition, a few students in both schools commented on PBL as a learning approach, six from Malmö, e.g., "stimulates interest and curiosity" (MU18), "actively learn new things" (MU26), and eight from Adelaide, who described it as experiential and active learning, e.g., "... a process of learning through our own experiences" (AU8).

Roles and Responsibilities in PBL

Some students in both schools, approximately 25% from Malmö and 8% from Adelaide, commented on PBL as requiring student independence. Malmö students expressed this directly as *self-responsibility* (MU6), or as being responsible for finding information or knowledge, e.g., "... the student has to seek their knowledge themselves" (MU36). Malmö students also expressed student independence by contrasting PBL with traditional teaching, e.g., "... given a problem instead of someone who tells you what you should know" (MU35). Adelaide students made similar comments about student *independence* and differences to traditional teaching, such as, "It's an alternative to teacher-to-class lectures, we're assigned a problem and must research it ourselves" (AU2). Only seven Malmö students referred to the PBL tutor: the common element in these responses being that the tutor's role was to keep students on *the right track* (MU21). At the start of the semester, no Adelaide students commented on the tutor.

Clinical Practice Context

The clinical practice context was a minor theme in Malmö commencement responses. Only eight (13%) Malmö students explicitly related PBL to their

future dental practice, six students described it either as learning to use knowledge/information, e.g., "... can be used in practice in the area one will work" (MU5), or as applying clinical processes to the problem, such as "... finding the disease profile and how one would best treat" (MU7). Only two gave more complex accounts of PBL. Clinical practice appeared in greater number and complexity in Adelaide responses. A number (32%) of Adelaide students noted future relevance, e.g., "... virtual practice to prepare (for) a real situation" (AU24), and application of clinical processes to PBL problems, such as "... work through the symptoms to make a diagnosis" (AU23). However, 11 Adelaide students gave more detailed descriptions of PBL as preparation for future practice, similar to the two from Malmö, which included learning how to think, how to approach patients, and wider professional skills, e.g.,

> **AU52**. I think that problem based learning is about developing not only knowledge in areas relating to dentistry, but also skills relating to dentistry. It is a method of learning which has been devised to prepare us for the sorts of situations we could face in the future years, whilst simultaneously building on our communications and people skills and the way we think, and thus learn.

5.3.2.2 End of First Semester, First Year

PBL Activities and Outcomes

In contrast to their previous simple descriptions of "problem-solving," most Malmö students' accounts of PBL were more detailed. The simplest accounts listed PBL steps: "explanation of the problem, problem formulation, brainstorming, formulation of hypotheses, collection of facts, group discussion" (MU16), while the more elaborate accounts explained PBL as a cycle of learning guided by student-identified learning goals, which were researched to test hypotheses, e.g., "... setting up hypotheses which you think are relevant and have some truth in them for the actual case ..." (MU28). Adelaide students also gave more detailed descriptions that included problem investigation steps; some were elaborated in terms of explanations and rationales, e.g., " ... problems are solved partly by searching through your brain for old knowledge which can be applied to the case and partly by actively proposing questions, hypotheses and learning objectives ..." (AU5). Whereas at commencement, Malmö students used "case" or "problem" interchangeably, after one semester, Malmö students distinguished between the case and the problems it contained. References to the group in Malmö, although fewer in number (six), were more elaborate, and were more consistent with the intended collaborative role of the group in supporting learning and providing feedback, e.g.,

> **MU24**. It is a method of learning where you put a big emphasis on arriving at things through group discussion. You get support from your group members with things you think are difficult and it is easier to find the essence i.e. the important things in what you read. You also get new ideas about how you can look at a problem and the solution. All this means that you learn in a very effective way.

Skill development was identified by nine Malmö students and six Adelaide students, and included skills related to analytical and critical thinking, independent learning, problem solving, and team-work. However, some Malmö and Adelaide students still gave simple "problem solving" type descriptions of PBL. Most students in both schools still represented PBL outcomes as fact-finding or looking for solutions.

Roles and Responsibilities in PBL

Student independence was noted by 20 Malmö students after one semester, expressed (similarly to commencement) as *responsibility*. Again, a few students contrasted PBL to traditional teaching. Self-responsibility as *independence* also remained at the end of the first semester for eight Adelaide students. Similar numbers of Malmö students commented on the tutor, and there was no change in descriptions of the tutor's role. Similarly, very few Adelaide students referred to the tutor, whose role was to *facilitate* (AU30) or *aid* (AU56) the group.

Clinical Practice Context

There was little change in the nature of Malmö students' responses after one semester. Only four students wrote of preparation to encounter problems, e.g., "... future problems will be solved in the same way" (MU27) or being able to "... put facts into a context" (MU46). In Adelaide, more than half the students continued to include in their descriptions of the systematic process, either a reference to preparing to encounter problems in the future, such as "in our careers as dentists" (AU8), or a reference to applying clinical processes, e.g., "learn from the situation on diagnosis and treatment" (AU28). Regarding more elaborate responses, three Malmö students and eight Adelaide students, provided more detailed accounts of the clinical relevance of PBL, e.g.,

> **AU19**. PBL is a great way to apply the theory aspect of dentistry to the clinical side of the profession as a way to understand and learn concepts of patient management. It identifies key aspects of what knowledge is needed not only related to theory but to every other aspect such as legal issues, professionalism and behaviour of patients. PBL also emphasises the way of thinking in the shoes of a clinician from first year.

All these elaborate responses comprised ideas such as learning knowledge and skills related to thinking and acting in a clinical and professional manner.

In summary, on commencement of the first semester, the majority of Malmö and Adelaide students described PBL as looking for information to solve problems, and some also noted that students had a lot of responsibility for their learning. Some students in both schools referred to the affective dimension (e.g., motivation), and the learning- and team-skills outcomes of PBL. The professional relevance of PBL and its intention for learning skills and process were not clearly identified by Malmö students, but were noted by several

Adelaide students. Few students in either school referred to the tutor's role. After one semester of PBL, Malmö and Adelaide students' descriptions of PBL were more congruent with curricular intentions for the systematic problem-investigation process. Responses continued to recognize the role/responsibility of the individual student in learning. However, the major focus remained on fact-finding or information collection with only a few students noting the collaborative role of the group. Learning of key skills and the role of the tutor were not consistently included in the key features identified by students. The relevance of the practice context remained unchanged for students at each site.

5.3.3 R-SPQ-2F

Figures 5.1 and 5.2 show the DA and SA scores for students at Malmö (2007 and 2008 combined) and Adelaide at the beginning and end of the first semester of their first year, respectively. In both institutions, and in the combined Malmö cohorts, the majority of students had high DA (>30) and low SA scores on both testing occasions (represented in the top left quadrant of Figs. 5.1 and 5.2). A

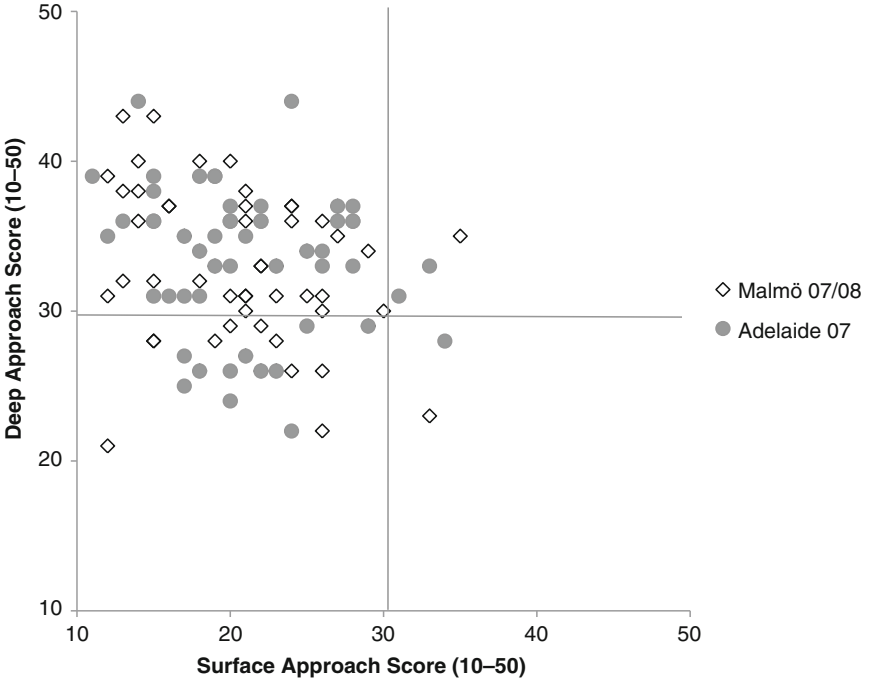

Fig. 5.1 Deep (DA) and surface approach (SA) scores for students at the beginning of the first semester, first year

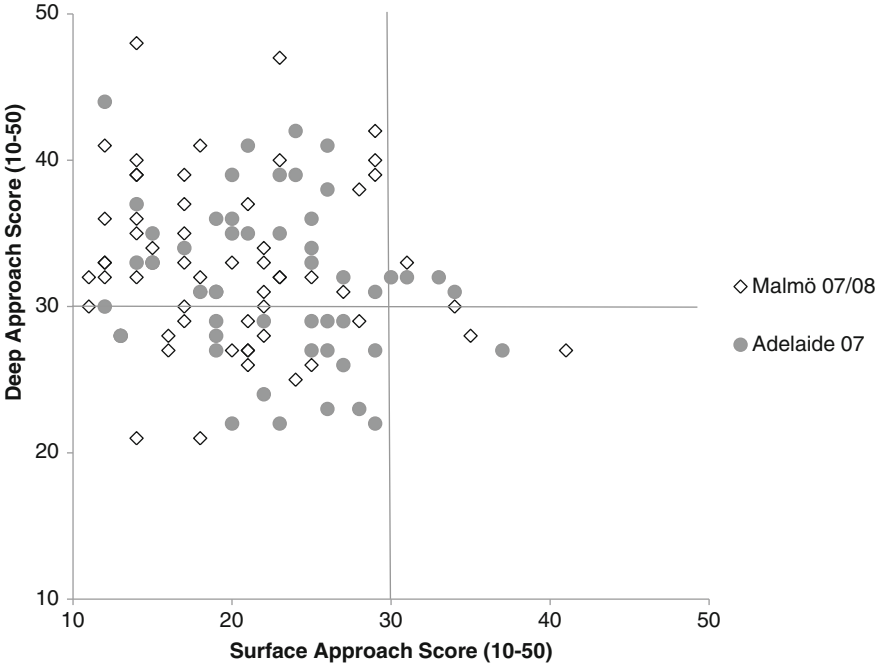

Fig. 5.2 Deep (DA) and surface approach (SA) scores for students at the end of first semester, first year

smaller group of students had both low DA and SA scores (bottom left quadrant) while only a few students had high DA and SA scores or high SA and low DA scores (top and bottom right quadrants; Figs. 5.1 and 5.2). At the end of the first semester, the number of Malmö students with high DA scores remained constant (refer Table 5.6). The number of Adelaide students with high DA scores decreased at the end of semester. Of 52 Adelaide students, DA scores decreased for 31 (54%) students compared with 21 (35%) Malmö students.

The mean DA and SA scores of first-year students at Malmö and Adelaide at the beginning and end of the first semester are shown in Fig. 5.3. Interactions between approach, year, and beginning or end of the semester were not demonstrated for these Malmö data. Comparison of the DA and SA means for the combined Malmö cohorts between the beginning and end of the semester demonstrated there were no significant differences. Analysis of the Adelaide DA and SA data revealed an interaction between approach and time related to the beginning and end of the semester. Paired t-tests revealed there was a significant decrease in DA and increase in SA scores for Adelaide students between the beginning and the end of the semester ($p < 0.05$) (refer Fig. 5.3).

Table 5.6 Number (percent) of students from each cohort in the four different categories for R-SPQ-2F scores

	Malmö		Adelaide	
R-SPQ-2F scores	S1a	S1b	S1a	S1b
DA $>$ 30; SA $\leq$ 30	41 (68%)	40 (66%)	38 (73%)	28 (54%)
DA $\leq$ 30; SA $>$ 30	1 (2%)	3 (5%)	1 (2%)	2 (4%)
DA $\leq$ 30; SA $\leq$ 30	17 (28%)	16 (27%)	11 (21%)	20 (38%)
DA $>$ 30; SA $>$ 30	1 (2%)	1 (2%)	2 (4%)	2 (4%)

S1a = beginning of first semester, first year; S1b = end of first semester, first year
DA deep approach, *SA* surface approach

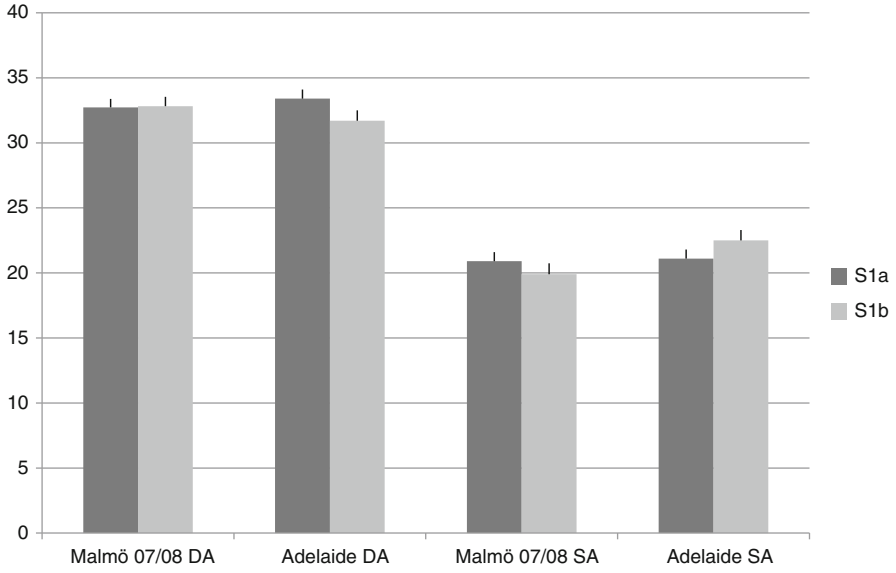

Fig. 5.3 Mean values and standard errors for deep (DA) and surface approach (SA) scores for students at the beginning (S1a) and end of first semester, first year (S1b). Statistically significant differences between the beginning and end of first semester were evident for Adelaide DA and SA ($p < 0.05$)

5.3.4 Students' Understandings of PBL, R-SPQ-2F, and Examination Results

For both Malmö and Adelaide cohorts, χ^2 analyses did not reveal any significant associations between the students' understandings of PBL, their DA/SA scores, or their examination results.

5.4 Discussion

5.4.1 Limitations of the Study

Participation rates were high at both sites; however, due to missing data, analysis rates were lower. As a result, the samples may not be entirely representative of the classes. However, comparisons of age and percentage of students achieving the different grades indicated participants were representative, except for gender, as more females participated than males at Malmö. Analyses of gender differences generally have not been reported in studies of learning approaches and differences based on gender are mixed (Sadler-Smith, 1996; Duff, 2002; Smith & Miller, 2005; Tiwari et al., 2006). The Malmö participants were also older than the Adelaide cohort; however the practical significance of this finding for interpreting the results is limited.

The sample size was small and the use of categories for grading performance, rather than marks, limited the types of analyses that were possible. However, Malmö students' responses to "What would you say to your friend regarding what PBL is about?" were consistent between years. For R-SPQ-2F results, the lack of a significant difference in DA or SA scores between the beginning and the end of the semester was consistent for both Malmö cohorts. Together, these provide support that the findings are representative of students' experiences of the Malmö curriculum. The data were from only one cohort in Adelaide, however, more students were involved.

Although one semester is a short period of time, the first semester is critical in students' transition to higher education (Higher Education Funding Council for England, 2001). The student experience within the first 4–7 weeks of the first year has been linked with various outcomes of student engagement, level of performance, satisfaction, and retention (Wilson, 2009). It is anticipated that changes may occur in students' understanding and approaches as they progress through the curriculum, although findings are mixed (Duke et al., 1998; Dochy et al., 2005; Loyens, Rikers, & Schmidt, 2009). Therefore, further data collection in their third year has occurred for the current cohorts which will enable investigation over a longer period.

5.4.2 Understandings of PBL

Curriculum planners are advised to incorporate student-support strategies into PBL curricular design to help students adapt to PBL (Prosser, 2004). Both Malmö (Rohlin et al., 1998) and Adelaide (Mullins, Wetherell, Townsend, Winning, & Greenwood, 2003) have well-developed induction programs that focus on developing students to think and act as dentists and address key educational objectives of PBL. However, despite our respective efforts, the limited identification of key features of PBL that match curricular intentions suggests that these key curricular outcomes were not well understood by

students. For example, the professional relevance of PBL and its intention for learning skills and processes were not consistently identified, particularly by Malmö students. This is consistent with previous reports that noted limited congruence between students' perceptions of PBL and curricular intentions (Duke et al., 1998; Ellis et al., 2008). The lack of "visibility" of a rationale or professional context in many students' responses suggests students were focused on the surface features of learning from PBL cases and were unable to relate various key PBL concepts and their learning (Lonka & Lindblom-Ylänne, 1996). This could explain the results for Adelaide students in terms of understandings of PBL and their approaches to learning but is not consistent with the findings related to deep approaches to learning reported by Malmö students. While relationships between understandings of PBL and approaches did not support this explanation, due to the issues with sample size, these findings need to be interpreted with caution.

The apparent "invisibility" of tutors and their metacognitive and modeling roles to students in both curricula is consistent with previous reports (Dochy et al., 2005). Tutors were apparently perceived by students to contribute least to their learning compared with the group, case, or other students. It is also possible that students only focused on key features of PBL from their perspective and, with further questions or surveys (Dochy et al., 2005; Loyens et al., 2009), would demonstrate understanding of other key PBL design features. Therefore, follow-up of students is needed to investigate whether these other aspects are recognized but only play a minor role in students' understandings of PBL.

5.4.3 Approaches to Learning

Despite the limited relationship between students' reported understandings of PBL and curricular intentions, at Malmö there was clear evidence that the curricular design was consistent with students retaining a deep approach to learning. However, in Adelaide, this was not the case, where the mean DA score decreased at the end of the first semester. This was despite obvious similarities in the design of the PBL activities and related assessment tasks between the two sites. Findings for Malmö students were consistent with previously reported associations between deep approaches and PBL (Newble & Clarke, 1986; Tiwari et al., 2006; Mok, Dodd, & Whitehill, 2009). Results for Adelaide students were not consistent with this literature. However, while more Adelaide students reported a decrease in DA scores, the practical significance of these results needs to be interpreted with caution, particularly in light of variations in students' approaches within different curricula designed to encourage deep approaches to learning (Vermetten, Vermunt, & Lodewijks, 2002; Ellis et al., 2008; Gijbels, Segers, & Struyf, 2008; Balasooryia et al., 2009a). It was reported that students' responses to their learning environments did not necessarily result in consistent and desired effects. The latter report demonstrated that a new curriculum resulted in different student responses, e.g., those who

maintained a deep or an intermediate approach (i.e., neither clearly a deep or surface approach) and those who maintained or adopted a surface approach. These studies highlight the complexity of the interaction of curricula and students' responses across a cohort. Curricular features identified as having a "polarizing effect," i.e., some students responding with a deep approach and others with a surface approach, included independent learning, integration of basic, clinical, social, and behavioral sciences, and team and collaborative learning (Balasooriya, Hughes, & Toohey, 2009b, p. 292).

As noted, one of the major differences between curricula in the current study related to student contact time and the number of sessions used for reviewing case learning goals. Workload has been shown to be associated with surface approaches being adopted by students (Kember & Leung, 1998). Students' perceptions of their workload and related factors at both sites could assist in clarifying whether workload plays a role in the decrease in deep approaches to learning at UA. However, it is unlikely that the explanation for the DA results in Adelaide students is as simple as a difference in hours of contact because a direct or strong relationship between students' perceptions of workload and class hours or class and study time has not been reported (Kember & Leung, 1998; Kember, 2004).

Another factor reported to influence students' views of workload includes perceptions of "content and difficulty" related to, for example, perceptions of having to learn numerous apparently unrelated topics (Kember, 2004, p. 177). This may be a more important issue in the curricular design at Adelaide in terms of students' learning approaches as they managed content from four concurrent courses. The original curricular design for Adelaide aimed to improve integration compared with the previous conventional curriculum (replacement of seven courses by four courses with integration of content across courses through the PBL cases) (Townsend et al., 1997). Initial feedback showed significant improvement in students' perceptions about the number of topics covered and time available to understand content (Townsend et al., 1997). However, the level of integration at Adelaide was not as great as that achieved by the curriculum at Malmö where the PBL case related to all learning activities within the same course for each week/fortnight.

Despite common approaches in assessment related to PBL cases, the different curricular organization between sites, with a greater number of courses and assessments at Adelaide, may have contributed to the learning approaches adopted by students. The number and type of assessment tasks in the other first-year courses at Adelaide may have discouraged deep approaches to assist in managing workload. The approaches adopted may also have related to students' perceptions of content difficulty with concomitant perceptions of increased workload (Kember, 2004; Kember & Leung, 2006).

The lack of a relationship between approaches and performance contrasts with previous studies (Crawford, Gordon, Nicholas, & Prosser, 1998; Leung et al., 2008; Ellis et al., 2008). However some of these studies used different methods to elucidate students' approaches to learning. In two recent studies in a

PBL context using R-SPQ-2F, relationships between approaches and examination marks were somewhat conflicting. Specifically, no relationship was evident for a cohort of second-year law students enrolled in a single course using PBL (Gijbels et al., 2005). However, students in an integrated PBL speech pathology program who achieved the highest levels of performance had significantly greater differences between their DA and SA scores than students who achieved the lowest scores (Mok, Dodd, & Whitehill, 2009). However, only a weak negative correlation between performance and SA scores at the beginning of the semester was found (Mok, Dodd, & Whitehill, 2009). The lack of association in the current study may also relate to the focus or type of Malmö and/or Adelaide assessment tasks that may not clearly match the learning activities from the students' perspective, the grading categories that were used in the analysis, the small sample size requiring collapsing of categories for understanding, approach, and performance, and/or students' perception of their learning context and what is required of them in assessment (Gijbels et al., 2005; Kember & Leung, 2006; Gijbels et al., 2008; Leung et al., 2008). Further investigations of students' understanding of the match between learning and assessment and whether they are assessed for understanding are needed to clarify these findings (Kember & Leung, 2006; Mok, Dodd, & Whitehill, 2009).

5.4.4 Implications for Practice

The current study has shed light on some PBL curricular features that are consistent with deep approaches to learning in the first semester of a PBL program. Major curricular features that differentiated the two sites were the integrated nature of the program at Malmö with only one course with all learning activities linked to the weekly/fortnightly case. There were also fewer summative assessment tasks and provision of significant time for self-directed learning. These features may explain the findings related to the maintenance of deep approaches by Malmö students. Testing whether similar results are found in other PBL contexts with curricular elements common with Malmö would provide evidence that these are key factors that can support deep approaches to learning by students. However, data from the current study may be more useful in "identifying curricula with issues that need to be addressed" (Kember, 2004, p. 181). Given the complexity of the interactions between curricular design, the nature of the learning environment, and students' experiences and their learning outcomes, further investigation of students' perceptions of a range of factors is needed to identify key features we need to maintain (Malmö) or change (Adelaide) in our curricula (Kember, 2004; Kember & Leung, 2006).

Students' explanations of PBL that closely match our curricular intentions provide a valuable resource as part of student induction to PBL. The Adelaide students' recognition of the clinical context for learning in PBL provides support for explicitly linking and discussing the parallel between PBL and clinical steps. Regular review and discussion of clinicians' systematic/scientific thinking

processes in conjunction with cases that require students to not only develop, but also to apply their knowledge are critical. As the important role of the tutor, e.g., modeling and reviewing thinking processes, was not a focus for students, investigations of their understanding of the tutor's role are needed. This apparent lack of recognition by the majority of students at both sites after a semester may explain the limited development of understanding of the main features of PBL and related outcomes.

5.5 Conclusions

First-year students' understandings of PBL in both Malmö and Adelaide developed over one semester to more closely align with planned intentions. However, several of the key characteristics of PBL were not noted by students in their first year of studies. Curricular experiences of students at Malmö supported deep approaches while Adelaide students' PBL experiences were associated with decreased deep approaches. This was despite a clear focus by Adelaide students on the professional relevance of their learning in PBL, in contrast to Malmö students. As has been reported by others (Duke et al., 1998; Vermetten et al., 2002; Ellis et al., 2008; Gijbels et al., 2008; Balasooriya et al., 2009a, 2009b), this study demonstrates that designing curricula based on theoretical underpinnings does not necessarily translate into preferred learning approaches by students with associated outcomes. This chapter highlights the importance of reviewing students' perceptions, understandings, approaches, and outcomes of their curriculum, particularly after their first-semester experience (Biggs et al., 2001; Prosser, 2004; Kember & Leung, 2006). Further investigation of other aspects of these curricula is planned to clarify key curricular components that support or hinder our desired outcomes. These findings will inform our understanding of the complexity of PBL contexts and how their design can support the planned development of students' understandings of PBL and associated quality-learning outcomes.

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References

Abrandt Dahlgren, M., & 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.

Balasooriya, C. D., Toohey, S., & Hughes, C. (2009a). The cross-over phenomenon: Unexpected patterns of change in student' approaches to learning. *Studies in Higher Education, 34*(7), 781–794.

Balasooriya, C. D., Hughes, C., & Toohey, S. (2009b). Impact of a new integrated medicine program on students' approaches to learning. *Higher Education Research and Development, 28*(3), 289–302.
Barrows, H. S. (1986). A taxonomy of problem-based learning methods. *Medical Education, 20*(6), 481–486.
Barrows, H. S. (2000). *Problem-based learning applied to medical education*. Springfield, IL: Southern Illinois University School of Medicine.
Biggs, J. (2003). *Teaching for quality learning at university* (2nd ed.). Berkshire: Society for Research in Higher Education & Open University Press.
Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor study process questionnaire: R-SPQ-2F. *British Journal of Educational Psychology, 71*, 133–149.
Chang, A. M., Chau, J. P. C., & Holroyd, E. (1999). Translation of questionnaires and issues of equivalence. *Journal of Advanced Nursing, 29*(2), 316–322.
Charlin, B., Mann, K., & Hansen, P. (1998). The many faces of problem-based learning: A framework for understanding and comparison. *Medical Teacher, 20*(4), 323–330.
Crawford, K., Gordon, S., Nicholas, J., & Prosser, M. (1998). Qualitatively different experiences of learning mathematics at University. *Learning and Instruction, 8*(5), 455–468.
Dochy, F., Segers, M., van den Bossche, P., & Struyven, K. (2005). Students' perceptions of a problem-based learning environment. *Learning Environments Research, 8*(1), 41–66.
Dolmans, D. H. J. M., de Grave, W. S., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2005). Problem-based learning: Future challenges for educational practice and research. *Medical Education, 39*(7), 732–741.
Duff, A. (2002). Approaches to learning: Factor invariance across gender. *Personality and Individual Differences, 33*, 997–1010.
Duke, M., Forbes, H., Hunter, S., & Prosser, M. (1998). Problem-based learning (PBL): Conceptions and approaches of undergraduate students of Nursing. *Advances in Health Sciences Education, 3*(1), 59–70.
Ellis, R. A., Goodyear, P., Brillant, M., & Prosser, M. (2008). Student experiences of problem-based learning in Pharmacy: Conceptions of learning, approaches to learning and the integration of face-to-face and on-line activities. *Advances in Health Sciences Education, 13*(5), 675–692.
Gijbels, D., Segers, M., & Struyf, E. (2008). Constructive learning environments and the (im) possibility to change students' perceptions of assessment demands and approaches to learning. *Instructional Science, 36*, 431–443.
Gijbels, D., van de Watering, G., Dochy, F., & van den Bossche, P. (2005). The relationship between students' approaches to learning and the assessment of learning outcomes. *European Journal of Psychology of Education, 20*(4), 327–341.
Gijbels, D., van de Watering, G., Dochy, F., & van den Bossche, P. (2006). New learning environments and constructivism: The students' perspective. *Instructional Science, 34*, 13–226.
Higher Education Funding Council for England. (2001). *Strategies for widening participation in higher education*. Retrieved September 6, 2010, from HEFCE 01/36 http://www.hefce.ac.uk/pubs/hefce/2001/01_36.htm
Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235–266.
Irvine, F. E., Lloyd, D., Jones, P. R., Allsup, D. M., Kakehashi, C., Ogi, A., et al. (2007). Lost in translation? Undertaking transcultural qualitative research. *Nursing Researcher, 14*(3), 46–59.
Kember, D. (2004). Interpreting student workload and the factors which shape students' perceptions of their workload. *Studies in Higher Education, 29*(2), 165–184.
Kember, D., & Leung, Y. P. (1998). Influences upon students' perceptions of workload. *Educational Psychology, 18*(3), 295–307.

Kember, D., & Leung, Y. P. (2006). Characterising a teaching and learning environment conducive to making demands on students while not making their workload excessive. *Studies in Higher Education, 31*(2), 185–198.

Leung, S. F., Mok, E., & Wong, D. (2008). The impact of assessment methods on the learning of nursing students. *Nurse Education Today, 28,* 711–719.

Liamputtong, P., & Ezzy, D. (2005) *Qualitative research methods* (2nd ed.). Melbourne, VIC: Oxford University Press.

Lonka, K., & Lindblom-Ylänne, S. (1996). Epistemologies, conceptions of learning and study practices in Medicine and Psychology. *Higher Education, 31*(1), 5–24.

Loyens, S. M. M., Rikers, R. M. J. P., & Schmidt, H. G. (2006). Students' conceptions of constructivist learning: A comparison between a traditional and a problem-based learning curriculum. *Advances in Health Sciences Education, 11*(4), 365–379.

Loyens, S. M. M., Rikers, R. M. J. P., & Schmidt, H. G. (2009). Students' conceptions of constructivist learning in different programme years and different learning environments. *British Journal of Educational Psychology, 79*, 501–514.

Lycke, K., Grøttum, P., & Strømsø, H. I. (2006). Student learning strategies, mental models and learning outcomes in problem-based and traditional curricula in Medicine. *Medical Teacher, 28*(8), 717–722.

Mok, C. K. F., Dodd B., & Whitehill T. L. (2009). Speech-language pathology students' approaches to learning in a problem-based learning curriculum. *International Journal of Speech-Language Pathology, 11*(6), 472–481.

Mullins, G., Wetherell, J., Townsend, G. C., Winning, T. A., & Greenwood, F. (2003). *Problem based learning in Dentistry: The Adelaide experience*. Melbourne, VIC: Lovel.

Newble, D. I., & Clarke, R. M. (1986). The approaches to learning of students in a traditional and in an innovative problem-based medical school. *Medical Education, 20*, 267–273.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*, 345–375.

Prosser, M. (2004). A student learning perspective on teaching and learning, with implications for problem-based learning. *European Journal of Dental Education, 8*, 51–58.

Prosser, M., & Trigwell, K. (1999). *Understanding learning & teaching: The experience in higher education*. Philadelphia, PA: Open University Press.

Ramsden, P. (2003). *Learning to teach in higher education*. London: Routledge Falmer.

Rohlin, M., Petersson, K., & Svensater, G. (1998). The Malmö model: A problem-based learning curriculum in undergraduate dental education. *European Journal of Dental Education, 2*, 103–114.

Sadler-Smith, E. (1996). Approaches to studying: Age, gender and academic performance. *Educational Studies, 22*(3), 367–279.

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology, 135*(5), 31–38.

Schmidt, H. G. (1989). The rationale behind problem-based learning. In H. G. Schmidt, M. J. Lipkin, M. W. de Vries, & J. M. Greep (Eds.), *New directions for medical education* (pp. 105–111). New York: Springer.

Schmidt, H. G. (1993). Foundations of problem-based learning: Some explanatory notes. *Medical Education, 27*(5), 422–432.

Schmitt, N. (1996). Uses and abuses of coefficient alpha. *Psychological Assessment, 8*(4), 350–353.

Smith, S. N., & Miller, R. J. (2005). Learning approaches: Examination type, discipline of study, and gender. *Education Psychology, 25*(1), 43–53.

Strauss, A., & Corbin, J. (1994). Grounded theory methodology: An overview. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 273–285). Thousand Oaks, CA: Sage.

Tiwari, A., Chan, S., Wong, E., Wong, D., Chui, C., Wong, A., et al. (2006). The effect of problem-based learning on students' approaches to learning in the context of clinical nursing education. *Nurse Education Today, 26*, 430–438.

Townsend, G. C., Winning, T. A., Wetherell, J. D., & Mullins, G. A. (1997). New PBL dental curriculum at the University of Adelaide. *Journal of Dental Education, 61*(4), 374–387.

Vermetten, Y. J., Vermunt, J. D., & Lodewijks, H. G. (2002). Powerful learning environments? How university students differ in their response to instructional measures. *Learning and Instruction, 12*(3), 263–284.

Wilson, K. (2009). The impact of institutional, programmatic and personal interventions on an effective and sustainable first-year experience. Keynote address: *12th First Year in Higher Education Conference,* June, Townsville, QLD. Retrieved September 3, 2010, from http://www.fyhe.com.au/past_papers/papers09/content/html/keynote.html

Chapter 6
Learning Styles and Academic Outcomes: A Longitudinal Study on the Impact of a Problem-Based Learning Curriculum

Ciara O'Toole

6.1 Introduction

The observation that students vary widely in how they learn and process information has encouraged educators to strive to improve learning experiences. This has led to the development of a variety of teaching methods, moving from lecture-based, didactic teaching to more hands-on, practical-based methods and, in more recent times, towards self-directed learning. In the early 1970s, David Kolb, at that time a teacher of management students, started to experiment with alternative teaching methods to the traditional lecture. He became aware that students had individual preferences for how they approached learning, or 'learning styles', which are 'the composite of characteristic cognitive, affective, and psychological factors that serve as an indicator of how an individual interacts with and responds to the learning environment' (Duff & Duffy, 2002, p. 148). Learning styles have sometimes been described in terms of the social situations in which people prefer to learn (alone or with peers); the learning environment (silence or background noise); or the depth of learning achieved ('surface', 'deep' or 'achieving') (Biggs, 1987b). Others have described an individual's learning style as the attitudes and behaviours that determine their preferred way of learning (Honey & Mumford, 1992).

A number of models of learning are associated with theories of learning styles. Kolb's theory of experiential learning is one of the more influential models. In this theory, 'knowledge results from the combination of grasping and transforming experience' (Kolb, 1984, p. 41). He proposed four stages of learning, beginning with 'concrete experiences', which form the basis for the next stage of 'reflective observations'. The learner then transforms the information into 'abstract concepts' before finally 'actively experimenting' with the ideas drawn. Kolb argued that learning is not complete until all stages of the cycle have been processed, and that they must be followed in sequence (Fig. 6.1).

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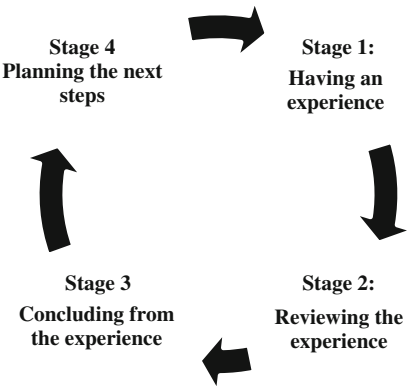

Fig. 6.1 Problem-based learning and Kolb's learning cycle
Source: Adapted from Kolb (2000)

However, he acknowledged that individual learners prefer to begin the cycle at different stages. For example, some prefer to actively engage with an experience before reflecting on it, while others prefer to explore abstract concepts theoretically before experimenting with them in practice (Kolb, Boyzantis, & Mainemelis, 2000). These individual preferences were characterised into Kolb's four dominant learning styles: 'diverging', 'assimilating', 'converging' or 'accommodating'. Kolb maintained that developing an awareness of one's learning style is a prerequisite to becoming a better all-round learner (Coffield, Moseley, Hall, & Ecclestone, 2004), and so devised the Learning Styles Inventory (LSI; Kolb, 1976) to help learners identify their styles.

Kolb's theory and inventory led to a large body of research in the area of experiential learning. Honey and Mumford (1992) credit Kolb for his theory which underlies their own model of learning styles, although they devised their own inventory, the Learning Styles Questionnaire (LSQ; Honey & Mumford, 2000), to identify these styles. This was because they found the LSI to have low face validity; they claimed that the LSQ had higher validity as the statements refer directly to behaviours, attitudes and preferences (Klein, McCall, Austin, & Piterman, 2007). The LSQ contains 80 statements that probe behaviours aligned with four main learning styles: 'reflectors', 'activists' 'theorists' and 'pragmatists'. Activists are said to prefer active experimentation, trying things out and thinking on their feet, while reflectors prefer reflective observation, researching and considering all perspectives before acting. Theorists like to draw conclusions based on abstract conceptualisation and complex theoretical constructs and pragmatists are essentially practical, preferring to implement actions based on concrete experiences (Coffield et al., 2004). Examples of statements in the LSQ that apply to each learning style are

- *Reflector*: I like to reach a decision carefully after weighing many alternatives
- *Activist:* In discussions, I usually produce lots of spontaneous ideas
- *Theorist:* I am keen to reach answers via a logical approach
- *Pragmatist:* I am keen to try things out to see if they work in practice

Honey and Mumford aligned their four learning styles with the four stages of Kolb's learning cycle and maintain that learners should become proficient in all four stages of the learning cycle, so that they review experiences, learn lessons and plan improvements. Honey (2002) also argued that individuals could enter the learning cycle at any stage depending on whether they want to reflect on information, test a hypothesis or implement information to see how it works in the real world.

Unfortunately, the learning styles theory has yet to have a strong empirical basis. Coffield and colleagues (2004) conducted a systematic review to investigate the impact of learning style theory on teaching and learning and found it to be an extensively studied but opaque, contradictory and controversial area. Overall, they identified very few robust studies that offered reliable and valid evidence for many learning style inventories, and there were few studies that provided clear implications for teaching. The review noted that Kolb's LSI had low psychometric properties. In addition, the review noted contradictory outcomes from studies considering the fit between Kolb's learning styles and teaching methods. Although some studies found that using the LSI was effective (Shaywitz et al., 1995) others found that it made no difference to the achievements of the group (McNeal & Dwyer, 1999). A study by Ehrhard (2000) found no significant differences between the academic outcomes of students who had identified their learning styles and those who had not, although those who identified their own learning styles reported increased self-esteem and self-understanding. Coffield and colleagues (2004) concluded their review of Kolb's theory of experiential learning by saying although explicit and robust, it did not yet have a strong empirical base to support it.

Studies that have used the LSQ have produced more positive, but also mixed results. For example, Honey and Mumford (1992, 2002) reported adequate test-retest reliability, claimed that the face validity of the LSQ is good, and have provided normative information for gender, geographical location and occupation. Other studies found that the temporal stability and internal consistency of the LSQ was satisfactory in comparison to similar learning styles instruments (Zwanenberg, Wilkinson, & Anderson, 2000). However, the concurrent and predictive validity of the LSQ was found to be not well established (Allinson & Hayes, 1990). Moreover, subsequent studies noted that the LSQ did not differentiate between the four learning styles to a sufficient degree (Swailes & Senior, 1999), and did not predict academic performance well (Dale, Price, Bishop, & Plomin, 2003; Duff & Duffy, 2002). The authors have responded by saying that the LSQ was not intended to be a psychometric instrument, but simply a checklist that invites people to consider how they learn from experience, more of a starting point for discussion between teachers and students (Coffield et al., 2004). This was why we began exploring the value of the LSQ as a measure of learning styles in clinical education. We felt that it might help supervising clinicians and students understand how they approach learning situations.

There is controversy in the literature as to whether learning styles are fixed traits or can be modified by experience and different learning methods. Those

that hold that they are fixed maintain that learning styles are easily identifiable by instruments such as the LSQ (Coffield et al., 2004). Others argue that they are flexible and can be changed if learners are cognisant of their particular learning style and the strengths and weaknesses associated with it (Kolb, 2000). It is important to note that although Kolb saw learning styles as having long-term stability, he did not see them as fixed traits, but maintained that educational experiences could shape them and that styles may change depending on the situation (Kolb, 2000). Honey and Mumford (2000) also hold that learning styles are modifiable through different learning experiences. The current study adds to this area by investigating learning styles with a group of students in a problem-based learning (PBL) curriculum and whether the styles would change over time with this new way of learning.

PBL is a method of integrated, student-centred learning that recognises that the goal of learning is to be able to apply knowledge in a sophisticated way to solve real-life problems efficiently (Fourie, 2008). Students work in small groups, setting their own learning goals by collaborating with each other in order to solve a 'problem' or a trigger that is presented to them. The perceived advantage of a PBL curriculum is that it simulates actual clinical experiences, team working and social interaction thereby facilitating the development of skills needed for professional practice. As opposed to other methods of teaching, the learner is not a passive recipient of the lecturer's knowledge (Fourie, 2008) and so has to actively engage with the material. Another advantage is that the stages and activities involved in PBL map onto Kolb's learning cycle. Thus, by engaging in all of the stages involved in PBL, students can develop all of the four main learning styles (Kolb, 1984). This is illustrated in Fig. 6.1.

At stage 1, students are confronted with a problem or a trigger. In clinical education, this is generally a patient's history, or data that the students need to explore. This corresponds with Kolb's stage of 'having an experience' and the preferences of the active learner. The structure of PBL forces learners to begin at this stage, where they are supposed to know little about the subject area, creating cognitive dissonance, an essential component of driving enquiry-led learning (Fourie, 2008). During this stage of PBL, a chair encourages the group to brainstorm while keeping on task and a secretary writes down key ideas, information and hypotheses from the group, which are based on any past experience or prior knowledge. Sugarman (1985) argued that teaching should always begin with this stage of concrete experimentation, where personal experiences are considered. At this second stage, the group also generates *learning issues*, which are key questions that form the basis for the next stage of the cycle, 'reviewing the experience'. This stage suits reflective learners, as students independently search the literature for possible answers to their learning issues. A few days later, the group meets to engage in the next stage of 'concluding from the experience', where students discuss the material they have found, aiming to draw relevant conclusions and reconsider their initial hypotheses. This involves forming abstract concepts, which is in line with the learning style of the theorist. The final stage of the PBL process matches the fourth

stage of Kolb's learning cycle, where conclusions from the previous stage are translated into action. In PBL, this is when learning issues are answered or a product of learning such as an information sheet or an academic journal is produced. The pragmatist prefers this stage, as it involves the practical application of information. Like the four stages in the learning cycle, the steps of the PBL process are mutually dependent, although time spent on each may vary considerably. Moreover, as Kolb maintained that students should become proficient at all four learning modes in order to become flexible learners (Coffield et al., 2004), the PBL process might also encourage students to develop all four learning styles.

Previous research related to the impact of PBL on learning styles is limited. Biggs (1987a, 1987b) used the Study Process Questionnaire (SPQ) to investigate the depth of learning achieved by a group of medical students who undertook a PBL course and found that they demonstrated deeper learning strategies than those who did not. Similarly, Mok, Dodd and Whitehill (2009) found that students exposed to PBL had a significant increase in their deep learning scores on the SPQ. However, Wun, Chan and Dickinson (1999) found no difference in deep learning scores on the SPQ between medical students who took part in a PBL module compared to their classmates who did not, although they were noted to make significant gains in their study skills. Baker, Pesut, McDaniel and Fisher (2007) used Kolb's LSI to evaluate the impact of PBL on the learning styles of nursing students. Although they found no significant change in any of the learning styles after two consecutive semesters of PBL modules, there was a reduction in the number of students selecting the 'accommodator' learning style (similar to the 'activist' on the LSQ).

Duff and Duffy (2002) noted that students with a preference for a particular learning style could be expected to outperform those with preferences for other learning styles in certain learning environments. Honey and Mumford (2000) provided a list of activities that are thought to match each learning style and which might be linked to variability in performance in different teaching and learning situations. For example, activists prefer small group discussion and learning through practice; reflectors prefer lectures and independent research; theorists enjoy structured situations with clear objectives and being involved in discussions involving complex ideas and concepts while pragmatists like practical activities and practicing techniques under coaching from an expert. It may therefore be the case that different learners will perform better or worse depending on whether the learning environment matches their individual learning style. The empirical evidence for this is limited, although Furnham and Medhurst (1995) correlated learning styles on the LSQ with a range of academic outcomes and found a positive correlation between 'pragmatists' and their scores in university seminars.

Kolb maintained that identifying and appreciating different learning styles would help people to work more effectively in teams, to communicate and resolve conflict, improving success rates in learning (Coffield et al., 2004). This is presumably because students can understand the changes they need to

make in their orientation to learning in order to suit how a subject is taught and teachers might be more empathetic to students who have difficulty with particular aspects of learning. As the LSQ has been found to have higher psychometric properties relative to other inventories, we used it to identify the learning styles of students entering a four-year PBL undergraduate speech and language therapy course and monitored their learning styles over a three-year period. We expected that the students, having come from a largely traditional, didactic teaching environment, would be predominantly reflective at the beginning of the year. As we considered PBL to address all four learning styles, we had no hypotheses as to which styles might change over time. However, because of the active nature of PBL tutorials and clinical placements, we did expect that students might show an increase in their active learning styles. Furthermore, as educational achievement is considered to be related to the learning opportunities provided, we were also interested in investigating whether there was an association between academic outcomes in the various courses taken by the students and their learning styles.

6.2 Method

6.2.1 PBL Curriculum

The Department of Speech and Hearing Sciences at University College Cork (UCC) was established in 2003 using a PBL-centred curriculum for the BSc (Hons) in Speech and Language Therapy. The curriculum was based on the University of Hong Kong curriculum, modified for the Irish context (Fourie, 2008) and is a 'hybrid' approach to PBL as students also attend traditional lectures and workshops for some modules. In UCC, the PBL sessions are structured in terms of an 11-stage process. These are listed below

1. Roles assigned to group members including a chairperson to facilitate discussion and a secretary to record information.
2. Problem presented and students define the content and identify key terms.
3. Students discuss what they know about the area from personal experience and prior knowledge.
4. Students hypothesise about the key features of the problem and justify their arguments.
5. Students identify questions or 'learning issues' in areas where they have insufficient knowledge.
6. Students are given references to key readings and divide the workload.
7. Students independently access books, journals and online resources.
8. Students reconvene to review learning issues and come up with key points.
9. Students reflect on what they have learned and develop a concept map or some other product of learning.
10. Students return to the problem and review the learning outcomes achieved.
11. Students reflect and evaluate their own and the group's performance.

The PBL curriculum centres on communication disorders in children and adults across years 1–3. Tutorial groups meet twice weekly for three-hour sessions. During this time students also attend other modules, most of which are integrated with the PBL topics of that particular week. These modules include anatomy, physiology, linguistics, speech and hearing sciences (instrumental and articulatory phonetics), research methods and clinical practice.

Over the four years, students are assessed in a variety of ways, from written assignments and essays, to oral examinations and presentations, class tests and exams. Clinical performance is assessed using an Irish competency-based instrument. The PBL curriculum is assessed through tutorial performance as rated by a tutor in each session and an academic reading form linked to the problem. Tutorial contributions are graded out of 100% for each tutorial based on a number of competencies, such as the students' ability to ask questions, help the group solve conflicts and their knowledge of the prescribed readings, and averaged over the semester. Reading forms are graded weekly, with feedback provided and involve the students completing a short essay applying relevant literature to the problem. The PBL module is also assessed through a written assignment and an open-book class test where students relate prescribed readings to a previously seen problem. There are two teaching semesters in the year (September to December and January to April) and in the third semester students attend block clinical placements. For further information on the PBL curriculum in UCC, see Fourie (2008).

6.2.2 Participants

The participants consisted of an entire class of 30 undergraduate speech and language therapy students All were female, and had a mean age of 19.8 years at the beginning of the study. Five students were 'mature' (over 23) and no student had previous experience with PBL.

6.2.3 Measurement Instrument

The LSQ (LSQ; Honey & Mumford, 2000) was completed in a classroom situation by all participants and took between 10 and 15 min to complete. Students self-completed the questionnaire to determine their scores for each of the four learning styles. Students had a range of learning style preferences. In addition, they could identify the strength of their preference for each style, based on standardised measures provided on the LSQ, ranging from 'very strong' to 'very low'.

6.2.4 Procedure

The students completed the questionnaire at five time points over a three-year period: at the beginning of their first year (Time 1), following the first semester (Time 2) and second semester (Time 3) of their first year, at the end of their second year (Time 4) and at the end of their third year (Time 5). Four students left the course and one deferred at the end of the first year so that 25 questionnaires were returned at the end of the second year (Time 4). One student then had to repeat the second year so that at Time 5 there were 24 LSQs completed. A record of student marks for each module over the three years was also maintained.

6.3 Results

6.3.1 Change in Learning Styles

The scores that students received for each learning style (maximum = 20) were entered into the Statistical Package for the Social Sciences (SPSS) Program (version 12.0.1) (SPSS, 2004). In addition, the strength of their preferences was also analysed. Table 6.1 provides an overview of the mean and standard deviation scores for all learning styles assessed on the LSQ over the five time points; for ease of interpretation, the results are also represented graphically in Fig. 6.2.

Table 6.1 Mean and standard deviation results for learning styles over time

	Reflector		Pragmatist		Theorist		Activist	
Time	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	14.31	3.97	13.86	3.5	12.17	3.03	7.55	2.98
2	15.03	3.63	11.52	3.7	12.45	4.07	7.90	2.98
3	14.15	4.1	12.11	3.4	12.07	3.61	8.19	3.41
4	12.22	3.54	12.65	3.2	13.61	4.34	8.57	3.76
5	14.21	4.01	12.5	2.8	11.79	4.34	9.04	3.57

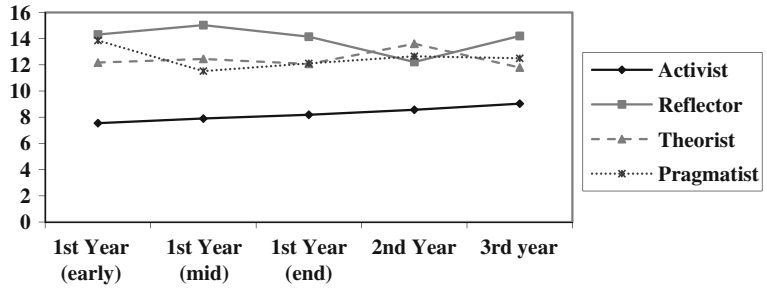

Fig. 6.2 Mean learning style scores (max=20) for group over time

Visually inspecting the data, students showed preferences for all four learning styles at the beginning of the first year, although the lowest score was for the activist. The students initially had a strong preference for both the pragmatist and reflector styles, although preference for the pragmatist style declined after one semester and then remained at a similar level over three years of the course. After one semester of PBL there was an increase in the scores for the reflector learning style, although this declined following the second year, and increased again following the third year. The theorist learning style remained relatively static over the three years, and scores on the activist style appeared to grow slowly. A mixed factorial ANOVA was carried out and the results indicated that there was a significant main effect of Learning Style, $F(1, 127) = 62.7$ $p \leq 0.001$. There was no significant effect for time and no significant interaction. Post-hoc analysis of learning styles showed that there was a significant difference between the activist learning style and the reflector, $t(131) = 10.87$, $p < 0.001$, the theorist, $t(131) = 8.05$, $p < 0.001$ and the pragmatist learning styles, $t(131) = 9.76$, $p < 0.001$. Furthermore, there was a significant difference between the reflector learning style and the theorist, $t(131) = 4.56$, $p < 0.001$; and pragmatic learning style, $t(131) = 3.59$, $p < 0.001$. No significant difference was found between the reflector and pragmatist learning styles. Despite the lack of significant main effect for time, we wanted to discover whether there was a significant change over time for any of the individual learning styles. Individual one-way Friedman's ANOVAs were carried out. The results indicated that the scores for both the reflector ($\chi^2(4) = 13.57$, $p \leq 0.01$) and the activist ($\chi^2(4) = 12.1$, $p \leq 0.01$) learning styles changed significantly over time. No significant change over time was found for the theorist or the pragmatist learning styles ($p > 0.05$). Visual inspection of the rankings in the reflector style indicated that there was an increase in the rankings from Time 1 to Time 2 (mean rank 2.94 to 3.72), followed by a sharp decline from Time 3 to Time 4 (mean rank 3.39 to 1.97) and a levelling off at Time 5 with a mean rank of 2.97. On the other hand, the mean rankings for the activist learning style increased in a gradual fashion from a mean rank of 2.33 at Time 1 to a mean rank of 3.94 at Time 5. Indeed, a Wilcoxon test revealed that this change from Time 1 to Time 5 was significant, $Z = 2.19$, $p < 0.05$. This change is also reflected in the increase in the number of 'strong' and 'very strong' preferences for the activist learning style over a three-year period from Time 1 to Time 5, as outlined in Fig. 6.3.

6.3.2 Learning Styles and Academic Outcomes

We then looked at student grades (out of 100%) in all subjects, and performed Spearman correlations to investigate whether there was an association between the scores received in a particular year and the various learning styles on the LSQ. Table 6.2 shows the associations. For the first year, the questionnaire taken at Time 3 was used as a measure of the students' learning style, as this was the data collection time closest to when the final assessments took place.

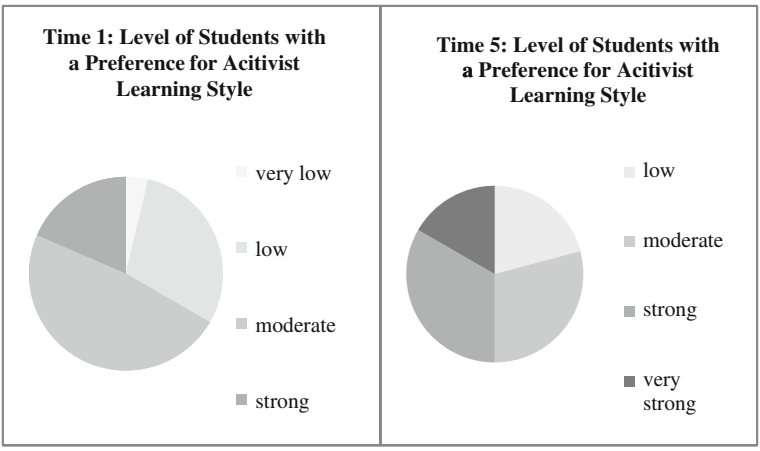

Fig. 6.3 Level of preference for activist learning style at (**a**) Time 1 and (**b**) Time 5

Table 6.2 Spearman correlations between learning styles and subject grades

Subject (Year)	Activist	Reflector	Theorist	Pragmatist
Year 1 (n=30)				
PBL (1)	NS	NS	NS	NS
Linguistics (1)	NS	NS	–0.39*	–0.44*
Speech & Hearing Sciences (1)	NS	NS	NS	–0.39*
Physiology (1)	NS	NS	NS	NS
Anatomy (1)	NS	NS	NS	NS
Final marks Year 1	NS	NS	NS	–0.43*
Year 2 (n=25)				
PBL (2)	NS	0.46*	NS	NS
Linguistics (2)	NS	NS	–0.51*	NS
Speech & Hearing Sciences	NS	NS	NS	NS
Anatomy (2)	NS	NS	NS	NS
Research Methods (2)	NS	NS	–0.43*	NS
Clinical Practice (2)	NS	NS	–0.57*	NS
Final marks Year 2	NS	NS	–0.63*	NS
Year 3 (n=24)				
PBL (3)	–0.42*	NS	NS	NS
Linguistics (3)	NS	NS	NS	NS
Speech & Hearing Sciences (3)	NS	NS	NS	NS
Anatomy (3)	NS	NS	NS	NS
Research Methods (3)	NS	NS	NS	NS
Clinical Practice (3)	NS	NS	NS	NS
Final marks Year 3	NS	NS	NS	NS

NS no significant correlations; * $p \leq 0.05$

In the first year of PBL, there was a significant negative correlation between pragmatist scores and results on linguistics ($r = –0.44$, $p \leq 0.05$), speech and hearing sciences ($r = –0.39$, $p \leq 0.05$) and the overall grade for the year ($r = –0.43$, $p \leq 0.05$). There was also a negative correlation between theorist

scores and grades in linguistics ($r = –0.39$, $p \leq 0.05$). In the second year, high scores for the theorist learning style had significantly negative associations with grades in linguistics ($r = –0.51$, $p \leq 0.01$), research methods ($r = –0.43$, $p \leq 0.05$), clinical practice ($r = –0.57$, $p \leq 0.01$) and the results overall ($r = –0.63$, $p \leq 0.01$). Moreover, there was a significantly positive association between scores for the reflector and results in the PBL module in this year ($r = 0.46$, $p \leq 0.05$). Finally, in the third year, there was a significant negative association between scores on the activist learning style and results on the PBL module ($r = –0.42$, $p \leq 0.05$). No other significant correlations were found between grades and learning styles in this year.

6.4 Discussion

6.4.1 Changes in Learning Styles

The results demonstrated that the learning styles as measured by the LSQ remained relatively stable over the three-year period, which was in line with Kolb's predictions of stability in learning styles (Kolb, 2000). Price and Richardson (2003) and Kappe, Boekholt, den Rooyen and Van der Flier (2009) also found that, overall, learning styles remained stable over a two-year period when measured on the LSQ. In the current study, the students initially had a high score for the reflector learning style, and scores generally remained high for this learning style over the period studied. As reflectors are said to prefer activities where they have time to prepare and research background information before producing reports (Honey, 2002), and as this represents much of the activity that happens during academic study, perhaps it is no surprise that students remained reflective learners over this period. However, we did find that as the students experienced a variety of learning environments and had an opportunity to develop all their learning styles, a gradual shift in their preferences was noted. For example, although the students initially received the lowest score for the activist learning style, following three years of PBL-based education their scores for this learning style increased and strengthened. While this cannot be directly attributed to PBL, it is likely that the variety of learning opportunities offered in a clinically oriented course, including clinical placements, are in line with the preferences of the active learner. Nonetheless, it is important to note that, overall, the students did not change their learning styles. It may be that developing an awareness of their learning style helps students to play to the strengths associated with it in order to overcome their weaknesses, and so their preference does not change. Indeed, Coffield and colleagues (2004) argued that the metacognitive awareness that comes from knowing one's own learning style should promote more organised and effective learning strategies in students.

6.4.2 Association Between Grades and Learning Styles

Analysing the association between academic grades and scores on the four learning styles, we found that in the first year, higher scores for the pragmatist learning style were correlated with lower results in linguistics, speech and hearing sciences and in the year overall. According to Honey and Mumford (1992), pragmatists are practical learners, and like to solve problems and see if theories and techniques work in practice. They are therefore technique-oriented but tend to reject anything without obvious application and so are not very interested in basic principles. This might explain the poor association with results in linguistics and phonetics, as pragmatists may not see the practical application of these subjects given that their clinical experience in this year is limited. Furnham and Medhurst (1995) found a positive association between pragmatists as measured on the LSQ and student performance in academic seminars in terms of students' grasp of the subject, motivation and written and oral expression. They attributed the association to that of 'performance' and with the fact that realism and innovation may help pragmatists to be highly rated in academic seminars. It may be that pragmatists need more of a practical environment in which to demonstrate their learning.

Furnham and Medhurst (1995) found a weak but positive negative association between theorists and their performance in academic seminars, which they attributed to their passive style of learning and the requirement of students to produce work. In the second year, scores for the theorist learning style were negatively associated with outcomes in linguistics, research methods and clinical education, and with the results for the year overall. Theorists are described as logical, rational, objective and good at asking probing questions. They do however have a low tolerance for uncertainty, disorder and ambiguity and can be restricted in lateral thinking. Although they may be good at integrating observations into complex theories, they may have difficulty applying these to practice. This might explain the negative association with outcomes in clinical education, but not necessarily in linguistics, which could be argued to be more theoretically oriented. However, the main assignment for the linguistics module in this year was to collect a language sample from a child and analyse it using a LARSP profile (Crystal, Fletcher, & Garman, 1989). In essence, this is a practical task of applying the profile to clinical data, and therefore may not be favoured by the theorist. Similarly, the research methods module was also essentially practical as it required carrying out statistical analysis on data, and so the practical orientation of the assessments in these modules might have contributed to the negative association with the theorist learning style in these modules and in the year overall.

In the second year, there was also a moderately positive correlation (–0.46) between reflector scores and results in the PBL module. Furnham and Medhurst (1995) also found a significant positive association between reflector scores and performance in academic seminars, and attributed this to the

fact that reflectors were assiduous in attendance and essay contribution to the seminars. On the other hand, Furnham, Jackson and Miller (1999) found that the reflector style was negatively related to work performance. They hold that this was because reflectors tend to hold back from direct participation, are indecisive, risk averse and unassertive, which results in a poor performance in telesales. Similarly, reflectors might be characterised as liking to stand back and think about experiences in PBL, then collect data from all sources before coming to a conclusion. It is possible that because reflectors are good at listening to others and assimilating information, it helps their performance in PBL assessment. Furthermore, given that a substantial part of PBL is assessed through class tests and assignments it might not be surprising that scores for the reflector learning style were positively associated with outcomes in this module.

After three years of learning through PBL we found that, contrary to expectations, the scores for the activist learning style were negatively associated with grades in PBL (–0.42). Although we have argued that the different aspects of PBL suit all learning styles, we did expect scores for the activist learning style to have a positive association with results in this module due to the 'hands on' nature of the learning environment. However, no significant association was found. Similar results were found by Furnham and colleagues (1999) and Furnham and Medhurst (1995) between scores on the activist learning style and performance in telesales and academic seminars, respectively. The strengths of activists are that they are flexible, open minded, and happy to try new experiences and be exposed to new situations. As previously mentioned, it was felt that the match between active learning style and an active learning environment such as PBL might be associated with enhanced performance in this module. However, previous studies have also confirmed that 'matching' the learning environment to the learning style does not necessarily result in higher academic outcomes. For example, Price and Richardson (2003) did not find that activists had higher academic performance in practical activities, such as work experience, compared to their peers with different learning styles. Similarly, Kappe and colleagues (2009) did not find increased grades when learning styles were matched to various learning environments including lectures, skills training, group projects, practical work and theses. Furthermore, as activists may have a tendency to rush into action without sufficient preparation and get bored with implementation or consolidation, it may be that assessment methods such as academic reading forms, assignments and class tests do not 'match' the learning style of the activist, and so they perform poorly. Some argue that it is actually mismatching of teaching and learning styles that benefits the student more than matching, as it helps students to overcome weaknesses in their styles and become overall better learners (Dale et al., 2003). This would also explain the unexpected positive association between reflectors and their performance on the PBL module in the second year.

6.5 Conclusions

One of the implications of the applications of Kolb's model of experiential learning is that instruction needs to be individualised. Although he acknowledges that this can be difficult with large group classes, he maintains it can be achieved through a change in the role of a teacher from a 'dispenser of information to a coach or manager of the learning process' (1984, p. 202). This very much mirrors the PBL approach to learning, where the tutor is considered to be a facilitator of student learning. Using Kolb's model of learning and the LSQ is a useful framework for students and tutors to consider when introducing PBL because it makes students aware of the learning cycle involved in PBL, and the challenges and opportunities that will present themselves to the students during stages of the cycle, depending on their own learning preferences. Even though Duff and Duffy (2002) argue that the LSQ is not sufficiently sophisticated to describe the learning that takes place in higher education, it does provide a measure of learning styles that remains largely stable over time. In the current study, it also showed that certain learning styles were negatively associated with many of the practical subjects in the clinical education of speech and language therapists, which would be useful to warn students about in advance, as they may have to put a greater effort into these particular subjects. Although this was a small-scale study and limited in the fact that we could not control for the teaching styles of teaching staff, we will continue to encourage students to identify their learning styles as it facilitates discussions between tutors and students and helps the students to identify their strengths and weaknesses. Future study might consider qualitative methods for exploring student perceptions of the benefits of knowing their learning styles and how this relates to their study methods and outcomes in PBL and other modules in clinical education.

References

Allinson, C., & Hayes, J. (1990). Validity of the learning styles questionnaire. *Psychological Reports, 67*, 859–866.

Baker, C. M., Pesut, D. J., McDaniel, A. M., & Fisher, M. L. (2007). Evaluating the impact of problem-based learning on learning styles of master's students in nursing administration. *Journal of Professional Nursing, 23*(4), 214–219.

Biggs, J. (1987a). *Student approaches to learning and studying*. Hawthorne, VIC: Australian Council for Educational Research.

Biggs, J. (1987b). *The study process questionnaire (SPQ) manual*. Hawthorne, VIC: Australian Council for Educational Research.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). *Learning styles and pedagogy in post-16 learning: A systematic and critical review*. London: Learning Skills and Research Centre.

Crystal, D., Fletcher, P., & Garman, M. (1989). *The grammatical analysis of language disability: A procedure for assessment and remediation* (2nd ed.). London: Whurr.

Dale, P., Price, T., Bishop, D. M. V., & Plomin, R. (2003). Outcomes of early language delays: 1 predicting persistent and transient language difficulties at 3 and 4 years. *Journal of Speech, Language and Hearing Research, 46*, 544–560.

Duff, A., & Duffy, T. (2002). Psychometric properties of Honey & Mumford's Learning Styles Questionnaire (LSQ). *Personality and Individual Differences, 22*, 147–163.

Ehrhard, B. (2000). The effect of learning style self-knowledge on student academic achievement. *Humanities and Social Sciences, 61*(6-A), 2267.

Fourie, R. (2008). Problem based learning and the construction of an SLP curriculum. *The South African Journal of Communication Disorders, 55*, 110–131.

Furnham, A., Jackson, C., & Miller, T. (1999). Personality, learning style and work performance. *Personality and Individual Differences, 27*, 1113–1122.

Furnham, A., & Medhurst, S. (1995). Personality correlates of academic seminar behaviour: A study of four instruments. *Personality and Individual Differences, 19*, 197–220.

Honey, P. (2002). Why I am besotted with the learning cycle. In P. Honey (Ed.), *Peter Honey's articles on learning and this and that* (pp. 115–116). Maidenhead: Peter Honey Publications Ltd.

Honey, P., & Mumford, A. (1992). *The manual of learning styles*. Maidenhead: Peter Honey.

Honey, P., & Mumford, A. (2000). *The learning styles Helper's guide*. Maidenhead: Peter Honey Publications Ltd.

Kappe, F., Boekholt, L., den Rooyen, C., & Van der Flier, H. (2009). A predictive validity study of the Learning Style Questionnaire (LSQ) using multiple, specific criteria. *Learning and Individual differences, 19*, 464–467.

Klein, B., McCall, L., Austin, D., & Piterman, L. (2007). A psychometric evaluation of the Learning Styles Questionnaire: 40-item version. *British Journal of Educational Technology, 38*(1), 23–32.

Kolb, D. A. (1976). *Learning styles inventory: Technical manual*. Boston: McBer & Company.

Kolb, D. A. (1984). *Experiential learning*. Englewood Cliffs, NJ: Prentice-Hall.

Kolb, D. A. (2000). *Facilitator's guide to learning*. Boston: Hay/McBer.

Kolb, D. A., Boyzantis, R. E., & Mainemelis, C. (2000). Experiential learning theory: Previous research and new directions. In R. J. Sternberg & L. F. Zhang (Eds.), *Perspectives on cognitive learning and thinking styles*. Mahwah, NJ: Lawrence Erlbaum.

McNeal, G., & Dwyer, F. (1999). Effect of learning style on consistent and inconsistently designed instruction. *International Journal of Instructional Media, 26*(3), 337–347.

Mok, C. K. F., Dodd, B., & Whitehill, T. L. (2009). Speech-language pathology students' approaches to learning in a problem-based learning curriculum. *International Journal of Speech-Language Pathology, 11*(6), 472–481.

Price, L., & Richardson, J. T. E. (2003). Meeting the challenge of diversity: A cautionary tale about learning styles. In C. Rust (Ed.), *Improving student learning and practice 10 years on*. Oxford: The Oxford Centre for Staff and Learning Development.

Shaywitz, B. A., Shaywitz, S. E., Pugh, K. R., Constable, R. T., Skudlarski, P., Fulbright, R. K., et al. (1995). Sex differences in the functional organization of the brain for language. *Nature, 373*, 607–609.

SPSS. (2004). *SPSS for windows (Version 12.0.1)*. Chicago: SPSS Inc.

Sugarman, L. (1985). Kolb's model of experiential learning: Touchstone for trainers, students, counsellors and clients. *Journal of Counselling and Development, 64*(December), 264–268.

Swailes, S., & Senior, B. (1999). The dimensionality of Honey and Mumford's Learning Styles Questionnaire. *International Journal of Selection and Assessment, 7*(1), 1–11.

Wun, Y., Chan, C., & Dickinson, J. (1999, December 9–11). *Does short-term problem-based learning change students' learning styles and preferences?* Paper presented at the First Asia Pacific Conference on Problem Based Learning, Hong Kong.

Zwanenberg, V., Wilkinson, L., & Anderson, A. (2000). Felder and Silverman's Index of Learning Styles and Honey & Mumford's Learning Styles Questionnaire: How do they compare and do they predict academic achievement? *Educational Psychology, 20*, 365–380.

Part III
Researching New Technologies for PBL Curriculum Design

Chapter 7
Multimodality in Problem-Based Learning (PBL): An Interactional Ethnography

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7.1 Introduction: A 'Next Generation' Research Agenda

Black and William introduced the term 'inside the black box' to research in educational assessment in the late 1990s. This metaphor can be applied to current research in problem-based learning (PBL). This chapter addresses the need to look inside the 'black box' of PBL by exploring two under-researched aspects – independent study and online learning. Using the Interactional Ethnographic (IE) approach to collect and analyse data in context and over time (across contexts), we systematically examined *how* students learn between tutorials to explore how online learning supports independent study in a PBL curriculum.

Despite PBL's 40-year history as an instructional method in undergraduate education, surprisingly few studies have examined and documented the in situ enactment of student learning in PBL contexts from an interactional perspective. While there is a growing body of student evaluation and outcomes data to support the efficacy of PBL programmes, research to date has relied mainly upon student and staff questionnaires and interviews. In dentistry, for example, the majority of studies have focused on problem design, course evaluation, and student achievement or performance. From a methodological perspective, the reliance on self-report data such as student course evaluation questionnaires across clinical education and staff surveys has come under some criticism. Concerns have been expressed regarding the status quo of this research agenda with a recent call to 'look inside PBL programmes', due to a perceived lack of studies into 'the way students experience and understand' PBL courses (Prosser, 2004, p. 204).

Of critical importance is the need to contribute further interactional data and analysis on PBL-in-action to support theory building. This is particularly the case given that the central, constructivist tenet of PBL is its 'process' approach

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to learning. PBL advocates argue that 'learner-centredness' is central to motivating student learning and fostering lifelong learning. However, how this is enacted in the learning process is not clear. Indeed, it is somewhat ironic that research projects designed to investigate a social constructivist instructional method have, in the main, not drawn upon this tradition in conceptualizing a research design.

Since the 1970s there has been a strong interest from educational researchers not only in focusing attention on classroom interaction as the locus of learning, but also on the social and cultural practice that is learning. Methodologically, the orientation to such research has been interpretive from fields such as sociolinguistics (Gumperz & Hymes, 1972), ethnomethodology (Baker, 1997; Freebody, 2003; Sacks, Schegloff, & Jefferson, 1974) and discourse analysis (Green, Dixon, & Zaharlick, 2003; Green & McClelland, 1999; Nuthall, 2000; Smith, 1987). Analysis draws on ethnographic data such as audio and video recordings and their transcriptions (see Appendix B), participant observations, and artefacts in the form of texts and photographs. The impact of these studies on classroom practice has been to raise awareness about patterns of talk and their impact on issues ranging from cognition to social access.

While the majority of studies has been in schools, there is a growing interest in interactional research in higher education with some work in medical education adopting conversational analysis (CA) to explore classroom interactions (Glenn, Koschmann, & Conlee, 1999) and discourse analysis (DA) to examine effective facilitator questioning techniques (Hmelo-Silver & Barrows, 2006, 2008). Given that such methods have provided insights into student cognition and teacher talk at the classroom-level, the use of such approaches to examine talk across time and across contexts (Agar, 2004) should provide a rich database and evidence of learning in higher education, in general, and the enactment of PBL, in particular. The focus of this study is therefore on investigating PBL-as-process in clinical education through detailed analysis of the 'way' students and their tutors construct knowledge and negotiate meaning in situ in a dental PBL curriculum. In the current era of global reform in both higher education and professional education, including clinical education, we envisage that this research agenda holds potential significance for informing the design and development of PBL curricula in this field.

7.2 Background

7.2.1 Multimodal Tools, Independent Study and Blended Learning

Renewed interest in PBL is evident across higher education as institutions seek instructional approaches that meet education reform calls for integrated, learner-centred and outcomes-based systems that support knowledge economies. A concern for many higher education curriculum leaders is how to design

programmes that engage the current generation of technologically connected learners, often referred to as the Net Generation. These learners arrive on campus with various technological skills in particular in utilising networked environments. The most recent wave of undergraduate clinical students are more increasingly engaged in Web 2.0 technologies that are generally synchronous and interactive (Bridges, Botelho, & Tsang, 2010; Bridges, Dyson, & Corbet, 2009).

In considering new text types, literacy theorists have recently been exploring the notion of multimodality where texts are 'constituted by a number of modes of representation' (Kress, 2000, pp. 183–184). The interest in multimodal texts in this study of Net Generation learners arises from attempts to understand how such learners use and create different texts to support their learning. Indeed, proponents argue that the concept of multimodality forces a rethinking of the distinctions usually made between communication and use, and in particular between reading and use as we shift to relying more heavily on the visual, aural and spatial (Kress, 2000, 2010). As a recent research field, its genesis can be traced to literacy theorists grappling with new text forms and how new literacy pedagogies can be developed using 'design' principles (New London Group, 1996). However, no research has examined multimodality in the context of PBL. For the purposes of this study, we focus on two key related notions: (i) modes as the types of print-based and visual texts, sounds, images, movements and gestures that are invoked across one problem cycle; and (ii) their 'modal affordances' (Jewitt, 2008) in examining how such texts mutually support meaning making across the learning experience.

From a higher-education design perspective, the incorporation of blended learning has been posited as the thoughtful fusion of face-to-face and online learning experiences (Garrison & Vaughan, 2008). The challenge for PBL curriculum developers creating online learning experiences is to understand how to structure blended approaches coherently to enhance student learning, thereby avoiding the trap of using technology as a novelty 'add-on'. While undergraduate curricula in dentistry are predominantly delivered in face-to-face modes, there is general consensus that online learning in the field has a growing future (Hillenburg et al., 2006). For PBL curricula, face-to-face facilitation of the PBL process provides important scaffolding for learners engaged in group problem solving. Independent learning is also a key facet as students engage in research between the first and final tutorials. In recognizing the role of self-directed learning (SDL) in PBL curricula, many higher-education institutions have provided infrastructure for online support of independent learning.

Many clinical faculties have employed learning management systems (LMS) embedded with multiple visual and aural texts to support and enhance lecture-based, problem-based and clinical learning. However, no research into real-time learning has explored how blended approaches in PBL support the achievement of learning outcomes. In what follows, we report on a small-scale ethnographic study that explores the role of multimodal texts in a blended PBL environment.

7.2.2 Context of the Study

PBL as both an instructional method and an educational philosophy is well aligned with Hong Kong's current education reform intentions with their focus on nurturing lifelong learners in a growing knowledge economy (Education Commission, 2000). The five-year Hong Kong Bachelor of Dental Surgery (BDS) has been cited as one of only three undergraduate curricula world-wide running a 'pure' PBL curriculum (Winning & Townsend, 2007). Recent studies in the region indicate the success of PBL curricula (either 'pure' or 'hybrid' by design) in comparison with non-PBL curricula, with first-year PBL students in Hong Kong 'more likely to develop generic, as well as subject specific skills' (Downing, 2009). Enactment of PBL in dentistry follows classic models premised on the use of complex, ill-defined, hypothetical problems grounded in real-life contexts to stimulate small group learning with an emphasis on active student engagement (see Fig. 7.1). Hmelo-Silver (2004) summarized the goals of PBL as helping students to develop flexible knowledge; effective problem-solving skills; self-directed learning skills; effective collaboration skills; and intrinsic motivation.

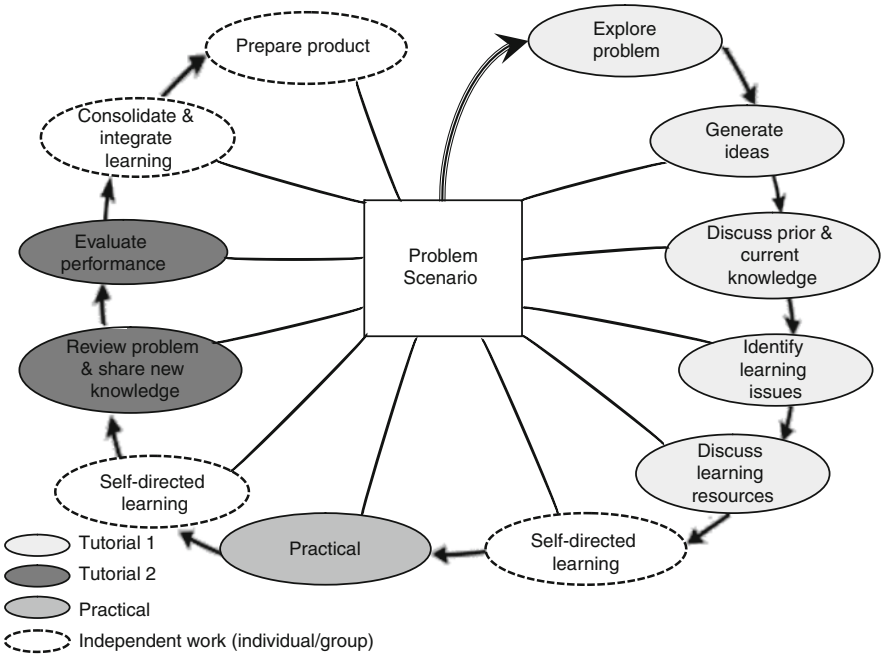

Fig. 7.1 The problem cycle in dental education in Hong Kong

In line with recent recommendations for curriculum design in undergraduate dentistry (Oliver et al., 2008), the PBL problems support vertical and horizontal integration of content across the curriculum (Barrows, 1999; Hmelo-Silver, 2004; McGrath, Comfort, Luo, Samaranayake, & Clark, 2006).

7.3 Theoretical/Conceptual Framework

This study adopts an interactional ethnographic (IE) framework to examine how the use of interactive technologies can support and shape the acquisition of disciplinary knowledge in a small group, problem-based learning (PBL) environment. As noted by Castanheira et al. (2007), the IE approach

> brings together an interdisciplinary set of social, cultural, educational and discourse theories from anthropology, education, linguistics and sociology, creating an orienting framework we use to examine the social construction of life, including identities, across times and events (p. 173).

Through this theoretical framework, the ethnographer studies how the disciplinary content that members of a social group (e.g., a PBL group) propose, recognize and acknowledge leads to the construction of particular knowledge, meanings of actions and patterns of activity. As such, IE has resonance with a social constructivist theory of learning (Palincsar, 1998). The goal of the ethnographer is to gain insider understanding of the processes and practices, norms and expectations, roles and relationships and rights and obligations of the community of practice (e.g., PBL group, a medical education programme). IE provides a systemic and empirical approach to recording, analysing, interpreting and reporting what counts as PBL in dentistry, and how disciplinary knowledge is 'talked into being' across an integrated PBL curriculum. The study therefore traces both collective activity and individuals within the collective across time and events that constitute a PBL problem cycle. This process then makes visible the situated understandings of dentistry as both scientific knowledge and clinical practice as constructed by participants (Castanheira, Crawford, Dixon, & Green, 2000).

Given a structured approach to collection and analysis, an IE logic of inquiry provides frames and iterative processes that support case and cross-case analysis. This approach supports exploration of similarities and differences in what members of a PBL group construct, what they take up and use (or not) from that which is proposed to them, and how their actions, individually and collectively, create a developing web of meanings, understanding and practices needed in subsequent problem-based events (Castanheira et al., 2000; Green & McClelland, 1999).

An IE provides a 'systematic way of studying learning as culturally and socially constructed' (Putney et al., 2000, p. 559) through examining language in use. Since the 'study of dialogue is at the centre of ethnographic work' (ibid., p. 561), the IE's sociolinguistic focus on language in use is particularly relevant. In a PBL curriculum, learning is seen as dialogic with students collaborating as meaning makers and tutors acting as facilitators or guides in the learning process. As Freebody (2003, pp. 90–91) argued, researching educational interaction and communication provides 'the framework through which materials/content can be brought to life and given their preferred interpretations'.

A further utility in adopting an IE approach is that it provides a longitudinal focus on constructed meanings. In educational research, this longitudinal focus can be seen in studies of the 'referential and intertextual nature of classroom life' over time (Green et al., 2003). From this perspective, texts (in all modalities, i.e., talk, print, screen) are seen as 'historically and situationally constructed artefacts' (Dixon, Green, & Brandt, 2005). Analysis focuses on exploring knowledge construction through tracing the way that texts are 'talked (acted) into being collectively and individually' (ibid.). Specifically, by adopting IE, analysis presented in this chapter traces 'how' meaning is negotiated and knowledge is constructed across student learning environments (PBL tutorial classrooms and student computer laboratory) and over time (across one problem cycle) through a focus on analysis of PBL discourse in relation to multimodal texts.

As such, the study has addressed the overarching research question of *how and when multimodal texts support knowledge construction across a problem cycle*.

7.4 Research Design

In this study, discourse analysis focused on naturally occurring talk. IE analysis of 'whole-part-whole' (Putney et al., 2000) focused on the various components of one problem cycle in the second semester of the third year of the curriculum. Interactional data were collected across a 'telling case' (Mitchell, 1984) that was traced in a data trail across contexts and over time. The telling case was a single third-year PBL group ($n = 8$) in an undergraduate dental curriculum as they engaged in learning activities across a problem cycle. The focus PBL problem was selected in consultation with discipline experts. The key criterion for selection was the PBL problem's use of multimodal inquiry (or stimulus) materials. The research focus examined the data trail across PBL learning events and contexts (from T1 to T2 and from tutorial classroom to computer laboratory) and the various discourse members involved.

One discourse member of the PBL group, Student 4 (S4), was selected as an anchor point for tracking across the data collection. Selection of S4 was based on three criteria. First, as a consenting participant, S4 provided data across all naturally occurring talk and screen captures (tutorials 1 and 2 and self-directed learning). Second, S4's activity across three events, and particularly in the second tutorial (T2), indicated consequential progression across a blended learning experience. Third, in analysing the historical relationships of multimodal texts across one problem cycle, S4's activities in T2 provided a key focal point for backward mapping.

This study examined student engagement with a variety of multimodal texts as learning artefacts. These included photographs and radiographs (both hard and digital versions), study casts, online resources and student-devised representations in the form of whiteboard drawings. This approach enabled a systematic and microanalytic analysis of student learning in PBL. Data sources

Table 7.1 Data collection: Focus Problem 3.9

Events	Location	Timing (problem cycle)	Data source	Student identifiers (Year 3)		Length
Tutorial 1 (T1)	Scheduled university tutorial room	Day 1 (AM)	Video + audio	$n = 8$	S1–S8	1:35:50
Self-directed learning (SDL) (1st of 3 sessions)	University student computer laboratory	Day 1 (PM)	Video (whole group) screen capture (Camtasia)	$n = 6$	S1 S4 S7 S8 S9 S10	0:29:57 0:29:37 0:30:52 0:30:57 0:29:52 0:29:20
Tutorial 2 (T2)	Scheduled university tutorial room	Day 9 (PM)		$n = 8$	S1-S8	2:08:01

included naturally occurring classroom and self-study data recorded with video and screen capture across one problem cycle (see Table 7.1). All participants consented to the recordings. Additional sources of ethnographic data included classroom artefacts such as curriculum documents, LMS resources and electronic whiteboard printouts following T1 discussions and products for T2. Audio and video data were transcribed using Transana™. As PBL tutorial groups are routinely rotated to enhance group dynamics and are different to clinical groupings, students were allocated with identifiers so that their talk could be traced across contexts.

Analysis presented in this chapter focuses specifically on two 'black box' areas of PBL as we explored how students engaged with visual representations and online materials to support their learning both within face-to-face tutorials and during SDL between these. Event mapping traced one focal student across real-time learning to explore the overarching research question.

Data were analysed inductively and recursively applying three key analytic constructs used in IE analysis:

1. Historical and over-time relationship between and among texts and contexts developed as forward and backward mapping from a key event.
2. Tracing whole-part, part-whole relationships from descriptions of the actions and discourse of members; and
3. Consequential progression analysis of how knowledge constructed in one context becomes socially and academically consequential to another (Putney et al., 2000).

Data analysis examines these three constructs across the phases of data collection as indicated in Table 7.1. The event map (Fig. 7.2) indicates the timing of the naturally occurring tutorial discussion and real-time online screen capture, including video footage of 'around screen' group activity and discussion.

7.4.1 Construct #1: Historical and Over-Time Relationship Between and Among Texts and Contexts

In examining the historical and over-time relationship between and among texts and contexts, the event map (Fig. 7.2) illustrates the key juncture in the third year of a five-year curriculum when the problem cycle under examination occurred. The event map does not depict the full suite of learning experiences over the third year, such as clinical learning, but rather presents the PBL domain that runs in parallel with clinical and other learning experiences across the year. The specific problem under investigation occurred in the third 'module' (an 8–10 week block) within the second semester. This was the ninth PBL problem encountered in the academic year. The event map (Fig. 7.2) illustrates the historical and over-time relationships between the various multimodal texts. S4's learning activities were identified for forward and backward mapping based on the 'key event' in the second, closing tutorial where she was asked to produce and explain an anatomical drawing.

Figure 7.2 traces the construction of disciplinary knowledge across real-time with particular analysis of one student's talk (S4) in relation to multimodal texts such as visual representations, solid objects and online learning, specifically:

1. Inquiry materials:
   a. in the first tutorial (T1) as hard copies or solid objects;
   b. via the LMS as digital resources for SDL.
2. Online links for research in SDL;
3. Supporting visual representations drawn on the whiteboard in the second tutorial (T2).

Indicated in Fig. 7.2 are the points across the problem cycle when the focus student, S4, engaged with multimodal texts and how the ensuing discussions of these led to hypothesis building in the first tutorial (T1) and synthesis of information for 'problem understanding' (Inman, cited in Butler et al., 2005) in the second tutorial (T2). The event map and the transcribed discussions describe how S4 and her peers seamlessly integrated multiple text types (clinical photographs, radiographs, study casts, online resources) across a learning cycle.

7.4.2 Constructs #2, #3: Consequential Progression Analysis across Whole-Part, Part-Whole Relationships

In what follows, we have identified three key events – T1, SDL and T2 – as 'parts' that we then relate to the 'whole' of a problem cycle. In analysing the relationship between multimodal texts and knowledge construction, the transcribed talk is used to locate *what* is said with respect to these texts and to identify *how* this is consequential to later discussions and learning. By tracing

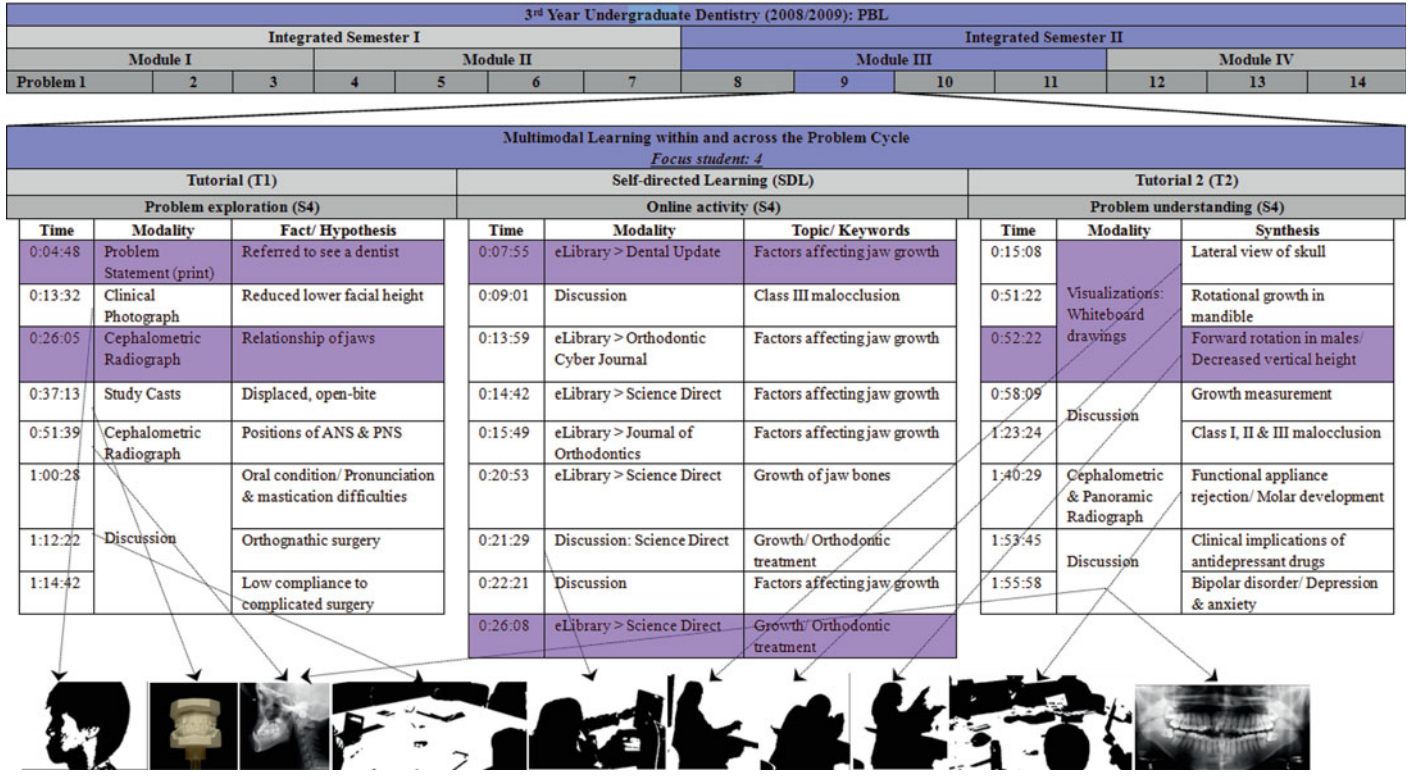

Fig. 7.2 Event map (Third Year PBL): Student 4 (S4) and multimodal texts

whole-part, part-whole relationships from descriptions of the actions and examination of the real-time discourse of members, we can delve more deeply into student learning. In particular, we can explore how the scaffolding inherent in a problem design can support the transition from naive to more sophisticated understandings of the problem and learning issues at hand.

The two constructs of tracing whole-part-whole and consequential progression are therefore examined simultaneously in the analysis that follows, i.e., we trace the learning from key events across the whole problem cycle to gain an understanding of how that which is said, viewed or done in one 'part' is consequential to learning in other 'parts'.

7.4.3 Event 1: The First Tutorial (T1)

As per the literature describing the PBL tutorial process (Barrows, 1985, 1988), the goal of the first tutorial is to arouse learners' curiosity by engaging them in a multidimensional, ill-defined problem. After initially reading the problem statement or 'trigger', one style of problem design, such as the one investigated here, is to incorporate the disclosure of additional information as stimulus or 'inquiry materials', which can refocus and further generate discussion. For clinical education, the introduction of additional inquiry materials such as clinical evidence can provide cognitive scaffolding whilst simultaneously increasing learner motivation.

In the event map above, it is evident that the problem design incorporated multiple visual tools including learning objects in 'hard copy' format i.e. a clinical photograph, two radiographs and two study casts. In this first tutorial, after S7 had read the problem statement to the group, the scribe or 'clerk' (S5) recorded all relevant facts with the last offered by S4 at the beginning of excerpt 1 (T1, 0:04:48.1). This was followed by S6's suggestion to consider the multiple sources of clinical information. Initially this created some dissonance and added initial 'cognitive load' (Kirschner, Sweller, & Clark, 2006) to the problem process as indicated by the lengthened silence (0:00:24.3) where the group began to fracture into sub-groups as students sought to examine the new information. For third-year PBL students now working in clinics with real patients, the heightened complexity of the simulated clinical task was designed to challenge them and increase motivation and engagement. Under the structure of a PBL format, this cognitive load was then strategically distributed amongst the collective (Hmelo-Silver, Duncan, & Chinn, 2007). In this case, this was when S5, the group 'clerk', refocused group attention with a request to 'discuss it one by one' (T1, 0:05:55.5) starting with the clinical photograph (T, 1 0:05:59.5).

After some pauses while students considered the photograph, S8 proffered the first 'fact' for whiteboard recording as 'concave profile' (T1, 0:06:09.7). As the photograph was shared, group members built on this by listing additional observed 'facts' for recording on the whiteboard.

Excerpt 1 'Maybe we can discuss it one by one'

0:04:48.1	S4	and Mr Chan is referred to see a dentist (0:00:34.7) ((scribe returns to table))
0:05:24.8	S6	Did anyone have anything to add? Otherwise let's move on to those materials ((S2 and S4 take the radiographs and put them onto the light board; S6, S7 and S8 examine the photo; S1 and S5 examine the study casts))
0:05:55.5	S5	Maybe we can discuss it one by one=
0:05:55.7	S7	=Okay
0:05:59.5	S5	Maybe we can first (.) discuss about this (.) photo (0:00:02.8). Maybe we can write down some facts (0:00:02.4) derived from this photo.
0:06:09.7	S8	Concave profile haha ((S3, S4 and S5 look at the photo))

In the ensuing group discussion stimulated by the clinical photograph, the group proposed many discipline-specific terms that prompted the facilitator to probe prior knowledge. In Excerpt 2, below, the facilitator then further focuses the specific, in-depth discussion of issues pertaining to the clinical photograph. S4 contributes her first response by identifying the starting point for analysis of a clinical photograph as 'the profile' (T1, 0:13:50.2). After discussion of the clinical photograph, S4 proposes the hypothesis that there was a problem with 'reduced lower facial height' (T1, 0:14:47.2). This then prompted disagreement by S5 (T1, 0:14:54.5) and further probing by the facilitator who challenged notions of 'normal' (T1, 0:14:55.8).

Excerpt 2 'Reduced lower facial height?'

0:13:32.2	F	Where did you learn all these terms?
0:13:35.0	All	Orthodontics
0:13:42.0	F	Okay, so when they=when you learn (.) about how to describe (.) this (.) photo, where do you start?
0:13:50.2	S4	The profile=
0:13:51.6	F	=Yeah, the profile (.) but there are a lot of components making up this profile, (.) right? So usually systematically ((using the photo to demonstrate)) either you start from top to bottom, inside out or outside in, or from bottom to top. Do you want to add anything? (0:00:25.0)
0:14:35.6	S3	The facial (.) proportion=
0:14:40.7	F	=Good ((nods)) facial proportion. What do you think? ((S5 and S6 look at the photo placed in the middle of the table))
0:14:47.2	S4	Reduced lower facial height? (0:00:02.7) Is that?
0:14:54.5	S5	I think it's pretty normal ((Ss laugh)) ((picks up the photo and looks again))
0:14:55.8	F	Again, what is normal? What is lower facial height? Measure from where to where?

In further seeking to establish information from the clinical photograph, the facilitator then focuses on the lips. There is an ensuing discussion punctuated by long silences that may indicate a possible knowledge gap across the group. Of

interest in tracing consequential progression is that after another attempt by S4 to contribute to this topic by commenting erroneously on muscle tone, she is silent for an extended period (~8) minutes and does not verbally re-engage until at 0:28.09.9 in Excerpt 3 below. During her extended period of silence, the entire group physically moves from sitting around the table to a sidewall within the room to view the panoramic radiographs on the light box (see Excerpt 3). S4, however, does not contribute to the group discourse as her peers consider the two radiographic X-rays and the facilitator probes for collective prior knowledge regarding both the process of reading radiographs as well as considering the problem at hand. After this sustained silence, S4 responds to the facilitator's revoicing and direct question regarding classifications (T1, 0:28:09.9).

Excerpt 3 'Maybe'

0:26:05.5	F	That means in simple terms the lower jaw (.) that is in front of upper jaw (.) whether one is protrusive or one is ah: retrusive or a combination. So, basically you see the lower jaw is in front. Okay↑ So, this is class three. (.) So, what is class one and class two? (0:00:18.4)
0:27:55.1	(S6)	(Upper jaws) (0:00:7.8)
0:28:09.9	S4	The class two is protrusive maxilla so the maxilla is more (lengthened)
0:28:21.0	F	Maybe↓ the maxilla is more in front, okay
0:28:27.6	F	Then what is the normal relationship I suppose to be class one? Normally (.) is the maxilla at the same place horizontally as the lower jaw? ((students shake heads)) No. So? (0:00:22.1)
0:29:06.5	S8	Eh, I think in class one, the maxilla is just slightly in front of the mandible but in class two, it is very ((gestures with hands)) in front yeah ha
0:29:19.8	F	Okay↓
0:29:27.9	F	Why do we do cephalometric radiograph?
0:29:34.1	S4	To do the analysis so that can compare patient's ah:: skeletal pattern and not the population or (0:00:5.2)
0:29:46.8	F	So what kind of analysis are you going to do? (0.5) You said 'analysis'.

The issue of bone growth seemed problematic for this group and was reinforced by S4's silence and difficulties in responding to facilitator questions. The topic was later identified as an area for independent study and reporting back in T2. Of interest to the notion of consequential progression is to explore how this identified knowledge gap was addressed individually in SDL time and how this then contributed to building collective understanding in T2.

7.4.4 Event 2: Self-Directed Learning (SDL)

As indicated in Fig. 7.2, the recording of online SDL occurred directly following the T1 during which the entire third-year cohort had simultaneously encountered the same problem for the first time. This initial independent learning session was conducted in the student computer laboratory in order to utilize

the screen capture software (Camtasia™). While on-screen activity was recorded, a video recording was also running to capture around-screen talk and activity. Six students, including the focus student (S4) volunteered to be recorded during the computer laboratory SDL session. Of these, S1, S4, S7 and S8 had been in the same T1 group recorded on the event map (Fig. 7.2). S9 and S10 had agreed to participate in the study but had been in two separate PBL groups. Notable in achieving the goals of the PBL instructional design process was that these students from three different groups started the SDL session with a shared understanding of the problem and issue to be researched.

In what follows, we track online activities and the around-screen talk generated by this cross-tutorial group of students. In doing this, we can trace not only group learning processes in action during SDL, but also, more importantly for the focus of this chapter, how S4's screen activity is consequential to both the prior tutorial and to her participation in the second tutorial. Tables 7.2 and 7.3 present excerpts from activity timelines for screen capture and indicate some areas of collective interest that generated group talk. It should be noted here that the activity was 'multi' in that all screens were recorded. Talk and activity were simultaneous, and so the visual activity represented on the screen often prompted group commentary as is indicated by the number of students contributing to the topic. Of interest in linear terms, however, is the cascade effect that individual or group commentary would bring to the screen activity. In some cases, when students commented on multimodal texts on their screens, others at separate computers then navigated to the same link or resource.

Table 7.2 Online learning (via dedicated LMS: Part 1)

Time	Student	Modality	Topic
0:04:00	S8	LMS > Learning Resources > Lecture Capture	Occlusion in restorative dentistry
0:04:03	Ss7, 9,10	LMS > Learning Resources > Lecture Capture	Occlusion in restorative dentistry
0:05:04	S9	Discussion	Webinar features
0:05:15	S8	LMS > Learning Resources > Video	Gag reflex, swallowing
0:05:32	S8	LMS > Learning Resources > Lecture Capture	Impact of oral conditions on life quality
0:05:39	Ss7,9,10	LMS > Learning Resources > Lecture Capture	Impact of oral conditions on life quality
0:06:35	S9	Question	PBL inquiry material
0:07:02	S8	LMS > Evaluation	Questionnaire
0:07:15	S7	LMS > Course Tools > Discussion board	Stressed patient
0:07:24	S8	Question	Definition of stressed patient
0:07:35	Ss1,8,9,10	LMS > Course Tools > Discussion	Corticosteroid
0:07:55	S4	E-Library > Dental Update	Factors affecting jaw growth; mandibular and maxillary growth
0:09:01	S4	Question	Current problem: Class III malocclusion only?
0:09:05	Ss9,10	Discussion	Current problem: Classification of malocclusion

Table 7.3 Online learning (via dedicated LMS: Part 2)

Time	Students	Modality	Topic
0:13:33	Ss7,8,10,4	Discussion	Current Problem: Development of jaw bones
0:13:45	S4	E-Library > Orthodontic Cyber Journal search	Factors affecting jaw growth
0:13:50	S8	LMS > Learning Resources > Video	Anatomy of Skull
0:13:59	Ss4,10,7	LMS > Learning Resources > Video	Anatomy of Skull
0:14:42	S4	E-Library > Science Direct search	Jaw/Mandibular growth
0:14:48	S8,10	Discussion	Resource Session
0:15:00	S8	LMS > Learning Resources	Ion excitability
0:14:25	S9	E-Library > PubMed search	Malocclusion oral health; Orthognathic surgery; Orthodontics
0:15:13	S10	E-Library > Journal of Orthodontics	Malocclusion
0:15:14	S8, S1	Discussion	LMS Resources
0:15:49	S4	E-Library > Journal of Orthodontics	Factors affecting jaw growth
0:18:23	S8	Question	Current Problem: What to look for
0:18:33	Ss8,10,9,4	Discussion	Orthodontic textbook
0:19:23	S9	E-Library > PubMed search	Perception of facial attractiveness
0:19:27	S7, S8	Discussion	Past problem
0:20:53	S4	E-Library > Science Direct search	Growth of jaw bones
0:21:41	Ss10,8,1	PDF Journal article > Discussion	Bone development
0:26:08	S4	Print: Journal article	Orthodontic treatment
0:26:12	S8	LMS > Learning Resources	Mandibular fractures
0:26:55	Ss4,10,7,9	Email: Journal article PDF	Growth in Orthodontic treatment
0:27:04	S8,	LMS: Problem Archive	Bone development
0:27:39	Ss4,8,1	Email: Journal article PDF	Orthodontic treatment

On beginning their on-screen work, the entire student group began with the (LMS). This group did not immediately navigate to the link for the current problem. Instead, they were greatly interested in the newest feature, the inclusion of lecture captures of faculty presentations from end-of-unit 'resource sessions' and public presentations for the continuing education of practising dentists. Online searching through the LMS focused on the problem at hand with one digression over a discussion board posting on corticosteroids. S4 did not join the general discussion on the new features but began searching for information on her key knowledge gap – jaw growth. Her question, when posed, was highly directed as she clarified which class of malocclusion was the focus of research. In her ensuing activity (Table 7.3) she remained focused on this topic weaving between modalities from online searching to viewing an anatomy video, to saving, printing and emailing relevant journal articles. S4's

switch in screen activity at 0.13.59 from a focused search on the electronic library was prompted by the cascade effect initiated by S8's discovery, four computer screens away, of an online anatomy video.

In a trilingual territory such as the Hong Kong Special Administrative Region (HKSAR), Chinese (specifically Cantonese, as below) is often the students' chosen language of communication outside formal learning contexts, which are in English. In Excerpt 4, we see the students engaging in informal talk in Cantonese whilst searching online and utilizing the dedicated LMS.

Excerpt 4 'So should I print it out?'

0:21:52.6	S8	[啊]我知你講咩喇 (bone development)
		[aa]ngo zi nei gong me laa (bone development)
		[Ah] I know what you're talking about (bone development)
0:21:54.9	S10	係呀即跟住佢就=
		hai aa zik gan zyu keoi zau=
		Yes she then=
0:21:56.6	S1	Endocondral ossification
0:21:59.9	S4	咁使唔使印呢?
		gam sai m sai jan ni?
		So should I print it out?
0:22:00.2	S10	別啊: 唔係呀係呀
		Ah: m hai aa hai aa
		Ah: mm yes yes
0:22:01.8	S4	都夠啦
		dou gau laa
		It's enough
0:22:05.0	S10	係呀係呀
		hai aa hai aa
		Yes yes
0:22:08.1	S8	Year one
0:22:09.3	S1	唔係講方向架咩°°咩向下°°
		m hai gong fong hoeng gaa me°°me hoeng haa°°
		Isn't it about direction °°something downward? °°
0:22:14.0	S4	有冇個factor點樣影響架=
		jau mou go factor dim joeng jing hoeng gaa=
		Is there a factor and how does it affect the=
0:22:18.5	S10	=即係你講malocclusion?
		=zik hai nei gong malocclusion?
		=So you mean malocclusion?
0:22:21.1	S4	Ah::影響咗growth
		Ah::jing hoeng zo growth
		Ah::affects the growth

In summary, it is evident from the time-stamped screen activities and the recorded around-screen talk that S4 used the SDL session in the computer laboratory to search for resources and information that would address the knowledge gaps implicitly identified in T1. It is also evident from the summary of her information searching immediately following T1 (see Tables 7.2 and 7.3) that this had been the issue of jaw growth and malocclusion. At the end of the

excerpt above, S4 still exhibits some hesitation and/or confusion over the topic of malocclusion (SDL, 0:22:14.0–0:22:21.1). Of interest is how this online searching and peer discussion become consequential to her second and final tutorial.

7.4.5 Event 3: The Second Tutorial (T2)

What becomes evident in T2 is the consequential progression of S4's learning across the three key components of the problem cycle. In the second tutorial, S4 displays her growing mastery of disciplinary knowledge. The silence in her first tutorial reflecting her confusion or lack of knowledge regarding bone growth prompted further research on the topic through online searching during SDL immediately following T1. In Excerpt 5 below, we see a transformative moment in S4's learning during T2 when she displays confidence by interjecting on behalf of S1 who is not able to respond to the facilitator's prompt regarding remodelling (T2, 0:49:09.9). The ensuing exchange indicates improved control of key concepts.

Excerpt 5 'What causes the remodelling?'

0:48:42.1	F	What kind of drugs? I'm always interested to know. ((Ss laugh)) (.)<u>What</u> causes the remodelling?
0:48:44.5	S1	Ah the cartilage, the carti=
0:48:53.8	F	=Cartilage?=
0:48:54.6	S1	=For=forgot sorry (cartilage)
0:49:09.9	S4	Is that the cartilage deposition posteriorly↑ and then ossify the bone and some remodelling occurs in another side to keep the shape?
0:49:18.6	F	Yes, but (.) we're talking about (.) what determines the (.) remodelling process. (.) So do you mean the condyle will continue to to grow? When you said the remodelling is because of deposition of the bone?
0:49:42.2	S4	Ah there there will be some (.) continued rotation of the mandible ah=in the adulthood but only a slight change=
0:49:50.6	F	=Continued rotation oka:y. Continued (.) rotation is towards which direction?
0:49:58.2	S4	For males it is more=more forward rotation and for females is more backward rotation
0:50:07.5	F	What is forward rotation, what is backward rotation?
0:50:09.2	S4	Ah forward is the vertical height will reduce and backward the vertical height will increase that the ((hands show a T shape and smiles to S6))
0:50:18.1	F	(That means) clockwise or anticlockwise=
0:50:22.9	S4	Oh, backwards=backwards is anticlockwise and forwards is clockwise ((S6 whispers))
0:50:34.1	F	So:: males will tend to rotate which direction?
0:50:38.1	S4	<u>Clock</u>wise (.)
0:50:47.1	F	Vertical=vertical growth, (.) increase in vertical growth?
0:50:51.9	S4	Decrease (.)
0:50:58.5	F	<u>De</u>crease but it's clockwise?
0:51:06.6	S4	You mean the mandible grows in anticlockwise but it=I don't know how to describe, it is (.) forward growth of mandible? =

At the end of this long exchange between S4 and the facilitator in excerpt 5, S4 admits her struggle to describe the complex physical features of mandibular growth patterns (T2, 0:51:06.6). The facilitator then interjects with 'Just draw it' (T2, 0:51:22.6) asking S4 to move to the whiteboard to create a visual representation of her description.

Excerpt 6 'Just draw it'

0:51:22.6	F	=Just draw it (.) arrow direction ((S4 moves to draw on the board while S8 and S1 discuss between themselves))
0:51:41.1	F	This is no::t rotation, it is AP, you are just shifting the whole thing AP.
0:51:58.5	S4	The bac=forward rotation is here↑ a::nd backward rotation ((finishes and walks back to her seat))
0:52:17.5	S4	°I didn't draw it round enough, I'll draw it again° ((returns and draws another one))
0:52:37.3	S4	This is (.) backward.
0:52:42.3	F	And this is female=
0:52:48.9	S4	=Yeah=
0:52:49.7	F	=Okay
0:52:50.3	S4	And forward is (.) you imagine it's (.) yeah another (one)
0:52:52.9	F	(But) then the:: vertical dimension is different (.) This is increased in facial height if this is backward. But you're talking about male is increased on vertical dimension right?=
0:53:04.8	S4	=Oh, decrease=
0:53:05.7	F	=Male is decreased. Okay?
0:53:11.6	S4	I dunno. It's written in the book that, the cranial facial growth in adult and when other dimensions cease, the vertical change still predominate ((looking up at the facilitator)) and there is a tendency for the male to have forward rotation (.) yeah
0:53:32.2	F	That means decrease in vertical dimension=
0:53:37.0	S4	=Mmm (0:00:10.0) ((S4 whispers to S6)) (0:00:24.2)
0:54:10.0	F	Okay

From this more dialogic exchange between the facilitator and S4 in excerpt 6, we see a transition from the use of visual tools as receptive prompts such as in T1 to a new visual text. This is the productive creation of a visual tool that cognitively assembles knowledge from both self-directed research and the printed texts and images she has brought to T2. In excerpt 6, S4 is challenged throughout the exchange with the facilitator to verbally articulate her understanding regarding 'jaw growth' whilst simultaneously visually representing this knowledge. Consequentially, we see this topic as the most challenging learning issue identified from T1.

7.5 Discussion

This study adopted IE to trace knowledge construction using multimodal texts across tutor-facilitated and student-directed learning. The small corpus of classroom interaction data (video/audio recordings) across one problem cycle over two weeks of learning was framed by using three lenses. First, by

investigating 'whole-part, part-whole relationships', it was evident that students accessed a range of multimodal texts including educational technologies to support learning within and across a problem cycle. Second, we traced 'consequential progression' and the 'historical and over-time relationship between and among texts and contexts'. A rationale for this was to establish if and how knowledge construction in T1 became socially and academically consequential to SDL and T2. Evidence was found that the use of multimodal texts within a problem cycle supported a discursive shift from *stimulus* for hypothesizing to *basis* for research and final *evidence* for hypotheses.

Few studies have explored PBL interactional data in the context of education theory. The focus on instructional approach to the detriment of clarity in PBL's relationship to theory building has been argued as a deficit in PBL research (Norman & Schmidt, 2000). Most studies acknowledge the underlying premise that, theoretically, PBL is constructivist in orientation (Gijselaers, 1996; Jonassen, 1997). More recently, researchers in clinical sciences have suggested a new form of 'information-processing constructivism' that moves away from the social nature of learning and focuses on the construction of new knowledge from multiple sources as a method of acquiring domain-specific knowledge (Schmidt & Moust, 2000). In exploring the role of multimodal texts across this social constructivist learning process, we now draw upon two explanatory theories. The first is Kress's notion of multimodality and a theory of semiotics or meaning making. The second is Vygotsky's sociocultural notion of mediating tools.

7.5.1 Theory of Semiosis

For Kress (2000, 2010), the possibilities of new modalities, particularly as they are focused on the visual, demand a 'new agenda of human semiosis in the domain of communication and representation' (Kress, 2000, p. 183). Building from his definition of multimodality, Kress's theory of communication focuses on three central concepts: materiality i.e. the (physical) materials of representation; mode i.e. the semiotically articulated means of representation and communication; and medium i.e. transmission and dissemination (ibid., pp. 186).

The third-year undergraduate students in this study engaged seamlessly with multiple physical and virtual materials of representation as part of their PBL process. These material representations ranged from print-based texts to clinically relevant materials such as study casts and radiographs to online resources to drawings made in class. Significant to the findings of this study was Kress's (2000) observation that

> Technologies of information lend themselves to 'visualisation', the phenomenon in which information initially stored in written form is 'translated' into visual form, largely because the transport of information is seen as more efficient in the visual rather than the verbal mode (p. 183).

From the analysis above, we can see the translation of knowledge gained in SDL as well as from the textbook brought into class into a visual form. Hence, the facilitator's strategy to ask S4 to 'just draw it' in T2 generates a cognitively

demanding task that asks the student to represent her knowledge visually. By transposing what was viewed during her online search and the picture in the text in front of her, the learner creates an 'intervisual link' (Kress, 2000, p. 196) that all who are present can associate with. They have all viewed and analysed the radiographs and have both separately and with peers examined images of jaw growth in their independent study. These intervisual relations then support and enhance collective and individual cognition.

7.5.2 Semiotic Mediation

Under the Vygotskian view of constructivism in a learning context, 'semiotic mechanisms mediate social and individual functioning' (John-Steiner & Mahn, 1996, pp. 192–193). External physical tools and internal psychological tools, therefore, contribute to the social acquisition of learning by 'tying mental functioning to cultural, institutional, and historical settings' (Wertsch, 1994, p. 204). Within the social learning process that is PBL, the accessing of visual tools and learning objects in the final tutorial becomes socially and academically relevant. From the IE above, we can see that the appropriation of mediating tools was dependent on their relevance to new knowledge. In T1 students were engaged physically with touching and manipulating study casts, as well as touching and viewing radiographs and the clinical photograph. In SDL, students moved to virtual images and exploring the learning issues in greater depth. In the final tutorial, students did not touch the physical objects, nor did they share virtual images via the interactive whiteboard. Instead, students drew representations on the whiteboard to illustrate the point currently being made. As (Bruner, 1962) noted,

> if neither hand nor intellect alone prevails, the tools and aids that do are the developing streams of internalized language and conceptual thought that sometimes run parallel and sometimes merge, each affecting the other (p. vii).

From this study, it was evident that the physical and psychological merged seamlessly both during specific PBL events and across the entire problem cycle. Significant to this notion of 'merging' in semiotic mediation was the transition from the *receptive* appropriation of curriculum materials to the *productive* creation of a drawing as a meaning-making tool in the social context of a PBL tutorial. The culmination of S4's accessing of a range of tools for learning in building disciplinary knowledge was the confident production and explication of an original visual representation of 'jaw growth'.

7.6 Conclusion

This chapter has taken a dual focus to explore 'inside' PBL. First, we have adopted a relatively new research methodology – interactional ethnography – to provide a principled and coherent framework for data collection and management. To understand how students experience PBL across a problem cycle, new methodologies must be adopted that look beyond evaluative data or short-term

learning experiences to examine learning in situ, particularly as students engage with online resources during independent study. The data and analysis presented in this chapter adopts an IE approach to trace 'how' knowledge is constructed in context and over time.

By adopting this framework, we have sought to explore the 'way' students experience and understand two 'black box' facets of their PBL learning, independent learning and online learning. IE provides a means of creating a conceptually organized archive; a systematic approach to analysing video records at multiple levels of scale; and an ethnographic framework for searching and retrieving video records that are intertextually tied. As such, an ethnographic approach affords educational researchers a principled approach to exploring how students learn. This approach enabled a systematic and microanalytic analysis of student learning in PBL in addressing the following key research question: *How and when do multimodal texts support knowledge construction across a problem cycle*? Analysis presented in this chapter focused specifically on two areas of the 'black box' of PBL as we explored how students engaged with online learning independent study and the ways multimodal texts and mediating tools supported learning within and between the first and final tutorials.

Second, we have drawn upon two analytic lenses as explanatory theories. Multimodality within a theory of semiotics enabled us to examine how the various multimodal texts that our focus student and her PBL group drew upon supported cognition and transformative learning. Vygotskian sociocultural theory of learning, specifically as it related to mediating tools, provided another explanatory theory to allow us to understand how physical tools support learner cognition in a social context. By focusing on multimodal texts and independent study, the results provide new insights into how blended approaches in PBL curricula support student learning and how students use visual objects to support learning. IE analysis of transcribed talk data tracked conceptual growth across one problem cycle. It was evident that students seamlessly integrated various face-to-face and virtual semiotic modes across a problem process to achieve learning outcomes.

The introduction of IE research holds great potential for understanding the learning process in PBL. The results of such investigations should inform the design of integrated, problem-based curricula in clinical education.

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References

Agar, M. (2004). We have met the other and we're all nonlinear: Ethnography as a nonlinear dynamic system. *Journal of Complexity, 10*(2), 16–24.

Baker, C. (1997). Membership categorisation and interview accounts. In D. Silverman (Ed.), *Qualitative research: Theory, method and practice* (pp. 130–143). London: Sage.

Barrows, H. (1999). A taxonomy of problem-based learning methods. In J. A. Rankin (Ed.), *Handbook on problem-based learning* (pp. 19–26). New York: Forbes.

Barrows, H. S. (1985). *How to design a problem-based curriculum for the preclinical years* (Vol. 8). New York: Springer.

Barrows, H. S. (1988). *The tutorial process*. Springfield, IL: Southern Illinois University Press.

Black, P. J., & Wiliam, D. (1998). *Inside the black box: Raising standards through classroom assessment*. London: King's College London School of Education.

Bridges, S. M., Botelho, M. G., & Tsang, P. C. S. (2010). PBL.2.0: Blended learning for an interactive, problem-based pedagogy. *Medical Education, 44*, 1131.

Bridges, S. M., Dyson, J. E., & Corbet, E. F. (2009). Blended learning, knowledge co-construction and undergraduate group work. *Medical Education, 43*, 490–491.

Bruner, J. (1962). Introduction. In L. S. Vygotsky (Ed.), *Thought and language* (pp. v–x). Cambridge, MA: MIT Press.

Butler, R., Inman, D., & Lobb, D. (2005). Problem-based learning and the medical school: Another case of the emperor's new clothes? *Advances in Physiology Education, 29*(4), 194–196.

Castanheira, M. L., Crawford, T., Dixon, C. N., & Green, J. L. (2000). Interactional ethnography: An approach to studying the social construction of literate practices. *Linguistics and Education, 11*(4), 353–400.

Castanheira, M. L., Green, J., Dixon, C., & Yeager, B. (2007). (Re)Formulating identities in the face of fluid modernity: An interactional ethnographic approach. *International Journal of Educational Research, 46*(3–4), 172–189.

Dixon, C., Green, J., & Brandt, L. (2005). Studying the discursive construction of texts in classrooms. In R. Beach, J. Green, M. Kamil, & T. Shanahan (Eds.), *Multidisciplinary perspectives on literacy research* (pp. 349–390). Cresskill, NJ: Hampton Press.

Downing, K. (2009). Problem-based learning and the development of metacognition. *Higher Education, 57*(5), 609–621.

Education Commission. (2000). *Learning for life, learning through life: Reform proposals for the education system in Hong Kong*. Hong Kong: Printing Department, Government of the HKSAR.

Freebody, P. (2003). *Qualitative research in education: Interaction and practice*. London: Sage.

Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. San Francisco: Wiley.

Gijselaers, W. H. (1996). Connecting problem-based practices with educational theory. In L. Wilkerson & W. H. Gijselaers (Eds.), *Bringing problem-based learning to higher educaiton:Theory and practice* (Vol. 68, pp. 13–22). San Francisco: Jossey-Bass.

Glenn, P. J., Koschmann, T., & Conlee, M. (1999). Theory presentation and assessment in a problem-based learning group. *Discourse Processes, 27*(2), 119–133.

Green, J., Dixon, C., & Zaharlick, A. (2003). Ethnography as a logic of inquiry. In J. Flood, D. Lapp, J. Squire, & J. Jensen (Eds.), *Handbook of research on the teaching of language arts* (pp. 201–224). Mahwah, NJ: Lawrence Erlbaum Asssociates.

Green, J., & McClelland, M. (1999). What difference does the difference make? Understanding difference across perspectives. *Discourse Processes, 27*(2), 219–231.

Gumperz, J. J., & Hymes, D. (1972). *Directions in sociolinguistics: The ethnography of communication*. New York: Rinehart & Winston.

Hillenburg, K. L., Cederberg, R. A., Gray, S. A., Hurst, C. L., Johnson, G. K., & Potter, B. J. (2006). E-Learning and the future of dental education: Opinions of administrators and informatin technology specialists. *European Journal of Dental Education, 10*, 169–177.

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

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-Based Learning, 1*, 21–39.

Hmelo-Silver, C. E., & Barrows, H. S. (2008). Facilitating collaborative knowledge building. *Cognition and Instruction, 26*, 48–94.

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

Jewitt, C. (2008). Multimodality and literacy in school classrooms. *Review of Research in Education, 32*, 241–267.

John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: A Vygotskian framework. *Educational Psychologist, 31*, 191–206.

Jonassen, D. H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Etr&D-Educational Technology Research and Development, 45*(1), 65–94.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychology, 41*(2), 75–86.

Kress, G. (2000). Multimodality. In B. Cope & M. Kalantzis (Eds.), *Multiliteracies* (pp. 182–202). London: Routledge.

Kress, G. (2010). *Multimodality: A social semiotic approach to contemporary communication*. London and New York: Routledge.

McGrath, C., Comfort, M. B., Luo, Y., Samaranayake, L. P., & Clark, C. D. (2006). Application of an interactive computer program to manage a problem-based dental curriculum. *Journal of Dental Education, 70*(4), 387–397.

Mitchell, J. C. (1984). Typicality and the case study. In R. F. Ellen (Ed.), *Ethnographic research* (pp. 238–240). New York: Academic Press.

New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review, 66*(1), 60–92.

Norman, G., & Schmidt, H. (2000). Effectiveness of problem-based learning curricula: Theory, practice and paper darts. *Medical Education, 34*(9), 721–728.

Nuthall, G. (2000). The anatomy of memory in the classroom: Understanding how students acquire memory processes from classroom activities in science and social studies units. *American Educational Research Journal, 37*(1), 247–304.

Oliver, R., Kersten, H., Vinkka-Puhakka, H., Alpasan, G., Bearn, D., Cema, I., et al. (2008). Curriculum structure: Principles and strategy. *European Journal of Dental Education, 12*(s1 Global Congress on Dental Education III), 74–84.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*, 345–375.

Prosser, M. (2004). A student learning perspective on teaching and learning with implications for problem-based learning. *European Journal of Dental Education, 8*, 51–58.

Putney, L. G., Green, J. L., Dixon, C., Duran, R., & Yeager, B. (2000). Consequential progressions: Exploring collective-individual development in a bilingual classroom. In C. D. Lee & P. Smagorinsky (Eds.), *Vygotskian perspectives on literacy research: Constructing meaning through collaborative inquiry* (pp. 86–126). New York: Cambridge University Press.

Sacks, H., Schegloff, E., & Jefferson, G. (1974). Simplest systematics for organization of turn-taking for conversation. *Language, 50*(4), 696–735.

Schmidt, H. G., & Moust, J. C. (2000). Factors affecting small-group tutorial learning: A review of research. In D. H. Evensen & C. E. Hmelo (Eds.), *Problem-based learning: A research perspective on learning interactions*. Mahwah, NJ: Lawrence Erlbaum Associates.

Smith, D. (1987). *The everyday world as problematic: A feminist sociology*. Boston: Northeastern University Press.

Wertsch, J. (1994). Mediated action in sociocultural studies. *Mind, Culture and Activity, 1*, 202–208.

Winning, T., & Townsend, G. (2007). Problem-based learning in dental education: What's the evidence for and against. . . and is it worth the effort? *Australian Dental Journal, 52*(1), 2–9.

Chapter 8
The Changing Face of Problem-Based Learning: Social Networking and Interprofessional Collaboration

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8.1 Introduction

The key problem facing dentistry is that the community remains unaware that dental caries can be effectively controlled or is unwilling to engage in the measures for its control. The problem is essentially one of communication about oral health behaviour change, increasing frequency of dental attendance and improving diet and oral hygiene. Although communication about caries management utilises a range of media forms, most dental schools provide training only in verbal communication with patients at chairside. Little effort has been made to develop competency with other media, particularly online and print media, which are important for community health education.

The problem of how to communicate the message 'Tooth decay can be stopped, reversed and prevented' to various community groups was presented to first-year dentistry students as the first 'real life' problem in the hybrid problem-based learning (PBL) programme at the University of Sydney. Situated in this way, it provided them with an introduction to important concepts in behavioural sciences, cariology, patient management and community dentistry to be explored in depth during their progress through the course. Furthermore, PBL was used to encourage each student to grapple creatively with this problem through research, self-directed learning, group discussion and integration of ideas into a product prototype for later development and implementation.

Most approaches to PBL are sequential, not surprising since its format traditionally comprises seven steps (Albanese & Mitchell, 1993). However, linear formats can be limiting where they impose a structure that does not always fit well with the iterative and reflexive processes that facilitate deep learning. Flexible interplay between 'step' components better reflects the social experience of students of the net-generation (Oblinger & Oblinger, 2005),

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especially where social networking sites are used to replace or augment the PBL tutorial group and whiteboard.

Online technologies of Web 2.0, in embracing PBL, have utilised blended learning formats, where face-to-face contact is supported by didactic or web resources such as *WebCT*™, *Blackboard*™, web-blogs or static websites. However, the effectiveness of these platforms for online learning has been limited by a typical Web 1.0 approach to teaching (Oblinger & Oblinger, 2005). The internet, when envisaged as a filing cabinet for resources or post-box for messages is too unwieldy to generate the experience of flow that motivates deep learning (Craig, Graesser, Sullins, & Holson, 2004). Further impeding the effective use of Web 2.0 technology has been the design of learning experiences by teachers from the baby-boomer or Gen-X generations, who may not think or learn in the same way as their students (McNeely, 2005). It is thus important that PBL flexibly encompasses the thinking and learning styles of both teachers and students. Existing PBL structures provide scaffolding for problem definition and access to resources and learning objective development, which are transferable to online platforms. However, for successful learning in the present online environments, teachers must now constructively address additional issues such as motivation to interact (Craig et al., 2004), processes of socialisation (Dede, 2005) and moderation of information exchange (Salmon, 2000).

A proposed nonlinear modification of Salmon's (2000) model for moderation of e-learning has been illustrated in Fig. 8.1. In this model, the learning experience is the context surrounding the process of knowledge construction, which is a bricolage of concepts and actions spanning two broad areas of

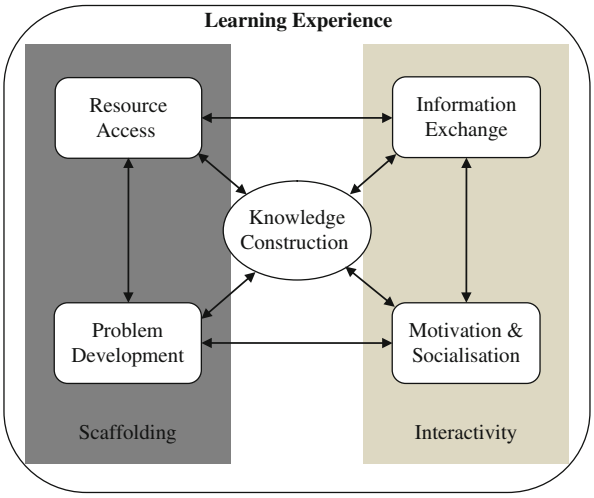

Fig. 8.1 A social interaction model of e-learning (after Salmon's (2000) model of moderating e-learning)

endeavour: educational and technological scaffolding and social interactivity. Access to resources and problem development inform the scaffolding while social interaction and information exchange are facilitated by the potential for interactivity of the learning tasks. All components of the process are interlinked. Since all members of the learning community (teachers, students and other relevant stakeholders) contribute to knowledge construction, they are not represented as disparate entities in this model. The traditional steps of PBL are subsumed in the educational scaffolding but are modified to suit the online technology.

8.2 Educational Methodology

Based on this model, a blended interprofessional PBL programme in oral health promotion was developed by the Faculty of Dentistry, University of Sydney and the School of Architecture, Chinese University of Hong Kong in 2008–2009. The PBL design and the structure of the programme are described below.

8.2.1 Scaffolding: Problem Development

The aims of the interprofessional blended learning programme were to (i) foster development of consultancy and expository skills in text-based and visual media for oral health promotion, and (ii) facilitate interprofessional learning in both local and international contexts.

The prime reason for failure of a community to understand, accept or act upon health information is its low level of literacy, not just in the sense of ability to read text, but also in the more specific sense of ability to understand health concepts, which we refer to as 'health literacy' (Nielsen-Bohlman, Kindig, & Panzer, 2004). Similarly, the community, including its health professions, has a poor understanding of basic principles of design (poor design literacy), which impedes acceptance and pursuit of aesthetics and elegance of function in all forms of design, including sustainable architecture (Boyd, 1960; Hollier, 2008) and, furthermore, obstructs accessibility of health information in text-based media.

Dentistry students require an understanding of communication in visual media and how design alters the efficacy of message transmission (Evans, Pakdamen, Dennison, & Howe, 2008; Katz, Kripalani, & Weiss, 2006). The quality of materials produced for use in public health education clearly shows failure to grasp basic graphic design skills (Schnabel & Howe, 2009). Architecture students, who have high design literacy but receive little training in consultancy (Woo, Herrington, Agostinho, & Reeves, 2007) especially in response to lay people who may be misguided, prejudiced or uninformed (Cuff, 1991) but whose satisfaction is the key concern in design business practice (Adam, Buchanan, Cook, & Till, 2008), require genuine clients, who can consult with

them, bring preconceived ideas to the table and question and challenge them as real clients do (Schnabel & Howe, 2009). To provide an exposure to an authentic client-expert relationship for each architecture student was a dilemma that was resolved by collaboration with dentistry students and, together, both groups of students learned about the challenges of persuasive communication in community engagement.

Each student of the School of Architecture at the Chinese University of Hong Kong ($N = 11$) was assigned as a consultant to a group of four students of the Faculty of Dentistry, the University of Sydney ($N = 43$). The remaining dentistry students ($N = 35$) worked in PBL groups without an assigned architecture consultant but were able to view the sites of all those PBL groups with consultants. The problem presented to all students was this:

> 'Tooth decay can be stopped, reversed and prevented' but nobody knows. How can this be changed?

The students were provided with in-class and live video-lectures as well as electronic resources before being assigned to their PBL group, each group working with a different target audience (e.g. infants, schoolchildren, teenagers, older adults, special needs, ethnic or indigenous communities). Each group was required to devise, research and answer its own questions in relation to its designated audience such as the following: What is our audience like? What specific needs do they have? How should we structure this message for them? What resources do we require? How can we develop a product prototype that meets our criteria? They reviewed literature about caries prevention, target audience characteristics and design concepts, then collaborated face-to-face and online to develop a booklet containing the evidence base for health educators working with the target group, a promotional product (poster, brochure, website, DVD, T-shirt, etc.), and an audio-visual presentation for peers. The products were assessed for research quality and quality of design communication and presented at the National Australian Oral Health Week.

The student groups presented their work with each target audience in peer-teaching seminars that were broadcast to the other university's location via a live video-stream using the free available *Skype* software. Students at both faculties evaluated the programme as a learning experience and provided qualitative feedback in focus group interviews. They finally provided evaluative feedback to each other about consultancy and teamwork skills using a protocol derived from Lurie, Lambert, Nofziger, Epstein, & Grady-Weliky (2007).

8.2.1.1 Scaffolding: Technology and Resource Access

Online learning strategies emerging in architectural education (Kvan, 2001; Achten, 2001; Schmitt, 1997; Kurmann, 1995; Maher, Simoff, & Cicognani, 2000) developed into real immersion within a virtual environment (Schnabel,

2002) and, with the advent of Web 2.0 technologies, within a social learning environment as well (Ham & Dawson, 2004). Social networking impacts quality of engagement and learning outcomes (Schnabel & Howe, 2008) through ease of communication, leadership opportunity, teamwork and a sense of community (Owen, Grant, Sayers, & Facer, 2006). The interesting possibility that design productivity may be better supported by remote settings than co-located ones was raised by Gao and Kvan (2004) and Kvan and Gao (2006) and prompted development of an interprofessional blended learning programme at the University of Sydney (Schnabel & Howe, 2008) as an international consultancy between dentistry students at Sydney University and architecture students at the Chinese University of Hong Kong.

Students were surveyed at the beginning of the semester on their use of social networking. Over 90% of students already used platforms such as *Facebook*™ or *MySpace*™ with over 80% reporting that social networking facilitated collaboration, communication and exchange. Concerns raised were the redundancy of joining a second network and issues of privacy. The site was made accessible only to members and was linked to the dentistry WebCT site to reduce redundancy for the dentistry students. This was not possible for the architecture students.

The free Web 2.0 interface, *Ning*™, was selected to serve both as an information repository for project research and a meeting place for information exchange. Students undertook research relating to their design task and target audience and posted this information as a shared resource for use and discussion by all participants. Significant opportunities were provided for student-staff interaction online, outside studio hours, and contact using other media was also possible (mobile phone, WiFi, other social networking sites etc.). Staff members were able to add comments and post additional resources in a manner that further blurred the distinction between virtual and real. In order to reduce the 'silo' mentality of thinking within faculty boundaries, staff entered the site and posted resources as a single persona 'Mr KnowItAll' (Mr KIA) who had his own strengths profile and personal page. It was envisaged that this personalisation would differentiate our site from the typical 'filing cabinet' Web 1.0 sites and humanise the provision of resources. All didactic and staff consultation components of the programme were accessible through Mr KIA's page.

8.2.1.2 Interactivity: Motivation and Socialisation

Motivation and socialisation were facilitated through site personalisation, opportunity for development of flow and diverse learning activities. However, students may lose valuable learning time because they are slow to warm to interaction with unknown group members (Woltering, Herrier, Spitzer, & Spreckelsen, 2009). Cho, Gay, Davidson and Ingraffea (2007) argued that personality surveys may be used as a facilitative device to improve collaboration. To implement this idea, all students completed the *VIA Signature*

Strengths Questionnaire (Peterson & Seligman, 2002) to identify key strengths to be featured in their online presence. This provided a structured activity to motivate early social interaction, potentially useful in team formation and subsequent role development.

Through respect of personal character in the learning experience and better alignment of skills with learning challenges, it was hoped to facilitate flow (Csikszentmihalyi, 1996). Flow is an important component of creative knowledge environments and has been found to facilitate content acquisition, teamwork and positive affect towards subject mastery (Beylefeld & Struwig, 2007). This positive affective experience in turn increases team effort and spontaneous communication. Huang (2003) argued that motivation is enhanced or maintained by flow, achieved when the site is pleasurable as well as functional. The project website included music, blogging, videos, chat, photographic images and RSS feeds designed to enhance motivation because they enable hedonistic experiences.

To reduce passive reliance on the 'expert' teacher and 'filed' resources, Mr KIA, the staff persona, was an active participant, a knowledgeable, talkative and approachable group member. Semiotic messages conveyed by site images (Bayne, 2008) were chosen to avoid the 'helicopter parent' stereotype of the online teacher and convey the idea that resources are actually text-based discussions with approachable teachers (Levy, 1997).

8.2.1.3 Information Exchange

While social interaction is necessary for information exchange, it may not be sufficient; the learning activities have to be varied, challenging and meaningful. Information exchange in the programme occurred in multiple areas of interaction: with peers, resources, teachers, other stakeholders and the community for whom the promotional products were designed. Not only does blended learning involve integration of different media for information exchange, it also involves amalgamation of the contributions of all members of the learning community, a process for developing collective intelligence (Levy, 1997). Social networking provides a mechanism for presenting collective information for individual use as well as aggregating individual insights into a collective decision (Surowiecki, 2005). The PBL experience was situated within both the professional communities to which students and teachers belong and the wider communities served by these professions, thus providing a transformative environment for blended learning.

The main tool for information exchange on the site was blogging. Blogging involves communication and reflection over a sustained period of time, linking people with resources, driving reflection and generating knowledge construction (Downes, 2004). Blogging, supported on the site by chat, video, photography, message broadcast and email facilities, permitted rich information exchange with both peer and teaching members that was accessible to all.

8.2.1.4 Knowledge Construction

Darling-Hammond et al. (2008) found that deep learning is enhanced when students apply classroom-gathered knowledge to real-world problems, a process requiring sustained engagement and collaboration. Active learning practices have an impact on student performance greater than any other variable, including student background and prior achievement. The current PBL experience addressed three criteria for authentic learning and teaching developed by Newmann & Wehlage (1993): construction of meaning and production of knowledge, disciplined inquiry to construct meaning and production of discourse, products and performances that have value beyond school. To research the problem required higher-order thinking combining knowledge from dentistry and design to construct a message for a specific community group. Students had to research the target audience and the preventive dentistry evidence base to develop a design concept, which integrated the information. The creation of real products for use in genuine health campaigns provided students with practical skills and professional recognition as well as fostering interaction between professions and engagement with the wider community.

In construction of learning products, social interaction intensified. Because each group member was responsible for production of one item that had to be thematically linked to all the others, the students remained motivated and engaged with the PBL programme. Similar to findings of Schnabel (2002), each member of the team had authority over (but not ownership of) parts of the design or collaboration, a process analogous to a typical collaborative scenario in practice, where designers and specialists contribute to an overall scheme in sequential and parallel activities. For the dental students, the greatest need in knowledge construction was access to appropriate skill to realise the products. For the architecture students it was skill in exposition of design concepts for a dental student audience with poor design literacy. The learning discussion involved social networking utilising both human resources and design technology, a convergence of social communication and technological environments. An important benefit of this convergence for facilitators is the opportunity to learn with and from the students. Students are often ahead of teachers in mastery of technology (McNeely, 2005). The loosening of the outdated hierarchical education system, reframing teachers as facilitators of social learning, provides a great opportunity for teachers to upgrade their own skills in the process of working with their students.

8.3 Evaluation Methodology

The learning products generated by the PBL groups were assessed for quality of research by a senior staff member in Community Dentistry and design by a graphic designer in Dental Behavioural Sciences. All students were invited to provide anonymous feedback and participate voluntarily in focus groups. Six

Table 8.1 Stem questions for the focused interviews

Scaffolding	Interactivity	Knowledge construction
How did similarity of the project site to other social sites (e.g. *Facebook*) affect your initial perceptions and use of the site?	How did sharing your strengths, experience and interest affect group formation and sharing of roles and tasks?	How did the task of developing promotional products assist your understanding of communication skills for different audiences?
What is your view of the effectiveness of virtual learning?	Which social interaction facilities on the site were helpful in developing a working team?	In what ways did the programme assist you to develop your understanding of visual media and design skills?
What impact did the opportunity for public recognition of your work have on your involvement and enjoyment?	To what extent did your experience of working relationships enhance your productivity and enjoyment?	How did the programme assist you in developing communication and consultancy skills?
How did interprofessional and intercultural collaboration affect the learning experience?	What aspects of the programme design assisted or hampered your development of a collaborative team?	The programme requires self-directed learning. What impact did this have on your involvement in and enjoyment of it?

architecture students (54%) and 27 dentistry students (34%) provided feedback. Human ethics approval for the study was obtained from both participating universities. One-way analysis of variance was used to compare project research and design assessments of the interprofessional and local PBL student groups. Statistical analyses were performed using *SPSS*™ quantitative analysis software (*SPSS* for *Mac*™, Version 17.0, 2008 *SPSS* Inc. Chicago, IL, USA). Stem questions (Table 8.1) developed for the focused interviews enabled evaluation of the components of the social interaction e-learning model presented in Fig. 8.1. The transcribed scripts of the focused interviews were collated using *NVivo*™ qualitative software (QSR NVivo Version 8.0.335.0 SP4, QSR International Pty Ltd). Thematic analysis was conducted according to Braun and Clarke's (2006) model, where a node coding scheme was devised and interpretative rigour maintained by two researchers applying the coding scheme to the transcripts and checking the results for inter-coder concordance. Log files on the website were reviewed to ascertain patterns of use of the online site.

8.4 Results

8.4.1 Knowledge Construction

All student teams developed product solutions meeting the two key objectives of the programme. Student groups successfully developed 20 research-based,

well-designed oral health promotion programmes of a high standard suitable for use in public campaigns as evaluated by the two teaching faculties. The PBL programme was successful in fostering development of skills in text-based and visual media for oral health promotion in dentistry students, regardless of whether they worked in dental groups or with design consultants. Students also reported that the interprofessional interaction deepened their understanding and value of each other's professional expertise and the importance of designing messages to meet both client and community needs and characteristics.

> (Dentistry students) ...We can see how a product can be designed better. ... it was so much better having something graphically effective. It looked more professional. That taught us to go that extra step.
>
> ... I tried to use big dental terms but discovered people didn't understand that so I had to remove the jargon and...put it into a context people could understand.
>
> (Architecture students) ... it made me feel good because they think you are the consultant or the person who gives opinions. They ask you questions and treat you as a professional and I can use my knowledge to help these people solve their questions.
>
> ... I think that when you express an opinion you have to make yourself clear and not use terms that are too professional or architectural so they understand what you are talking about.

Comparison of design and research outcomes for the PBL groups with international design consultants and local groups comprising dentistry students only are presented in Table 8.2.

The dentistry-only groups performed at a significantly higher standard than the interprofessional groups on both research ($F(1,87) = 29.02$, $p < 0.001$) and design ($F(1,87) = 8.95$, $p < 0.004$) measures. This result does not support the findings of Gao and Kvan (2004) and Kvan and Gao (2006). Focus group feedback indicated that this unexpected finding in our student groups is likely to have occurred because of inadequacies in our PBL scaffolding for the interprofessional groups, who experienced marked communication delays and frustration. The interprofessional groups had to navigate international time zones and mutual availability within two busy professional education programmes where there were differences in daily routines (dentistry students are 'larks', architecture students 'owls') resulting in communication that was essentially asynchronous and less dynamic than that of the local groups.

Table 8.2 Comparison of assessment results for the interprofessional and local PBL groups

	Architecture consultant 11 groups (n=54)			Dentistry-only 9 groups (n=35)				
	Grade %	M	SD	Grade %	M	SD	$F(1,87)$	p
Research result	66	26.69	4.79	81	32.43	5.1	29.02	< 0.001
Design result	70	70.28	8.49	76	76.00	9.3	8.95	< 0.004
Grades	D=4, Cr=3, P=4			HD=1, D=5, Cr=2, P=1				

> (Dentistry student) . . . It is difficult. . ...so for us it might be frustrating that they're not responding straight away but for them maybe they just generally don't respond for a day or two. We don't know. So there's a lot of cultural sensitivity. . .

> (Architecture student) . . . My group will sleep at 10 o'clock in their time zone so when I get back to home and have contact with them they've all gone to sleep. Of course you can contact with the forum and the site but instead I would rather be contacting them instantly. To me the face to face would have been better.

It is likely that communication difficulties had the effect of reducing time available for learning discussion in the interprofessional groups. Since all students had access to the whole site, the local groups made use of information communicated by the design consultants to the interprofessional groups, thus having the learning benefit without the communication problems.

> (Dentistry student) . . . I can remember one group did a storybook and I thought the use of images was really good. It was good to see how people took the idea in different directions.

Students requested modification of the project scaffolding to allocate communication times within the course timetables in future years to avoid this problem. However, further research needs to be undertaken into processes of information acquisition in PBL conducted through open social networking sites.

8.4.2 Scaffolding

Because of limited flexible time in the curricula of two professional faculties, students had to develop efficient ways of communicating with each other, holding team meetings and delegating individual responsibilities. The site platform allowed students to work synchronously, asynchronously and remotely. Resources had been provided to assist understanding of meeting procedures and students documented their application of strategies for team organisation, role delegation, meeting minutes and individual research contributions. However, despite general recognition of the requirement for self-directed learning, face-to-face contact in and between classes was reported to have made meeting easier for the co-located students. Focus group discussion explored the idea of using media that permitted virtual instant voice-message and webcam-based communication including a new application (available online from *Ning*™ only at the end of the project) that would permit the group members to videoconference on the site during the design phase.

Analysis of the site usage files revealed several thousand online interactions. During the semester, the course website reported 3,533 visits, with up to 120 site visits per day by members, culminating in 35,154 page views in total. Unit evaluation revealed 76.6% agreement with the statement that 'the online teaching and resources in this unit enhanced my learning experience', a 13.2% increase upon the 2008 *WebCT*™ programme where social networking was

not used. Agreement with the statement that 'the technologies used to deliver the online content in this unit performed satisfactorily' increased from 68.2% in 2008 to 76% in 2009.

Overall evaluation of the learning management system was positive. They reported that it allowed them to participate naturally and collaborate within their accustomed pace and style. Their experience with other social networking sites enabled them to use the project site easily, although the architecture students were more impressed with the utilitarian performance of the site than were the dentistry students.

> (Architecture students) ... the WebCT is like a one-way communication from the professor to us and then a multimedia platform online but to me the Ning site is more like interaction between the two different countries and students. It's more instant, more like Facebook interaction with different people online.
>
> ... The Ning site is not made by the school and it's easier to talk with the students in a casual way and explain what we are thinking about ...
>
> ... And when using this site you feel that the user is the student not the teacher ... so we are happy to leave the message.

It appears from these comments that the staff presence was unobtrusive when clothed in the persona of Mr KIA. The multiple channels for communication were enjoyed by most students, although a small number found them distracting from the main academic task.

> (Dentistry student) ... [These resources] brought the enthusiasm up and the interaction
>
> (Architecture student) ... if people want to get to know us they could add me on *Facebook* ... maybe make it more pure for academic things...

Many students posted their musical performances, photography and travel blogs in their informal communications. They appreciated having access to all resources (teaching, reading, consultation, video and photography and social interaction) in one location. Among disappointments were that the *Ning* platform kept blogging but not 'chat history', and that the university computers did not provide webcam technology.

The issue most impacting student satisfaction was the posting of information and resources in the virtual studio format. They enjoyed the multidimensionality of the site and its scope for interaction. The students were unanimous in their appreciation of the virtually augmented seminars, where the two student cohorts were linked via video-streaming, as a rich learning experience. The comment below emphasises the need for webcam-based technology to facilitate instant virtual face-to-face communication.

> (Architecture student) ... The idea is exciting. ... .you feel very close to someone who is actually overseas. . .but how to make it really work maybe is to have more participation of us so we can involve more and really have more communication with them because for me the most exciting part was to see them in the camera and when we had lessons at the same time. If we had another presentation in the middle, that would be good.

The final virtual seminar was the highlight of the programme; the presentation of their creative solutions to the same problem for different target audiences was deeply engaging for both cohorts of students and for other stakeholders attending as assessors and guests.

> (Dentistry student) . . . We learned how other groups decided to present their information to different cultures and how different groups respond to that. . .and different mediums we'd use as well. We learned a lot about how we'd spread the message to people with intellectual problems or people in the outback without access to proper health care.

8.4.3 Interactivity

The publication of personal strengths, derived from the *VIA Signature Strengths Questionnaire* (Peterson & Seligman, 2002) was found by some students to be useful in facilitating development of communication between the dentistry group members and their architecture consultants.

> (Dentistry students) . . . I think I felt I knew some people from here already but I didn't know the person from Hong Kong at all and I felt it would be good to know what they're good at. . . .I'm guessing it was the same for him. He could see a bit about us as well.
>
> . . .If there's a chance to have instant communication it might be more effective
>
> . . .We've got strengths that we'd never heard . . .so that was interesting to use when it came to dividing the work.
>
> (Architecture student) . . . It was quite amazing when I see the result. It's another way for me to know myself.

Both dentistry (36%) and architecture students (80%) identified curiosity as their signature strength; in the architecture group, this appeared to be a defining characteristic. The other signature strengths of architecture students were fairness and spirituality (each 50%), social intelligence, integrity and appreciation of beauty (all 40%). Somewhat in contradistinction to prevailing stereotypes but not surprising in a health profession, dentistry students cited their other strengths as loving and being loved (48%), gratitude (48%), kindness (43%) and fairness and citizenship (each 41%). Reservations about the strategy included its similarity to *Facebook* quizzes and the greater need for knowledge of experience rather than character. Both cohorts reported that understanding each other's character strengths helped them to get to know each other but some students stated a preference for less 'literal' media. The consensus was that the strategy was most useful where PBL group members were strangers.

This led to discussion of the value of randomisation of students to PBL groups in order to improve learning experience (although the previous years had expressed a preference to work within existing friendship groups). Cho, Lee, Stefanone and Gay (2005) support randomisation as a motivational

strategy because remaining in pre-existing social networks can influence learning outcomes by reducing opportunities to explore new contacts and resources.

A common difficulty in small groups is inequitable contribution of self-directed learning experience to the group, where some students coast as 'passengers' on the effort of other team members. All aspects of communication and social engagement of the site, with the exception of 'instant chat', were visible to supervisory staff, generating an incentive for every student to take part in the whole interaction process. The contribution of each team member was openly commented upon by other participants, utilising the evaluation protocol (Lurie, Lambert, Nofziger, Epstein, & Grady-Weliky, 2007). This open evaluation was rigorous, honest, diplomatic, constructive and informed, this last quality being one often not open to academic staff assessing students' work.

> (Architecture student) . . . When we think it's not something that is given by the teacher and when we feel what we are working on is our stuff, we put more effort into it.
>
> (Dentistry student) . . . each person in the group came up with something different and then everyone merged it
>
> You sort of had to do your own bit and bring it all together. At the end it meant that everyone. . .knew what they were talking about, and when you read somebody else's stuff that makes it a bit different.

In all but one group, where the design consultant failed to engage well with the PBL group, working relationships were found to enhance productivity and enjoyment, although some groups reported difficulty in managing the large amount of background material generated by diligent research of the topic area. They suggested that inclusion of a F2F/virtually augmented group discussion would assist them with this problem.

Although the site had provided access and training for *Adobe*™ programmes, the need for access to a wider range of software programmes was discussed by the students.

> (Dentistry student) . . . Having a student with this design knowledge helped but actually constructing it, putting it together was immensely difficult because we don't have any of these programmes. . .

In 2008, University of Sydney students had access to their architecture colleagues' laboratories on the same campus. The virtual interaction with another university in 2009 did not permit this solution and thus some groups were frustrated by their inability to utilise programmes that would have enabled them to realise their ideas more effectively.

8.4.4 Teacher Evaluation of the Learning Experience

To collaborate in a new teaching medium requires commitment, generosity and a spirit of adventure. Collaboration and cooperation are not the same. Collaboration is much more demanding; it is a shared creative enterprise involving

simultaneous understanding of three points of view in the student-teacher-colleague relationship. We drew heavily on the experience of critical friendship (Costa & Kallick, 1993; Gardiner, 1998) to mentor and critique each other's work and to forgive and repair occasional mistakes. In such a public learning space, where all members of the learning community, teachers and students alike, are learning from each other, it is important to be flexible and human. The blended persona of Mr KIA was very helpful in this respect, as he prevented students from accessing only their 'own' teacher and ensured that both teachers were privy to each other's decisions and communications. Two reflections on our learning practice informed our work in this project:

> (Dentistry staff) . . .Working together does not mean dividing and sharing each task equally. Rather, it is the discovering of each other's strengths and the application of these to the task in a complementary way. Your role is to do whatever the other person cannot or does not. The sharing lies in the commitment to collaborate

> (Architecture staff) . . .Working together in its collaborative sense adds a different facet to teaching and learning. One can embrace more strongly one's own expertise, while absorbing knowledge at the same time from others. This is similar to a theatre performance. Everybody has a different seat with a different perspective of the play. Nobody feels that their experience differs from the one of any other person in the audience. Yet only the collection of all viewers and their perspectives reflects the full experience of the performance.

The most difficult experience to counter was the students' competitive approach to learning. They initially requested that their group sites be closed to view by other groups so that their ideas could not be hijacked and used by others, not recognising how readily apparent this would be if it happened. The concept of a collective intelligence, developed in a shared public space, was difficult for them to encompass in the academic context, despite their openness on nonacademic social networking sites. In many ways this experience reflects the challenge to universities of managing intellectual property and privacy in increasingly open global communication environments.

8.5 Conclusion

The interprofessional PBL programme moved both faculties from sequestered autonomy into an enriching, deep learning experience in communication, consultancy and design for both cohorts of students. It engaged both students and academic staff in learning about professionalism, communication, collaboration, consultation and community engagement.

Online social network environments offer new opportunities for creative development of PBL because disciplinary, professional, institutional and national boundaries are more easily permeated. Social multinodal networking sites, such as *Ning*™, *YouTube*™, *Google Docs*™, *Doodle*™, *Wiki*™, various multidimensional software platforms, real-time video streaming and image

processing, as well as interactive chat environments, like *Facebook*™ and even *Twitter*™ can be meaningfully integrated in learning activities, which enable communication of learning goals, disseminate learning resources, create knowledge and original ideas, provide feedback and align with assessment of learning outcomes. Providers of integrated portals, like *Google Wave*™ or Microsoft's *Connected Services Framework*™, are already facilitating multichannel engagement. These media-rich platforms allow us to reframe our problems and subsequently the ways in which these problems can be explored in learning activities, thus enriching our current praxis of PBL. They are effective at tapping into social capital; thus the process facilitates student self-directed learning in problem formulation and research and it becomes possible to embrace global professional and interprofessional social communities to achieve higher levels of collective intelligence. The challenge remains the same: to facilitate student learning. It is the way in which we engage each other in these activities that is evolving to match today's communication needs.

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References

Achten, H. H. (2001, August 29–31). Normative positions in architectural design: Deriving and applying design methods. In H. Penttilä (Ed.), *Architectural information management – 19th conference on Education in Computer Aided Architectural Design in Europe (eCAADe)* (pp. 263–268). Helsinki, Finland.

Adam, R., Buchanan, P., Cook, P., & Till, J. (2008). Oxford Union Debate: Architecture would be better off without Schools of Architecture. In S. Roaf & A. Bairstow (Eds.), *The Oxford conference: A re-evaluation of education in architecture*. Southampton: WIT Press. Retrieved from http://www.oxfordconference2008.co.uk/debate.htm

Albanese, M. A., & Mitchell, S. (1993). Problem-based learning: A review of the literature on its outcomes and implementations issues. *Academic Medicine, 68*, 52–81.

Bayne, S. (2008). Higher education as a visual practice: Seeing through the virtual learning environment. *Teaching in Higher Education, 13*(4), 395–410.

Beylefeld, A. A., & Struwig, M. C. (2007). A gaming approach to learning medical microbiology: Students' experiences of flow. *Medical Teacher, 29*(9–10), 933–940.

Boyd, R. (1960). *The Australian ugliness*. Melbourne, VIC: Cheshire.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*, 77–101.

Cho, H., Gay, G., Davidson, B., & Ingraffea, A. (2007). Social networks, communication styles and learning performance in a CSCL community. *Computers and Education, 49*, 309–329.

Cho, H., Lee, J. S., Stefanone, M., & Gay, G. (2005). Development of computer-supported collaborative networks in a distributed learning community. *Behaviour and Information Technology, 24*(6), 435–447.

Costa, A. L., & Kallick, B. (1993). Through the lens of a critical friend. *Educational Leadership, 51*(2), 49–51.

Craig, S., Graesser, A., Sullins, J., & Holson, B. (2004). Affect and learning: An exploratory look into the role of affect in learning with AutoTutor. *Learning, Media and Technology, 29*(3), 241–250.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York: Harper Perennial.

Cuff, D. (1991). *Architecture: The story of practice*. Cambridge, MA: MIT Press.

Darling-Hammond, L., Barron, B., Pearson, P. D., Schoenfeld, A. H., Stage, E. K., Zimmerman, T. D., et al. (2008). *Powerful learning: What we know about teaching for understanding*. San Francisco: Jossey-Bass.

Dede, C. (2005). Planning for neomillenial learning styles: Implications for investments in technology and faculty. In D. Oblinger & J. L. Oblinger (Eds.), *Educating the net generation* (pp. 15.1–15.22). Boulder, CO: EDUCAUSE.

Downes, S. (2004, September/October). Educational blogging. *Educause Review, 39*(5), 14–26.

Evans, R. W., Pakdamen, A., Dennison, P. J., & Howe, E. L. C. (2008). The caries management system: An evidence-based preventive strategy for dental practitioners: Application for adults. *Australian Dental Journal, 53*, 83–92.

Gao, S., & Kvan, T. (2004). An analysis of problem framing in multiple settings. In J. S. Gero (Ed.), *Design computing and cognition '04* (pp. 117–134). Dordrecht: Kluwer.

Gardiner, C. (1998). Mentoring: Towards a professional friendship. *Mentoring & Tutoring: Partnership in Learning, 6*(1), 77–84.

Ham, J. J., & Dawson, A. (2004, September 15–18). Managing digital resources for design education. In *Architecture in the Network Society, 22nd eCAADe Conference Proceedings* (pp. 444–450). Copenhagen, Denmark.

Hollier, N. (2008). *The new Australian ugliness*. Retrieved from http://www.overlandexpress.org/183%20editorial.html

Huang, M. H. (2003). Designing website attributes to induce experiential encounters. *Computers in Human Behaviour, 19*, 425–442.

Katz, M. G., Kripalani, S., & Weiss, B. D. (2006). Use of pictorial aids in medication instructions: A review of the literature. *American Journal of Health-System Pharmacy, 63*(23), 2391–2397.

Kurmann, D. (1995). Sculptor – A tool for intuitive architectural design. In M. Tan & R. Teh (Eds.), *The global design studio – Sixth international conference on computera aided Architectural design futures (CAAD Futures)* (pp. 323–330). Singapore: Centre for Advanced Studies in Architecture, National University of Singapore.

Kvan, T. (2001). The pedagogy of virtual design studios. *Automation in Construction, 10*(3), 345–354.

Kvan, T., & Gao, S. (2006). A comparative study of problem framing in multiple environments. In J. S. Gero (Ed.), *Design computing and cognition '06* (pp. 245–263). Eindhoven, Netherlands: Springer.

Levy, P. (1997). *Collective intelligence: Mankind's emerging world in cyberspace* (Translated from French by R. Bononno). New York: Plenum.

Lurie, S. J., Lambert, D. R., Nofziger, A. C., Epstein, R. M., & Grady-Weliky, T. A. (2007). Relationship between peer assessment during medical school, dean's letter rankings, and ratings by internship directors. *Journal of General Internal Medicine, 22*(1), 13–16.

Maher, M. L., Simoff, S. J., & Cicognani, A. (2000). *Understanding virtual design studios*. London: Springer.

McNeely, B. (2005). Using technology as a learning tool, not just the cool new thing. In D. Oblinger & J. L. Oblinger (Eds.), *Educating the net generation* (pp. 4.1–4.10). Boulder, CO: EDUCAUSE.

Newmann, F., & Wehlage, G. (1993). Five standards of authentic instruction. *Educational Leadership, 50*(7), 8–15.

Nielsen-Bohlman, L., Kindig, D. A., & Panzer, A. M. (2004). *Health literacy a prescription to end confusion*. Washington, DC: National Academies Press.

Oblinger, D., & Oblinger, J. L. (2005). *Educating the net generation*. Boulder, CO: EDUCAUSE.

Owen, M., Grant, L., Sayers, S., & Facer, K. (2006). Social software and learning. *Futurelab, 1*(71). Retrieved from http://www.futurelab.org.uk/resources/documents/opening_education/Social_Software_report.pdf

Peterson, C., & Seligman, M. (2002). *Via signature strengths*. Retrieved from Positive Psychology Center, University of Pennsylvania. Retrieved from http://www.authentichappiness.sas.upenn.edu/tests

Salmon, G. (2000). *Five step model in e-moderating: The key to teaching and learning online*. London/Sterling: Kogan.

Schmitt, G. (1997, August 4–6). Design medium-design object. In R. Junge (Ed.), *CAAD futures 1997 – 7th international conference on Computer Aided Architectural Design Futures (CAAD Futures)* (pp. 3–13). München: Kluwer.

Schnabel, M. A. (2002, December 3–6). Collaborative studio in a virtual environment. In R. Kinshuk, K. Lewis, R. Akahori, T. Kemp, L. Okamoto, L. Henderson, et al. (Eds.), *Learning communities on the internet – Pedagogy in implementation*, Proceedings of the International Conference on Computers in Education (ICCE) (Vol. 1, pp. 337–341). Auckland, New Zealand: IEEE.

Schnabel, M. A., & Howe, E. L.C. (2008, November 26–28). *Design communication: An authentic consultancy for Architecture students in development of a professional performance portfolio for Dental graduates – New Knowledge in the Architectural Sciences*. Proceedings of the 42nd annual conference of the Australian and New Zealand Architectural Science Association (ANZAScA), Newcastle, Australia.

Schnabel, M. A., & Howe, E. L. C. (2009). Client design literacy and consultancy skills in architectural education. In N. Gu, M. Ostwald, & A. Williams (Eds.), *Computing, cognition and education – Recent research in the architectural sciences* (pp. 205–218). Australia: Australian and New Zealand Architectural Science Association (ANZAScA) and University of Newcastle.

Surowiecki, J. (2005). *The wisdom of crowds*. New York: Anchor Books.

Woltering, V., Herrier, A., Spitzer, K., & Spreckelsen, C. (2009). Blended learning positively affects students' satisfaction and the role of the tutor in the problem-based learning process: results of a mixed method evaluation. *Advances in Health Science Education, 14*, 725–738.

Woo, Y., Herrington, J., Agostinho, S., & Reeves, T. (2007). Implementing authentic tasks in web-based learning environments. *EDUCAUSE Quarterly, 30*(3), 36–43.

Chapter 9
Effects of Video Triggers on the PBL Process

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9.1 Introduction

9.1.1 The Paper Trigger in Traditional Problem-Based Learning

Problem-based learning (PBL), which first started in Canadian medical schools in the 1970s (Barrows & Tamblyn, 1980; Barrows, 1994), has been widely accepted in medical schools as a pedagogical method for training clinical practitioners.

In PBL, the problem used as the trigger of the learning process is usually a clinical case presented as a written text ('paper trigger') (Davis & Harden, 1999). This kind of teaching material is relatively easy to produce. The paper trigger is also the most controlled presentation of the problem in PBL, since the information that the students need to know is presented in a logical and concise format.

Paper triggers, however, are far removed from the situations students will face in the clinical setting (Hoffmann and Ritchie, 1997; Chan et al., 2010). In paper triggers, many of the real aspects of clinical problem solving have been edited out: the communication with the patient; the interpretation of what the patient actually said; the definition of the patient's problems; the interpretation of some physical signs, etc. Paper triggers also lack contextualization. Students may have difficulty relating PBL scenarios to the real-world situations they are intended to represent. Moreover, paper-triggered PBL activities typically challenge students' cognitive skills only, while real clinical situations will also challenge their social, emotional, and clinical skills (Dammers, Spencer, & Thomas, 2001).

An alternative to the "thin-narrative" paper-based medical cases is the "rich-narrative" paper case (Bizzocchi & Schell, 2009). These types of "media-rich" (video rather than the traditional paper cases) and "thick-narrative" (rich in narrative information) cases may provide a more realistic context for learning

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than traditional "thin-narrative" paper cases because the rich cases more accurately reflect the complex nature of patient presentation. They also may help to lay the foundation for the development of a more holistic and patient-centered awareness during the training of health professionals (Bizzocchi & Schell, 2009).

9.1.2 Other Forms of Triggers in PBL

There are many other forms of PBL triggers that try to overcome the limitations of paper triggers, ranging from the use of real patients (Dammers, Spencer, & Thomas, 2001; Diemers et al., 2007) to videos (Chan et al., 2010). The use of real patients complements the PBL approach in a number of ways. First, the strong motivational context enables learners to see the relevance of the learning to actual problems. Second, the relationship with the patient creates a sense of responsibility and involvement in the patient's care. Third, the complexity of real patients enables what Coles calls 'elaborated' learning (Coles, 1988), when new information is incorporated into what the learner already knows and is restructured into more complex knowledge networks. Fourth, the empathic dimension of using real patients is unmatched by paper cases. The main problems with using real patients are the difficulty in identifying patients who match the intended topics and themes, and in getting sufficient numbers of such patients (Diemers et al., 2007). Because of these problems with real patients, some authors have suggested the replacement of "paper" cases by virtual patients (Poulton, Conradi, Kavia, Round, & Hilton, 2009; Ward & Hartley, 2006). Virtual patients are computer-based simulations (Huang, Reynolds, & Candler, 2007) in which patient cases unfold only in response to learner input (Cook & Triola, 2009). The virtual patients are usually internet accessible and media rich, but are associated with significant production costs (Huang et al., 2007).

Another alternative to paper triggers is video triggers, which are considered to more closely depict the clinical problems which medical students are being trained to solve. The production of video triggers costs more than the paper triggers since it often involves professional audiovisual crews and actors (though sometimes real patients are involved). However, video triggers were considered to be superior to paper cases because they encourage active extraction of information from the case materials, preserve the original language of clinical consultations, preserve nonverbal information such as the appearance and emotions of the patients, allow observation of patient-doctoral interaction and clinical skills, avoid depersonalization of the patients, and enable closer contextualization of learning (Chan et al., 2010).

A previous survey study showed that PBL medical students and facilitators very much preferred video triggers to paper triggers (Ip, Patil, Chen, & Chan, 2007; Chan et al., 2010). Most of the students and facilitators thought video triggers could enhance students' observational powers and clinical reasoning,

and could help them to integrate different information. It appears that video triggers may help to close the gap between PBL on paper and problem-solving in the ward.

9.1.3 The PBL Process in Video-Triggered PBL

Although students and facilitators highly rated video-triggered PBL (Chan et al., 2010), the effects of the video triggers on the PBL process are not clear, such as their effects on the different stages of critical thinking in PBL. Kamin, O'Sullivan, Deterding, and Younger (2003) analyzed critical thinking in PBL as consisting of the following stages (Table 9.2): problem identification; problem description; problem exploration; applicability; and integration. Problem identification and description are important in solving medical problems because medical problems are often ill-structured, and being able to identify the problem early on can assure success in later stages of the problem-solving process. Problem identification involves recognizing relevant known and unknown information. It depends on students' knowledge of concepts and principles of the subject domain. This determines what students need to learn first and thus specifies basic learning issues and objectives. Research in the area of expertise has shown that experts and novices identify problems differently because their knowledge is structured differently (Glaser & Chi, 1988). The acquisition of problem identification skills is also related to the way problems are presented. For instance, studies have shown that problem-identification skills can be acquired effectively when video simulations are implemented (Roberts, 2000).

Problem description involves defining problems and generating mental representations of problem spaces. Defining problems includes stating the scope and goals of the problem-solving process while representing problem spaces involves specifying how problems are organized (Pretz, Naples, & Sternberg, 2003). Whereas the scope, goals, and the mental representations of problem spaces are clear for well-structured problems, this is not the case for ill-structured problems, such as medical problems. Ill-structured problems can be understood in different ways and selecting appropriate mental representations of problem spaces from competing options is very important (Jonassen, 1997). Problem solving may include the causes of problems in problem statements based on the information students select and evaluate. Further, when problems are presented in different formats, such as picture and text, novices must use different cognitive processes to transform the different types of information into mental representations of the problem space.

The latter three stages of critical thinking in PBL of problem exploration, applicability, and integration are more important in critical thinking and problem-solving skills (Kamin, O'Sullivan, Younger, & Deterding, 2001; Kamin et al., 2003; Hmelo-Silver, 2004) since they involve higher categories of cognitive functions in Bloom's Taxonomy of educational objectives

(Anderson et al., 2001) such as interpretation of data, developing hypotheses, justifying hypotheses, discussing utility or approach to patients, synthesizing learning issues, and application to problems.

Kamin and colleagues (Kamin et al., 2001, 2003) found that critical thinking is enhanced by video-triggered PBL. However, both studies by Kamin and colleagues were conducted with third-year medical students in their pediatric clerkship, when students already have some clinical experience. For first- and second-year medical students without much clinical experience, the use of video could potentially be a distraction from the learning of critical thinking and problem-solving skills.

In video-triggered PBL, students need to extract the key pieces of information from the video clips, meaning that a larger part of their discussion may be spent on problem identification and description (in Kamin's terminology), such as interpreting the history and the physical examination. Consequently, less of their discussion in the PBL session might be on the remaining stages, which are more important for the learning of higher cognitive functions like critical thinking and problem solving. We suspected that this situation is more likely to occur among first- and second-year medical students, who have not had much clinical exposure. In the present study, we aimed to determine whether students are more focused on problem identification and description and less on other stages of the PBL process in video-triggered PBL compared to paper-triggered PBL.

9.2 Method

The study took place in the Li Ka Shing Faculty of Medicine at The University of Hong Kong (HKU) with approval from the institutional review board. One PBL group of 11 second-year medical students and their facilitator voluntarily participated in the study.

We selected the video-triggered case and one of the three paper-triggered cases in the musculoskeletal-system block for comparison because both cases depicted a patient complaining of pain due to degeneration of the musculoskeletal system, one in the spine and one in the knee. The patient in the video-triggered case was a 65-year-old man who was suffering from back pain due to lumbar spondylosis (lumbar spine degeneration). The patient in the paper-triggered case was a 60-year-old man who was suffering from bilateral knee pain due to knee osteoarthritis (knee degeneration). Case materials were disclosed progressively (Table 9.1).

We used two different cases with two different diseases as the video- and paper-triggered cases, which allowed the same group of students and facilitator to work on both cases. This arrangement has the advantage that the learning styles of the two groups being compared were uniform since the same students and the facilitator were in both groups. It also has the disadvantage that the case

Table 9.1 Progressive disclosure of case materials in the PBL cases

Video-triggered case: Tutorial 1	
Video clip 1: History	History taking.
↓	
Discussions	
↓	
Video clip 2: Physical Examination	Physical examination of the back, lower limb neurology, and distal pulses.
↓	
Discussions	
Video-triggered case: Tutorial 2	
Reporting of learning objectives	
↓	
Video clip 3: Results of laboratory orders	Clinical consultation on X-ray and MRI findings.
↓	
Discussions	
↓	
Video clip 4: Clinical management	Clinical consultation on treatment options. Surgical treatment was offered and explained to him if non-operative treatment failed.
↓	
Discussions and end of the case	

Paper-triggered case: Tutorial 1	
Page 1: History	Patient's history.
↓	
Discussions	
↓	
Page 2: History	Further elaboration of patient's history.
↓	
Discussions	
↓	
Page 3: Physical Examination	Results of physical examination.
↓	
Discussions	
Paper-triggered case: Tutorial 2	
Reporting of learning objectives	
↓	
Page 4: Results of laboratory orders	Radiographs of the patient's right knee shown to the students. Also a report of blood tests.
↓	
Discussions	
↓	
Page 5: Clinical management	Aspects of management of the patient's condition.
↓	
Discussions	
↓	
Page 6: Socio-economic management	Effects of the patient's knee problem on his job and his life.
↓	
Discussions and end of the case	

content may have caused differences in the results. However, had we used the same case but with one version in video and another in paper, they would have had to have been used by different groups of students and facilitators because the same group could not use the case twice. Thus, the differences in the learning style of the two groups being compared might have caused some of the observed differences.

The medical program at HKU uses English almost exclusively as the medium of instruction in all of its teaching and learning activities. Therefore, the paper trigger and all PBL discussions were in English. However, the conversation in the video trigger was conducted in Cantonese (a dialect of Chinese), since it is the usual language of over 90% of the population in Hong Kong (Census and Statistics Department of The Government of the Hong Kong Special Administrative Region, 2006), including the patient in the video trigger and the participating medical students. Nevertheless, English subtitles are inserted during the production of the video triggers to facilitate their use by students or facilitators whose usual language is not Cantonese.

The group of students and the facilitator typically used two sessions, of about 2 hours each, to discuss each case. The four PBL sessions were videotaped and transcribed. Content analysis was performed using the qualitative data analysis software Nvivo 8 (QSR International Pty Ltd, 2007).

Transcript units used for coding were phrases and sentences that had a singular meaning. Transcript units were assigned to one of the five stages of critical thinking of PBL in a coding schema modified after the schema used by Kamin and colleagues (Kamin et al., 2003): problem identification; problem description; problem exploration; applicability; and integration (Table 9.2). The miscellaneous category was for transcript units that did not fit into the

Table 9.2 Coding schema of the present study

Stage		Examples (P: paper-triggered case; V: video-triggered case)
Problem identification		
►New problem-related information	P	He felt discomfort in both knees which was worse on the right side.
	V	He finds that the pain's more severe when he walks and stands but it subsides or actually is less when he sitting down.
Problem description		
►Discuss ambiguities or facts to clear them up; push limits of knowledge	P	(After reading from the paper trigger that the patient had his ESR checked) I think the ESR is checking for suppurative arthritis.
	V	How old is he . . . not mentioned in the video, but he's already retired for long time . . . so probably 60, 70.

Table 9.2 (continued)

Stage		Examples (P: paper-triggered case; V: video-triggered case)
►Drawing on personal experience	P	From my relative's experience of using...
	V	This is the experience of my patient, she said she had...
Problem exploration		
►Linking facts or ideas	P	The chief complaint this time is discomfort in both knees and the patient has less exercise tolerance because of this discomfort.
	V	Colon is retroperitoneal; so the pain actually may radiate to the back and manifest as back pain.
►Interpretation of data; what was said in text/ what was seen in video	P	Mr Ho is 60; so the ESR should be less than 30 and he has 25, so he is normal.
	V	If it is a radiation of pain to leg, it is quite suggestive of nerve and neurological problem, but one thing special is he has no numbness.
►Guiding or focusing group by synthesizing where the group is or what they need to do; asking about reasoning; probing questions	P	Given the patient's background and his job and his medical history what do you think about the differential diagnosis?
	V	... there is a problem here this. The pain of the leg is bilateral. If one of the facets is affected, unilateral pain is more likely. If there is a bilateral pain it could be due to some kind of compression
►Develop working hypotheses; brainstorming stage when all possible explanations are listed	P	Could the episode of inflammation be due to an episode of erosion of the cartilage exposing the subchondral bone to synovial fluid?
	V	One differential diagnosis is sciatica, it may be due to what you have mentioned is spondylosis ...leading to the pain in the thigh and the leg region and also back pain.
►Justifying hypotheses or orders/ action by providing examples or explaining or reasoning; comparing advantages/ disadvantages of hypotheses or orders/ treatment; moving hypothesis up/down or out in ranking.	P	I think we can eliminate myopathy because the muscle strength of the lower limbs including the thigh, leg, and foot are alright.
	V	Because the pain from bone cancer may intensify at night, apparently he does not have this problem, so the chances of having bone cancer is less likely.
Applicability		
►Discuss practical utility or concerns about approach to patient, lab orders, or treatment	P	In the market they take a lot of supplements such as glucosamine...but the American doctor admits that the efficacy of improving osteoarthritis is actually very controversial.
	V	I would delay surgical methods since actually he is quite old.

Table 9.2 (continued)

Stage		Examples (P: paper-triggered case; V: video-triggered case)
Integration		
►Reporting or synthesis of learning issues and application to problem; link findings after self-study to hypotheses; generalize to broader application	P	Such erosion of the cartilage will lead to acute episode just like those in Mr. Ho but unfortunately I think this situation is less likely in our patient because . . .
	V	If our patient's having spondylolisthesis it would be most likely to be degenerative and usually this degenerative form developed as a result of facet arthritis or facet remodeling.
Miscellaneous		
►Receiving case information	P	Mr. Ho is a 60-year-old machine operator in a government factory who enjoyed good health previously (reading the paper trigger)
►Group process	P	Shall we progress to second page?
	V	Are there any more points you want to add?
►Evaluation of objectives	P	I think we need to discuss the multidisciplinary approach in the management of chronic arthritis.
	V	Learning objective number one is the anatomy and the function of the spine.

Source: Modified after Kamin et al. (2003)

above five stages, including "receiving case information," "group process," and "evaluation of objectives." The coding of all four transcripts was performed by the same co-author (ALMY).

To check the reliability of the coding, 10% of the transcripts were randomly selected and coded by another colleague who was not involved in the study. Cohen's kappa statistic was employed as a measure of agreement between two coders. The result was $\kappa = 0.954$; $p < 0.01$, indicating a high reliability in the coding.

9.3 Results and Discussion

As indicated in Table 9.3, the percentage of transcript units in the problem-identification stage was higher in the video-triggered case (12.30%) than in the paper-triggered case (3.74%). The problem-identification stage consists of identifying new problem-related information. The probable reason for relatively more transcript units in this stage in the video-triggered case is that the information delivered through video is much richer (de Leng, Dolmans, van de Wiel, Muijtjens, & van der Vleuten, 2007) when compared to the written

Table 9.3 Percentage of transcript units in the five stages of critical thinking in the paper-triggered and video-triggered cases

Triggers		Paper	Video
Stages of critical thinking	Problem identification	3.74% (16)	12.30% (45)
	Problem description	21.73% (93)	9.29% (34)
	Problem exploration	43.93% (188)	51.64% (189)
	Integration	10.05% (43)	11.75% (43)
	Applicability	1.40% (6)	3.01% (11)
Miscellaneous	Receiving case information	1.87% (8)	0.00% (0)
	Group process	13.79% (59)	8.74% (32)
	Evaluation of objectives	3.50% (15)	3.28% (12)
Total		100% (428)	100% (366)

information in the paper case. The students thus needed to spend a larger part of their discussion in extracting the relevant information from the video. A number of factors were identified as contributing to this relatively longer time in this stage. In retrieving the history of the patient in the video-triggered case, the students needed to mentally convert what the patient said in the video in his native language (Cantonese) into an English-language medical history. However, in the paper-triggered case, the medical history was already written in English on the papers given to the students. In retrieving the results of the physical examination of the patient in the video-triggered case, the students needed to observe the examination and interpret the visual images in the video. They inevitably also needed to spend a larger part of their discussion in extracting this information. But in the paper case, the results of the physical examination were written down for the students.

The "repleteness" of information delivered through video is considered to be one of the advantages of using video to trigger PBL (de Leng, Dolmans, van de Wiel, Muijtjens, & van der Vleuten, 2007; Chan et al., 2010). The original language of the clinical interaction is preserved. In our case, the conversation between the patient and the doctor was in Cantonese. The nonverbal information of the patient is also preserved, e.g., the appearance of the patient, the facial expression, the gestures, gait, movement, personal hygiene, and even his or her emotional state, which are also lost in written text in the paper triggers in PBL. Video not only shows what the patient said, but also his/her face, voice, emotions, etc. These are the things that make the patient human, and not just a character on paper. In paper cases, not only is the nonverbal information about the patient lost, but what the patient said is also modified to fit a medical history, in a language that oftentimes encourages depersonalization of the patient by granting "primacy to the observations of medical staff, … while devaluating or eliminating the patient's interpretations of reality" (Kenny & Beagan, 2004, p. 1075).

The percentage of transcript units in the stage of problem description was lower in the video-trigger case (9.29%) than in the paper-trigger case (21.73%). This observation can be explained by the scarcity of information in the

paper-trigger case. The patient's information has been extracted and converted into English by the case writer. Much information is lost or interpreted by the case writer. When information was given in the paper case, it was oftentimes stated without qualification or explanation. For example, in the paper case, when the students were told that the patient had a varus deformity, they may not be sure what the word "varus" means. They consequently spent a few transcript units in the stage of "problem description" on clarifying what this meant. To illustrate this point, in one exchange, one of the students said "there is varus and valgus deformity (.) These are the two types of deformities in the knee (.) varus means that these two legs are bow inward (.) valgus means its bow outward," and then another said "yeah there is bowing inward (.) valgus means out." In video-triggered cases, the information delivered to the students is much richer. Sometimes, what is being said is shown on the video.

We had hypothesized that since the problems presented in a video-triggered case are less well defined, students may need to spend a larger part of their discussion on the first two stages of critical thinking in PBL (problem identification and description), and less on the later stages. The results of this study do not support this hypothesis. Although students did spend a larger part of their discussion on problem identification in the video-triggered case, they spent less in problem description. The subtotal percentage of transcript units in problem identification and description of 21.59% in the video-triggered case is actually lower than the 25.47% in the paper-triggered case. Moreover, the percentage of transcript units in problem exploration is slightly higher in the video-triggered case (51.64%) than in the paper-triggered case (43.93%). These findings were contrary to what we had expected from our hypothesis. The concern that the video may provide too much information, especially for junior medical students, thus acting as a distraction, instead of as an aid to learning, is unsubstantiated by the results of this study.

9.4 Conclusions

There is no evidence to suggest that video triggers would act as a distraction to the learning of critical thinking skills even in junior medical students with little clinical experience. In the video-triggered case, although students spent more of their discussion in problem identification, they spent less in problem description. The discussion spent on other, higher stages of critical thinking in PBL was not diminished in the video-triggered case. The video presented a realistic person with a voice, face, and emotions, instead of a text-character that has been shaped by the perspectives and views of the case writer. The information presented to the students is much richer, thus creating a more realistic "problem" in the PBL context.

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References

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Kathleen, A., Cruikshank, K. A., Mayer, R. E., et al. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing – A revision of Bloom's taxonomy of educational objectives*. New York: Addison Wesley Longman Inc.

Barrows, H. S. (1994). *Problem-based learning: Problem-based learning applied to medical education*. Springfield, IL: Southern Illinois University School of Medicine.

Barrows, H. S., & Tamblyn, R. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.

Bizzocchi, J., & Schell, R. (2009). Rich-narrative case study for online PBL in medical education. *Academic Medicine, 84*(10), 1412–1418.

Chan, L. K., Patil, N. G., Chen, J. Y., Lam, J. C. M., Lau, C. S., & Ip, M. S. M. (2010). Advantages of video trigger in problem-based learning. *Medical Teacher, 32*, 760–765.

Coles, C. (1988). How students learn: The process of learning. In B. Jolly & L. Rees (Eds.), *Medical education in the millennium* (pp. 63–82). Oxford: Oxford University Press.

Cook, D., & Triola, M. (2009). Virtual patients: A critical literature review and proposed next steps. *Medical Education, 43*, 303–311.

Dammers, J., Spencer, J., & Thomas, M. (2001). Using real patients in problem-based learning: Students' comments on the value of using real, as opposed to paper cases, in a problem-based learning module in general practice. *Medical Education, 35*(1), 27–34.

Davis, M. H., & Harden, R. M. (1999). Problem-based learning: A practical guide. *Medical Teacher, 20*(2), 317–322.

de Leng, B. A., Dolmans, D. H. J. M., van de Wiel, M. W. J., Muijtjens, A. M. M., & van der Vleuten, C. P. M. (2007). How video cases should be used as authentic stimuli in problem-based medical education. *Medical Education, 41*, 181–188.

Diemers, A., Dolmans, D., van Santen, M., van Luijk, S., Janssen-Noordman, A., & Scherpbier, A. (2007). Students' perceptions of early patient encounters in a PBL curriculum: A first evaluation of the Maastricht experience. *Medical Teacher, 29*(2–3), 135–142.

Glaser, R., & Chi, M. T. H. (1988). Overview. In M. T. H. Chi & R. Glaser (Eds.), *The nature of expertise* (pp. xv–xxviii). Hillsdale, NJ: Lawrence Erlbaum Associates.

HKSAR Census and Statistics Department. (2006). *Table 140: Population aged 5 and over by usual language*. Retrieved from http://www.censtatd.gov.hk/hong_kong_statistics/statistical_tables/index_t.jsp?charsetID=1&tableID=140

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

Hoffmann, B., & Ritchie D. (1997). Using multimedia to overcome the problems with problem based learning. *Instructional Science, 25*, 97–115.

Huang, G., Reynolds, R., & Candler, C. (2007). Virtual patient simulation at US and Canadian medical schools. *Academic Medicine, 82*, 446–451.

Ip, M., Patil, N., Chen, J., & Chan, L. K. (2007). *Advantages of video trigger in problem-based learning: Abstract*. Paper presented at the fourth congress of the Asian Medical Education Association 2007, Bangkok, Thailand.

Jonassen, D. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology Research and Development, 45*, 65–94.

Kamin, C. S., O'Sullivan, P. S., Deterding, R., & Younger, M. (2003). A comparison of critical thinking in groups of third year medical students in text, video and virtual PBL case modalities. *Academic Medicine, 78*, 204–211.

Kamin, C. S., O'Sullivan, P. S., Younger, M., & Deterding, R. (2001). Measuring critical thinking in problem-based learning discourse. *Teaching and Learning in Medicine, 13*, 27–35.

Kenny, N. P., & Beagan, B. L. (2004). The patient as text: A challenge for problem-based learning. *Medical Education, 38*, 1071–1079.

Poulton, T., Conradi, E., Kavia, S., Round, J., & Hilton, S. (2009). The replacement of 'paper'cases by interactive online virtual patients in problem-based learning. *Medical Teacher, 31*(8), 752–758.

Pretz, J., Naples, A., & Sternberg, R. (2003). Recognizing, defining, and representing problems. In J. E. Davidson & R. J. Sternberg (Eds.), *The psychology of problem solving* (pp. 3–30). Cambridge: Cambridge University Press.

Roberts, J. (2000). Problem-solving skills of senior student nurses: An exploratory study using simulation. *International Journal of Nursing Studies, 37*(2), 135–143.

Ward, K., & Hartley, J. (2006). Using a virtual learning environment to address one problem with problem based learning. *Nurse Education in Practice, 6*, 185–191.

Part IV
Exploring 'Inside' the PBL Tutorial Process

Chapter 10
Japanese First-Year PBL Students' Learning Processes: A Classroom Discourse Analysis

Rintaro Imafuku

10.1 Introduction

Problem-based learning (PBL) is characterised by small group collaborative learning, with a strong emphasis on the development of autonomous learning, problem-solving and critical thinking skills. These competencies are regarded as the key generic skills which need to be acquired in higher education (NCVER, 2003). PBL was originally developed in medical education at McMaster University in the late 1960s. The implementation of this educational model subsequently has been adopted widely in higher-education curricula. One of the defining characteristics of PBL is learner-centredness, in which students identify their own learning objectives from a scenario and 'solve' them (Hmelo-Silver, 2002). The PBL classroom differs pedagogically from traditional tertiary classrooms in that students are encouraged to collaboratively and autonomously build new knowledge based on each others' contributions to discussions.

Successful implementation of PBL which effectively promotes student learning and produces better learning outcomes has been found in previous studies, such as studies focusing on students' information literacy (Blumberg & Michael, 1992) and reasoning skills (Frederiksen, 1999). On the other hand, several pedagogical issues relating to students' participation in PBL have arisen (e.g., Khoo, 2003; Legg, 2005; Imafuku, 2007a; Woodward-Kron & Remedios, 2007). Asian higher education appears to have more pedagogical challenges, perhaps relating to the fact that the educational innovation has been quite recent, in comparison with Western countries where PBL approaches have been employed for more than 30 years. Khoo (2003) noted that the successful application of PBL methods to Asian schools might be impeded by some practical challenges, such as students' strong awareness of assessment during their performance, their lack of confidence, and their limited understanding of the pedagogical intent of PBL.

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The aim of this study was to examine how first-year undergraduate students adapt to a new learning culture over time. To investigate the changes in students' approaches to learning in PBL, the study explored the students' learning experiences at three different stages of their first year. To accomplish these major objectives, the following research questions were addressed:

1. What are the characteristics of discursive practices of Japanese students in PBL tutorials at different stages of the first year of university education?
2. How do Japanese students adapt to a new learning environment at university, and what are the factors that shape the new learning processes?

10.2 Student Learning in PBL

A PBL approach requires students themselves to construct knowledge through problem-solving tasks. That is, in the participant structure of PBL, students and tutors are expected to contribute to the discourse in different ways from the conventional classroom. The emergence of students' co-constructed knowledge and their highly interactive dynamics in tutorial groups have been illustrated in several previous studies (e.g., Hmelo-Silver & Barrows, 2008; Koschmann, Glenn, & Conlee, 1997; Visschers-Pleijers et al., 2006; Woodward-Kron & Remedios, 2007). Visschers-Pleijers and colleagues (2006) found that in a PBL setting collaborative knowledge construction amongst students occurred more frequently than any one student's elaboration of knowledge.

On the other hand, some research has highlighted differences between students' actual learning processes and the intentions of a PBL curriculum. For example, a study of PBL conducted in an English-medium of instruction university in Hong Kong (Legg, 2005) and an investigation of faculty-based support for PBL (Imafuku, 2007b) found that a 'Initiation-Response-Evaluation' (IRE) discourse sequential pattern, which is a strong characteristic of the conventional mode of classroom discourse, was prevalent in PBL. Imafuku (2009) argued that the emergence of different discourse patterns amongst PBL groups is associated with several factors, such as students' perceptions of learning in PBL, their learning styles and social relationships with peers. Hawthorne, Minas and Singh (2004) found that international students at an Australian university achieved lower results in PBL communication skills and showed a reluctance to adopt PBL tutorial roles when compared to Australia-born and Asia-born permanent resident students. Furthermore, quiet international students in PBL were much more likely to obtain marks in the lower 50% in subject-content areas than overseas-born Australian-education students. These results indicate that students' prior learning experience and cultural factors affect their learning processes in PBL.

Students' processes of socialisation into discourse are a pivotal aspect to reveal the complexities of student learning in a new educational context (Morita, 2002). Goffman (1981) proposed that students' socialisation processes

impact on the development of a participant framework which encompasses the configurations of interactional rights and responsibilities in a particular classroom activity, and the speaker's perceptions of others in terms of participant roles and social identities. To better understand the participant framework in the first-year PBL programme, it is also necessary to analyse students' cognitive dimensions, such as students' concepts of social identity, negotiating membership and perceptions of the learning environments, which are unavailable from video-recorded data of tutorials.

10.3 Conceptual Framework

In this study, discourse and culture are considered central aspects for investigating student learning in PBL. This leads to an examination of students' learning processes, i.e. the situated nature of pedagogical phenomenon. Lave and Wenger's (1991) notion of legitimate peripheral participation (LPP) was employed as a conceptual framework. The framework presents a situated process where a newcomer becomes a full participant in a sociocultural practice through interaction with more competent members. LPP is not necessarily characterised by harmony and peaceful processes, but can be a conflictual process of negotiation and transformation, because legitimate peripherality is implicated in social structure involving power relations amongst members in a community of practice (Lave & Wenger, 1991; Morita, 2002).

The legitimacy of participation constitutes a defining characteristic of ways of belonging that is not only a crucial condition for learning, but also a constitutive element of its content (Lave & Wenger, 1991). In this sense, anyone can be a potential member in a community of practice. Wenger (1998, p. 101) further elucidates legitimacy by noting that 'in order to be on an inbound trajectory, newcomers must be granted enough legitimacy to be treated as potential members'. The term peripherality is associated with 'an approximation of full participation that gives exposure to actual practice' (Wenger, 1998, p. 100). Peripheral participation means that participants who are not central but are on the margins of the activity in question acquire knowledge through their involvement with it (Flowerdew, 2000).

Based on this notion, this study regards academic discourse socialisation in PBL environments as a situated process in which first-year students become gradually competent in academic ways through their experiences of student-centred learning and interactions with group members in a given community (Morita, 2002). However, Nemoto (2007) noted that the concept of LPP tends to consider all novice members as equal. That is, the investigation of student learning from the perspective of LPP needs to carefully take account of students' negotiation of membership within a specific social context. In this study, for example, some first-year students may play a more central role in PBL, whereas others may be on the margins of the learning activity.

10.4 Research Methodology

10.4.1 Research Site

A private medical university in Japan agreed to be involved in this research. With a purpose of training medical experts who fully understand the importance of team care, an 'interdisciplinary' PBL approach, with groups consisting of 9 students from different faculties, is employed in the first-year educational programme. Each theme is completed in two tutorial sessions over 2 weeks, and the duration of each tutorial is approximately 3 h. In Session 1, students are encouraged to identify their learning objectives based on information from a scenario through discussions. Session 2 is undertaken to share the results of their independent learning. Specifically, learning objectives are presented with students taking turns to summarise their findings until all objectives have been covered. A summary of the PBL process at the university is provided in Table 10.1.

10.4.2 Participants

Four first-year undergraduate students were selected from three different faculties, namely, Aya, Ai, Takeshi and Ken (pseudonyms), all aged between 18 and 19 years. Table 10.2 provides an overview of the participants and their backgrounds.

Table 10.1 PBL process in the first-year programme

Session 1–3 h	
Step 1	- Read the scenario.
Step 2	- Select keywords or interesting information.
Step 3	- Identify the problems to discuss and knowledge gaps.
Step 4	- Draw up a mind-map to outline the mechanisms that relate each selected keyword.
Step 5	- Identify the learning issues.
Self-directed learning	
Step 6	- Individually study the allocated learning objectives using a variety of resources. - Submit summaries of independent learning to the PBL web system.
Session 2–3 h	
Step 7	- Share the results of independent learning. - Reach an understanding of what has been shared in the presentations.

Table 10.2 Participants in the first-year PBL programme

Name	Gender	Age	Faculty/School	First semester	Second semester
Aya	F	18	Pharmaceutical Sciences	Group 1	Group 3
Ai	F	18	Nursing	Group 1	Group 4
Takeshi	M	19	Pharmaceutical Sciences	Group 2	Group 4
Ken	M	18	Medicine	Group 2	Group 3

Since all PBL groups were rearranged in the second semester, the participants studied with new members in the second semester. In the first semester (April to August), Aya and Ai were in Group 1, while Takeshi and Ken were in Group 2. In the second semester (September to January), Aya and Ken were in Group 3, while Ai and Takeshi were in Group 4.

10.4.3 Data Collection and Analysis Procedures

The main data collection, which included classroom observations, recordings of PBL sessions and interviews with students, was conducted in June, September and December 2009. The themes of PBL during the data collection were as follows: Terminal cancer and informing (June), nutritional balance and osteoporosis (September) and social-welfare for the disabled (December). Since the PBL tutorials and interviews were conducted in Japanese, the data which appear in the following sections have been translated into English by the author.

Video-recordings of the PBL tutorials were undertaken by placing two HD-recorders in the corners of a classroom to record the tutorials from different angles. For this study, six 2.5-h video segments from Step 3 to Step 5 in each first PBL session were transcribed, because the process of formulating their learning issues in these steps can be fundamental to student learning in the subsequent session and also directly influence student learning outcomes in PBL. In discourse analysis, a move is regarded as a unit of analytical discourse organisation and is defined as a 'unit of discourse organisation that a speech functional pattern expresses' (Eggins & Slade, 1997). A new turn occurs when transferring from one speaker to another in a conversation. One turn can encompass one or more moves. Although Eggins and Slade's work (1997) was on casual conversations, this framework is transferable to the conversational context in this study in that their classification of various discourse purposes allows the researcher to codify all moves used in discussions involving multiple participants.

The first step of coding is to distinguish between two different macro-functions. Christie (2002) argued that all pedagogic activities contain two sets of language choices. First, the regulative macro-function is associated with instrumental functions to determine the directions of classroom activity. Second, the instructional macro-function is related to the 'content' that builds the substance of the teaching-learning activity, and is embedded in the regulative discourse (Christie, 2002).

In the second step of coding, each move in the instructional macro-function was provided with a speech function label. There are four main classes of moves: opening, continuing, responding and rejoinder (Eggins & Slade, 1997). Eggins and Slade provided a detailed analysis of casual conversations by employing 45 subclasses of moves, whereas this study simplified this typology in order to effectively examine the PBL discourse from a holistic point of view by identifying the use of specific key speech functions such as opining, developing, answering, clarifying and challenging moves. Figure 10.1 illustrates the

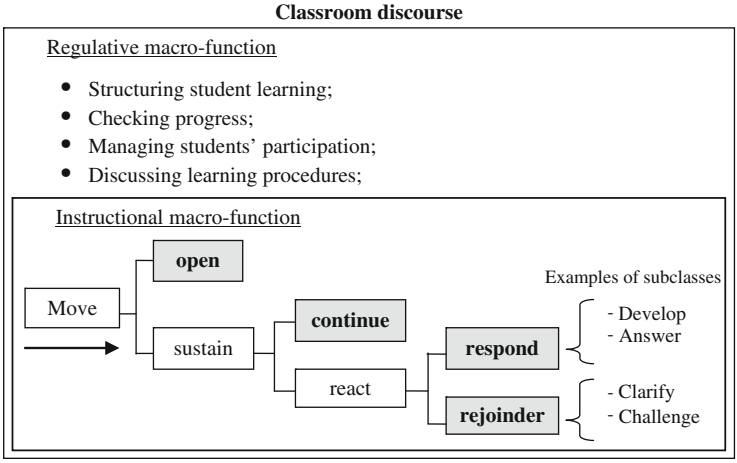

Fig. 10.1 Integration of the models of classroom discourse and speech functional analysis (Eggins & Slade, 1997; Christie, 2002)

modified framework of classroom discourse in this study based on the studies of Christie (2002) and Eggins and Slade (1997).

The opening, responding and rejoinder moves are a particular focus of this study, because these were the main moves used for students' collective knowledge-building, whereas elaboration of one student's opinion by continuing moves seldom occurred. Opening moves function to initiate talk through the introduction of a new proposition. A reacting move, which is achieved by another speaker taking a turn, contains two classes of moves. First, responding occurs when a speaker intends to complete the negotiation of a proposition. Second, a rejoinder occurs when the move exchange under the same proposition is prolonged to the next move. Each participant was assigned a code: facilitators (F1, F2, etc.), focal students (using the pseudonyms above) and other individual students (S1, S2, etc.). In analysing the transcriptions, first each turn was numbered, and then was divided into moves. Subsequently, a speech function name was given to each move based on the analysis of a function within the discourse (cf. Legg, 2005). Transcription conventions are provided in Appendix B (see also Bridges, McGrath, Yiu, & Cheng, 2010 for a discussion of multilingual transcriptions).

In addition to the observational data, contextual information, including the students' prior learning experiences, perceptions of learning in PBL and their cognitive process during the discussion, was elicited through semi-structured interviews conducted immediately after the recorded PBL tutorials. Following the Grounded Theory approach (Strauss & Corbin, 1998), interview transcripts were carefully reviewed multiple times to inductively generate salient categories of main factors attributing student learning.

10.5 Results

10.5.1 Students' Speech Functional Choices

In this study, four students' participation in PBL group discussions was observed over time. Since PBL groups were reorganised in September, the groups observed were different between the first semester (June) and second semester (September and December) (Section 10.4.2). The speech functional choices used by the participants on the three occasions are provided in Table 10.3. Five key moves in the instructional macro-function were identified in these group discussions, namely, open, develop, answer, clarify and challenge.

The following sections will focus on the features of total number of moves, developing and clarifying moves. The use of these moves can be pivotal to students' learning in PBL. Developing moves to add new information or modification to the previous move are necessary for the effective knowledge construction in group discussion (Imafuku, 2007b). Moreover, clarifying moves to obtain further information for a better understanding of the previous move are directly related to active listening skills which are an extension of generic communication skills (Robertson, 2005).

10.5.2 Total Number of Moves in Instructional Macro-functions

The overall oral participation patterns of the four students were examined first, by looking at the total number of moves including both opening and reacting. In Fig. 10.2, two types of change in oral participation can be observed.

As can be seen in Fig. 10.2, the quieter participants in June (Aya and Ken) took even less moves in September. However, they both made more contributions to the discussion in December. On the other hand, the two more active

Table 10.3 Overview of the changes in students' speech functional choices

				Sustaining: React				
		Total	Open	Develop	Answer	Clarify	Challenge	Others
Aya	June	19	0	0	1	0	0	18
	September	5	2	0	2	0	0	1
	December	34	1	10	3	2	0	18
Ai	June	74	3	4	25	3	0	40
	September	90	10	20	15	2	1	42
	December	83	3	29	15	1	2	35
Takeshi	June	145	17	17	15	8	5	83
	September	240	35	24	26	24	6	125
	December	182	7	47	10	32	6	80
Ken	June	34	3	7	14	1	0	9
	September	22	7	4	5	2	1	3
	December	146	31	31	9	13	5	57

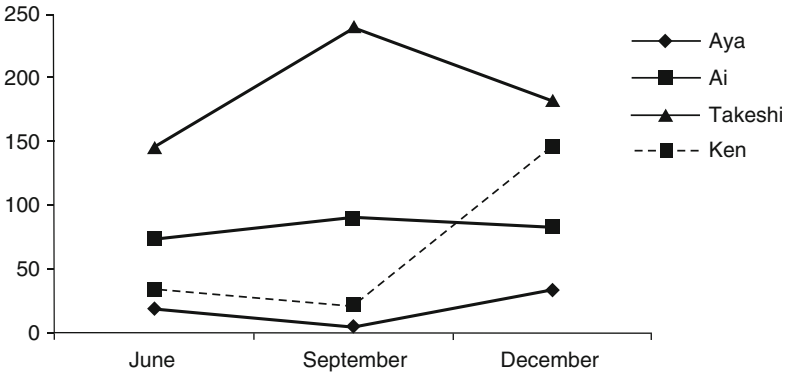

Fig. 10.2 Total number of moves taken by the students during 2009

participants in June (Ai and Takeshi) tended to take a greater number of moves in September, but then decreased their oral participation in December.

These participation patterns are probably associated with the students' perceptions of student learning in PBL, which strongly links with factors shaping the new learning processes as outlined below (see Section 10.6). For instance, at the early stage, Aya, who was a quiet participant, felt difficulty in expressing her opinions during the discussion. Her reticent behaviour can be attributed not only to her consideration that group conversation should not be interrupted by introducing her opinion which is not directly related to the topic, but also her anxiety about other members' negative evaluation of her opinion. She stated that she often gave up stating her opinion when the group's conversation shifted while she was still forming her ideas in her mind.

However, as Excerpt 1 shows, in December she started to realise that expressing opinions is an essential skill for her future career. That is, as she got a strong sense of becoming a medical professional in future, she became highly motivated for learning in PBL. The change in her perceptions of learning in PBL is considered to be related to the rise in the number of her moves as indicated in Fig. 10.2 (from 19 moves in June to 34 moves in December):

Excerpt 1
I'm sure that in future I will have to participate in discussions like PBL in a health care setting. If I didn't experience PBL, I couldn't probably express any opinions in the meetings. Through the PBL, I became more conscious of the importance of an active attitude. Particularly, it's important to more actively express my opinions based on a clear understanding of what other members said. Moreover, I think in PBL I could learn a little bit how to find an appropriate opportunity to speak along the direction of discussions. (Aya, 1 December 2009)

Takeshi, who was an active student initially, changed his participation patterns in PBL over the semesters in a different way from Aya. Although Takeshi was regarded as a dominant participant in June and September, his

total number of moves in December greatly decreased, as indicated in Fig. 10.2. He appeared to consider the nature of better communication skills through his experiences of PBL. Excerpt 2 indicates that he obtained a broader conception of what better communication is.

Excerpt 2
I think the purposes of PBL are to improve students' communication and teamwork skills. In the first semester, I tended to be talkative, and always wanted to express my thoughts in words. However, now, before speaking I try to think about whether my thoughts are appropriate to discussion. Imposing my opinion on other people is not better communication. In discussion, firstly it's important to listen to others. I realised the importance of carefully listening to others and understanding their opinions. In order to become a man who is good at communicating with people, it is important to become a good listener. (Takeshi, 7 December 2009)

In the first semester, Takeshi viewed speaking as the most significant behaviour in PBL. On the other hand, at the end of year, he was aware that communication is a two-way process and that listening is also an important skill in group work. Thus, he attempted to understand others' opinions, and then to expand on the discussion by providing his opinion or factual information. The decrease in his total number of moves in December reflected his changed attitude towards communication, including that listening is one of the most important skills. This active student managed his own participation to maintain the balance of other members' contributions.

10.5.3 Developing and Clarifying Moves

In the following section, the focus is on an analysis of the students' use of developing and clarifying moves. In order to elaborately construct knowledge in group discussion, it is important to expand on a previous speaker's proposition by adding further information, exemplifying or providing causal qualifications. Table 10.3 above indicates that all four of the focal students increasingly took developing moves over the academic year. Aya expressed her hopes for the next PBL tutorials in Excerpt 3:

Excerpt 3
In the next PBL, without hesitation, I want to provide my opinion of what a previous speaker said, for instance, making a contribution to the discussion, um, by expanding on other members' ideas. (Aya, 28 September 2009)

An example of Aya's use of developing moves in December can be found in Excerpt 4, below. In this segment of discussion, students in Group 3 discussed support for disabilities. In Move 767, Aya expanded on S1's suggestion in the previous turn by paraphrasing it into 'their personal experiences' based on her understanding. Furthermore, in Move 769, Aya made a contribution to the discussion by indicating the importance of investigating the support from various points of view.

Excerpt 4

	762	F1	さっきのお話聞いてると(.) いろいろ家族のこととか (.) いろいろ言ってたけど (.) どうですか. sakkino ohanashi kiiteruto (.) iroiro kazoku no koto toka (.) iroiro ittetakedo (.) doudesuka. Just before (.) you were talking about the disabled people's families weren't you?	Open
	763	S1	あー (.) 周りのサポート (.) 家族からの aa (.) mawarino sapooto (.) kazoku karano Ah, a kind of support from people around them, from their families.	Answer
	764	S2	家族のサポートって知らないね (.)でも調べられかな? Kazoku no sapoototte shiranaine (.) demo shiraberareru kana? We don't know much about what kinds of support they provide (.) but can we study it?	Develop
	765	Ken	うーん (.) 答えを全部調べなくちゃいけないわけじゃないし Uun (.) kotae wo zenbu shirabenakutya ikenai wake janaishi Umm (.) we don't have to study all kinds of support for the next tutorial	Develop
	766	S1	じゃあ (.) どんなサポートをしてるかって聞く(.) 障害者に jaa (.) donna sapooto wo shiterukatte kiku (.) shoogaisha ni So (.) we can ask some disabled people about what kinds of support they have received	Develop
→	767	Aya	体験談みたいな = taikendan mitaina = Like their personal experiences related to the support =	Develop
	768	S1	=そう (.) 体験談 =soo (.) taikendan =Yes (.) experiences	Agree
→	769	Aya	障害者 (.) 障害者の身近な人 (.) 家族からの= shoogaisha (.) shoogaisha no mijikana hito (.) kazokukara no= From the perspectives of a disabled person, people who are close to him, and his family=	Develop
	770	Ken	=周りの人がどのようなサポートをしているのか =mawarino hito ga donoyouna sapooto wo shiteirunoka =How they provide help with the disabled people.	Develop

(Group 3's PBL session, 1 December 2009)

Aya attempted to take part in the discussion by adding further information or her opinion to the previous move. Although she was still regarded as a quiet student in December, her attitude towards learning in PBL seems to have changed as indicated by the fact that Aya made 10 developing moves in December. One could argue that she is in the process of an 'approximation to full participation' (Wenger, 1998, p.100).

The second key speech function is the clarifying move which has a discourse purpose of getting additional information needed to understand a prior move (Eggins & Slade, 1997). A clarifying move is one of the important functions in group discussions in that the discourse purpose of obtaining a better understanding of a previous speaker's opinion is closely related to active listening skills. On the other hand, a resolving move is employed to provide clarification which has been demanded in a clarifying move. That is, these moves are often used as a pair of linguistic exchanges.

One instance of a conversation including clarifying and resolving moves is provided in Excerpt 5. In this exchange, the students discussed a physical disability handbook issued by the Japanese government. In Moves 86 to 90, Ai and S12 shared their knowledge of the disability handbook. Subsequently, Takeshi took a clarifying move to get further information of the value of the handbook (Move 91). Furthermore, he asked members to provide an example of 'no admission fee' in Move 95. Because he was apparently not familiar with the support system for disabilities in Japan, he tried to be actively involved in the conversation by obtaining more general information about the handbook.

Excerpt 5

84	S10	あとさ (.) サポート(.) 聞いたことあるよね. いろいろ. 例えば援助 (.) 金銭的な atosa (.) sapooto (.) kiitakoto aruyone. iroiro. tatoeba enjo (.) kinsentekina And (.) I heard the disabled have several supports (.) such as financial, or livelihood assistance.	Open
85	S12	[うん] [Un.] [yes.]	Acknowledge
86	S12	障害者手帳ってあるよね? Shoogaisha techoo tte aruyone? They have a physical disability handbook which is issued by the government, haven't they? =	Develop
87	S10	=うん= =un= = Yes =	Acknowledge
88	S12	=なんかランク付けみたいなのあって =nanka rankuduke mitainano atte = It is graded according to the extent of disability.	Continue
89	Ai	なんかいっぱい公共施設とかバスとか無料になったりする. Nanka ippai kookyooshisetsu toka basu toka muryooni nattarisuru. I suppose, people who got the handbook can use public facilities and transportation for free.	Develop
90	S12	高校のときの担任の先生は(.) 耳悪くて持ってた. koukouno tokino tanninno sensei wa (.) mimi warukute motteta. My teacher in high school has the handbook because he can't hear very well.	Develop

(continued)

→	91	Takeshi	え(.) 何かに使えるの?その手帳は. e? (.) nanikani tukaeruno? Sono techoo wa. If they can have the handbook, what kinds of advantages can they enjoy?	Clarify
	92	S12	うーん(.)なんか入場料がただとか(.)たぶん uun (.) nanka nyuujooryoo ga tadanitoka (.) tabun Umm (.) no admission fee for them (.) maybe.	Resolve
	93	Ai	[うん] [un] [hmm]	Agree
→	94	Takeshi	え?どういうとこの?= e? douiutokono?= What? For example?=	Clarify
	95	Ai	=バスとか電車とか =basu toka densha toka =Such as (.) bus, train and so on.	Resolve
	96	Takeshi	へえ. hee. I see.	Acknowledge

(Group 4's PBL session, 1 December 2009)

Takeshi's use of clarifying moves indicates that listening is not simply hearing others in silence but actively understanding others' opinions and the topic by sometimes asking for further related information and clarification. The increase in the number of clarifying moves in Takeshi's use of speech functions from 8 moves (June) to 32 moves (December) was probably associated with his perception that active listening is pivotal to better communication.

These findings show that these four focal students tried to identify what they need to improve in order to better participate in group discussion. For instance, Aya needed to more actively express her opinions, whereas Takeshi sought to improve his listening skills to better understand other members' opinions. Changes in their approaches to learning in PBL appeared to influence changes in their use of speech functions over time.

10.6 Factors Shaping the New Learning Process

In this study the four focal students appeared to attempt to manage their own tutorial participation and adjust themselves to the new educational context so as to become full participants in PBL. In the following sections, four factors that appeared to shape their new learning process are presented, based on the introspective (interview) data. Although the four key factors will be introduced separately, it is likely that they are interconnected in various ways.

10.6.1 Prior Learning Experience and Apprehension About Communication

Some students stated that their prior learning experiences gave rise to apprehension about communication in discussion sessions. As Excerpt 6 shows, in the first semester, Ai was confused about the new pedagogical environment of PBL due to a lack of experience with an interactive learning mode:

Excerpt 6
Because I seldom had an opportunity to do group discussion previously, I felt difficulty in doing PBL at the early stage. In the first semester I worried a lot about other members' negative reaction towards my opinions, and I was often afraid about whether other members thought my opinions were irrelevant or even stupid. So, I sometimes intentionally kept silent even though I had a certain opinion. However, now I understand the importance of sharing my opinions in the discussions. (Ai, 7 December 2009)

Specifically, it seems that most of the students in this study tended to be apprehensive not that their knowledge might be wrong, but that they might stand out among other group members by making irrelevant remarks to a discussion topic. Their tendency to align to the group could obstruct the necessary actions in discussion, such as making a counterargument and promoting a better understanding of the theme by returning to a previous topic. In Excerpt 7 below, Ken emphasised the importance of maintaining the smooth flow of the group's conversation rather than sharing his opinion on the previous topic:

Excerpt 7
Ken: Even though I have a firm opinion, I tend to concede the floor to him when he starts to speak a little bit earlier than me, and I will wait until he finishes talking. However, if he changes it to the new topic during his conversation, I'm sure I will give up expressing my opinion about the previous topic. I don't want to interrupt the group's conversation. (Ken, 29 June 2009)

His oral participation might have been affected by the cultural notion derived from the prior experience of schooling that stresses group conformity and solidarity (Kubota, 1999). As indicated in Table 10.3, Ken made only 33 moves in June. Most of his reticence can be explained by a sociocultural silence influenced by norms of classroom communication and communication in general in Japanese society (Nakane, 2002). However, the influence of such apprehension towards communication and participation appeared to be weakening as the students acquired experience of PBL.

10.6.2 Identity as a Medical Professional and Motivation

The fact that the development of identity as a medical professional can be influential to students' learning in PBL was introduced in Excerpt 1 of Aya's case. Students' consciousness of their future career seemed to have been stimulated by a 2-week practical training programme implemented in the middle of the academic year (September). In this practical training programme, the

first-year students were encouraged to observe a health care site and assist in some simple tasks through communication with medical professionals and patients. Their experiences of this programme appeared to positively influence their participation in PBL in the second semester. Excerpt 8 clearly shows the relationship between Ai's experience of practical training and her participation in PBL in the second semester:

Excerpt 8
In the first semester, when I took the PBL, I wondered why I had to do these classes. However, after experiencing the practical training, I strongly think that effective communication amongst medical professions is essential to provide better medical care for patients. I also noticed the importance of expressing my opinions in a health care site. In fact, a group study such as PBL provides a good opportunity to practice my communication skills, because I need to discuss with my colleagues in the future. (Ai, 7 December 2009)

Her identity as a future nurse, which was developed in the practical training programme, resulted in enhancing her intrinsic motivation to participate in PBL. Furthermore, her experience of this training partly appears to have led to the change in her conceptions of learning in PBL. Excerpt 8 implies that, in investigating students' learning in PBL, it is also important to understand the relationship between their experiences of PBL and other courses.

10.6.3 Students' Perceptions of Learning in PBL

A 1-year observation of these students' learning in PBL found that their participation was associated with their perceptions of the learning environment in PBL. As mentioned in the previous sections, once they identified essential skills for their future career, Ai and Aya regarded PBL as a good training environment for these skills.

Ken also changed his perceptions of the PBL learning environment. In June, he considered PBL only as an opportunity to display his knowledge from a medical student's perspective. Based on the comments from the students in other disciplines, namely Ai, Aya and Takeshi, medical students are generally more self-confident in content knowledge than the group members from other faculties. The interviews also indicated that they are regarded by others as the more intelligent group members, because the medical students passed an entrance examination with a higher level of difficulty. However, in September, Ken was able to consider PBL as a place where students try to identify the problem and solve it together. Excerpt 9 shows his hopes for the next tutorial in terms of his perceptions of PBL as collective learning:

Excerpt 9
Today, I should have given more help to other members, particularly when the chair and scribe were confused with their roles. I think that my feeling that today's group discussion was unsatisfactory can be due to my participation which couldn't help other members. Next time I need to improve this point. (Ken, 28 September 2009)

10.6.4 Social Relationship with Peers and Positioning in Group

Lastly, data analysis indicated that the social relationship with peers influenced the students' learning processes in PBL. Because at this Japanese university PBL groups are reorganised in the middle of the academic year, students need to work with new group members from September. As Excerpt 10 shows, Takeshi expressed uncertainty, as he began to work with the new group members:

Excerpt 10
Today, I was rather quiet, because I don't like this new group very much. ... I found that one member tends to actively manage group learning as a leader, which is the same character as mine. If possible, I always want to become the chair to manage the group discussion. But if two students want to be the chair in one group, it was not effective. (Takeshi, 5 October 2009)

In September, he encountered a new member who was similar in character to himself, in attempting to take the lead in the discussion. There were some cases in this particular tutorial in which Takeshi hesitated to take the initiative in the discussion and kept silent. He often sat far back in his chair, slightly further away from the table than others, which might have indicated his reluctance to be involved in the discussion. Takeshi was not satisfied with his own participation, and started to consider how he could contribute to PBL learning in this particular group. Consequently, as Excerpt 11 below indicates, in December Takeshi adopted a position of creating an open and free atmosphere for the effective group discussion instead of taking the lead in the discussion. Remedios (2005) proposed that such positioning activity is a fundamental tool for negotiating membership in a group:

Excerpt 11
I found that my role in this particular group is to establish a better learning atmosphere and social relationship among members so as to prompt all members' participation. It is not good to fall silent like the PBL in September. I need to consider how I can contribute to this group. (Takeshi, 7 December 2009)

Takeshi dealt with the interpersonal difficulty with regard to social relationship with peers during PBL tutorials by identifying a suitable position for the new circumstance. The change in his attitude towards tutorial participation appeared to have been based on his thoughts that maintaining social harmony between group members promotes effective group work. This case, where Takeshi's participation is associated with both his perceptions of a learning environment and of the self in relation with others, clearly indicates that different factors are overlapping.

10.7 Discussion

This chapter examined discursive characteristics of students' participation in PBL and factors that shape their new learning process. The main findings were that students attempted to contribute to the PBL learning by accomplishing

their own roles in the particular context of the group discussion with the intention to participate as fully as possible. The study suggested that their socialisation process into the new academic community might be positively or negatively affected by several factors, such as prior learning experience, identity as a medical professional, perceptions of learning in PBL and power relations with peers. Although the PBL environment can be a challenging one for first-year students, it can also provide an opportunity to autonomously develop their generic skills.

In order to reveal the complexities of student learning, the educational contexts should be comprehensively examined from various analytical perspectives. First, as students' identity formation in a given community is interrelated to their participation, it is important to investigate students' learning process with the concept of a trajectory which 'has a coherence through time that connects the past, the present and the future' (Wenger, 1998, p. 154). That is, a better understanding of students' prior learning experience, present participation, aspirations for future learning and identity as a future medical professional is essential to explore PBL in an in-depth manner. Second, students' learning in PBL should be examined on the basis of Wenger's (1998) concept that the community of practice cannot be understood independently of other practices. It is therefore important to analyse not only their participation in PBL but also the interconnection between their experiences of PBL and other courses as academic communities. For instance, Ai's awareness of the importance of effective communication skills through her experience of practical training promoted the change in her perceptions of learning in PBL. Furthermore, in this study, most Japanese students had a strong sense of membership in the PBL groups, which might be associated with a Japanese cultural norm stressing group-centred, harmonising behaviour in the society (Takai & Ota, 1994; Matsudaira, Fukuhara, & Kitamura, 2008). As a result, the students tended to maintain harmony with peers and to worry about other members' evaluations of their opinions. This finding implies that the relationship between students' learning and social context is a pivotal analytical dimension in that the students' learning process is situated in a Japanese higher-educational context.

Even though these findings cannot be generalised to all Japanese students in the first year of PBL, this study suggests that the combination of analyses of speech functions and introspective data is an effective analytical method of obtaining a better understanding of students' learning processes.

References

Blumberg, P., & Michael, J. A. (1992). Development of self-directed learning behaviors in a partially teacher-directed problem-based learning curriculum. *Teaching and Learning in Medicine, 4*, 3–8.

Bridges, S., McGrath, C., Yiu, C. K. Y., & Cheng, B. S. S. (2010). 'Reassuring' during clinical examinations. *Journal of Asian Pacific Communication, 20*(2), 185–206.

Christie, F. (2002). *Classroom discourse analysis: A functional perspective*. New York: Continuum.

Eggins, S., & Slade, D. (1997). *Analysing casual conversation*. New York: Cassell.

Flowerdew, J. (2000). Discourse community, legitimate peripheral participation, and the nonnative-English-speaking scholar. *TESOL Quarterly, 34*(1), 127–150.

Frederiksen, C. H. (1999). Learning to reason through discourse in a problem-based learning group. *Discourse Processes, 27*(2), 135–160.

Goffman, E. (1981). *Forms of talk*. Oxford: Blackwell.

Hawthorne, L., Minas, I. H., & Singh, B. (2004). A case study in the globalization of medical education: Assisting overseas-born students at the University of Melbourne. *Medical Teacher, 26*(2), 150–159.

Hmelo-Silver, C. E. (2002). Collaborative ways of knowing: Issues in facilitation. In G. Stahl (Ed.), *Proceedings of computer supported collaborative ways of learning* (pp. 199–208). Hillsdale, NJ: Erlbaum.

Hmelo-Silver, C. E., & Barrows, H. S. (2008). Facilitating collaborative knowledge building. *Cognition and Instruction, 26*(1), 48–94.

Imafuku, R. (2007a). Oral participation in medical problem-based learning tutorials. In C. Gitsaki (Ed.), *Language and languages: Global and local tensions* (pp. 61–77). Newcastle: Cambridge Scholars Publishing.

Imafuku, R. (2007b). A case study of a medical PBL tutorial: Tutor and student participation. In H. Marriott, T. Moore, & R. Spence-Brown (Eds.), *Learning discourses and the discourses of learning* (pp. 11.1–11.17). Melbourne, VIC: Monash University ePress.

Imafuku, R. (2009). Students' academic experience in medical problem-based learning tutorials. In M. Carroll, D. Castillo, L. Cooker, & K. Irie (Eds.), *Proceedings of the independent learning association 2007 Japan conference: Exploring theory, enhancing practice: Autonomy across the disciplines*. Kanda University of International Studies, Chiba, Japan.

Khoo, H. E. (2003). Implementation of problem-based learning in Asian medical schools and students' perceptions of their experience. *Medical Education, 37*(5), 401–409.

Koschmann, T., Glenn, P., & Conlee, M. (1997). Analyzing the emergence of a learning issue in a problem-based learning meeting. *Medical Education Online, 2*(2), 1–9.

Kubota, R. (1999). Japanese culture constructed by discourses: Implications for applied linguistics research and ELT. *TESOL Quarterly, 33*(1), 9–35.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Legg, M. (2005). *Student and tutor roles in problem-based learning medical tutorials at Hong Kong University*. Unpublished MA thesis, Macquarie University, Sydney.

Matsudaira, T., Fukuhara, T., & Kitamura, T. (2008). Factor structure of the Japanese interpersonal competence scale. *Psychiatry and Clinical Neurosciences, 62*, 142–151.

Morita, N. (2002). *Negotiating participation in second language academic communities: A study of identity, agency, and transformation*. Unpublished PhD thesis, University of British Columbia, Vancouver.

Nakane, I. (2002). Silence in the multicultural classroom-perceptions and performance in Australian university classrooms. *Inter-cultural Studies: A Forum on Social Change and Cultural Diversity, 2*(1), 17–28.

NCVER (National Centre for Vocational Education Research). (2003). *Defining generic skills at a glance*. Adelaide: NCVER.

Nemoto, H. (2007). Incomplete participation in academic contact situations: Japanese exchange students at an Australian university. In H. Marriott, T. Moore, & R. Spence-Brown (Eds.), *Learning discourses and the discourses of learning* (pp. 1–16). Melbourne: Monash University ePress.

Remedios, L. (2005). *Experiences and responses of overseas-educated students to problem based learning in an Australian physiotherapy setting*. Unpublished PhD thesis, The University of Melbourne, Melbourne.

Robertson, K. (2005). Active listening – More than just paying attention. *Australian Family Physician, 34*(12), 1053–1105.

Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Thousand Oaks, CA: Sage.

Takai, J., & Ota, H. (1994). Assessing Japanese interpersonal communication competence. *The Japanese Journal of Experimental Social Psychology, 33*(3), 224–236.

Visschers-Pleijers, A., Dolmans, D., de Grave, W. S., Wolfhagen, I., Jacobs, J. A., & van der Vleuten, C. P. M. (2006). Student perceptions about the characteristics of an effective discussion during the reporting phase in problem-based learning. *Medical Education, 40*(9), 924–931.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Woodward-Kron, R., & Remedios, L. (2007). Classroom discourse in problem-based learning classrooms in the health sciences. *Australian Review of Applied Linguistics, 30*(1), 9.1–9.18.

Chapter 11
Sounds of Silence: Examining Silence in Problem-Based Learning (PBL) in Asia

Jun Jin

11.1 Introduction

11.1.1 Students' Participation in EMI Universities

Many research studies indicate that Asian students tend to be silent in participation in EMI contexts in Asian universities (Jackson, 2005; Littlewood, Liu, & Yu, 1996) and western universities (Braddock, Roberts, Zheng, & Guzman, 1995; Chan, 1999; Jones, 1999). Communicative competence (Jackson, 2005), lack of opportunity to practice oral English (Jackson, 2005; Littlewood et al., 1996; Tang, 2007), and cultural differences (Flowerdew & Miller, 1995; Lee, 1999) have been frequently identified as primary barriers to participation in spoken English interaction. However, it may be an over-simplification to portray Asian students as having the characteristic of silence. Other factors, such as learners' identities (Lam, 2006) and interpersonal relations (Cheng, 2000; Kubota & Lehner, 2004; Wong, 2004), are being considered to more fully explore spoken English interaction in higher education. It is necessary to rethink learners' silent behavior in spoken English interaction. Examining this in the situated context may provide us with better understanding of silence in spoken English interaction of learners in EMI contexts. As Zhou, Knoke, and Sakamoto (2005) noted, "placing emphasis on individual characteristics of Chinese students, without considering aspects of the educational context with which those characteristics interact, may over-simplify and distort the mechanism underlying their silence in the classroom" (p. 287). This chapter therefore aims to explore silence in one situated context.

Problem-based learning (PBL) has increasingly been employed as a teaching and learning approach in higher education, particularly in healthcare education. In PBL tutorials, students are encouraged to learn collaboratively. Only a few researchers have addressed PBL in second-language learning contexts

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(e.g. Legg, 2007) with no in-depth qualitative work done to date on students' silence in PBL tutorials in this area. Given this specific context of the study, this chapter examines students' silence in PBL tutorials in an EMI university in Asia.

11.1.2 Spoken English Interaction in PBL

Interaction plays an important role in small-group collaboration and learning. To understand spoken English interaction in PBL, we need to be aware of the goal of PBL and its tasks first. The goals of PBL include helping students develop (1) flexible knowledge, (2) effective problem-solving skills, (3) self-directed learning skills, (4) effective collaboration skills, and (5) intrinsic motivation (Hmelo-Silver, 2004; Hmelo-Silver & Barrows, 2006). The goal of being a good collaborator and the interactive process of learning are often woven together (Hmelo-Silver, 2004). This interaction strongly influences student learning (Cohen, 1994; Van der Linden, Erkens, Schmidt, & Renshaw, 2000) and group effectiveness (Dolmans, Wolfhagen, & Van Der Vleuten, 1998; Wenger, 1998). Researchers argue that deep processing interactions can promote deep learning rather than surface learning (Visschers-Pleijers et al., 2006), so that students develop and construct a critical understanding of the knowledge (Newman, Johnson, Webb, & Cochrane, 1997), and enhance problem-solving skills and higher-order thinking (Brown, 1995; Brumenfeld, Marx, Soloway, & Krajcik, 1996; Vye, Goldman, Voss, Hmelo, & Williams, 1997).

In qualitative research studies of PBL in healthcare education, few studies have focused on the actual interaction process in PBL (Visschers-Pleijers, Dolmans, de Leng, Wolfhagen, & van der Vleuten, 2006; Visschers-Pleijers et al., 2006; Woodward-Kron & Remedios, 2007). Hmelo-Silver (2004) indicated that there is little empirical evidence as to what students are learning PBL, and how. Dillenbourg, Baker, Blaye, and O'Malley (1995) also emphasized that collaboration in the PBL process should be investigated more closely. There has been a general call for research that can assist practitioners to understand better what is happening and under which circumstances interaction can be effective in PBL tutorials (Visschers-Pleijers et al., 2006).

One approach to more closely examine group interactional processes is to draw on discourse analysis. A small number of such studies have appeared in the field of PBL (DeGrave, Boshuizen, & Schmidt, 1996; Hmelo-Silver & Barrows, 2006; Woodward-Kron & Remedios, 2007). DeGrave et al. (1996) observed and videotaped a group of Year 2 medical students in the PBL process to investigate cognitive and metacognitive processes in PBL tutorials. They found that the majority of verbal interactions were categorized as theory building or data exploration and examined when and where in the problem-analysis phase theory building occurred. While qualitative in design, the analysis of this classroom discourse adopted a cognitive approach to examine reasoning processes. In another qualitative study, Woodward-Kron and

Remedios (2007) adopted Halliday's systemic functional linguistics and examined the ways in which the students and their tutor negotiated and constructed meanings through language by videotaping one Year 1 physiotherapy PBL tutorial at an Australian university. The discourse analytical description of the interactions showed how knowledge was co-constructed and negotiated, as well as how the tutor used minimal but strategic interventions to scaffold the students' learning. The study presented in this chapter takes a sociocultural and critical perspective in examining the roles of silence within the interactional dynamics of PBL tutorials. This is elaborated in the methodology; however before presenting the details of the study, it is necessary to conceptualize silence in spoken English interaction in order to understand how silence is exercised and negotiated in PBL tutorials.

11.1.3 Silence

The concept of silence in this study is captured as a means of communication in ongoing classroom processes. Even though silence is often taken for inaction in communicative settings, the conceptual understanding of silence in this study aligns with the premise that silence has a communicative purpose (Jaworski, 1997; Saville-Troike, 1985). Communication theorists have long recognized that silence is an aspect of effective communication (Grice, 1989). Dauenhauer's (1980, p. 138) analysis of the "interpenetrating of discourse, silence, action and desire" also suggested that silence can be an active performance.

To further understand the issue of silence using discourse-based approaches, the study presented in this chapter employed conversation analysis (CA) to initially identify silence at the turn-taking level. Critical discourse analysis (CDA) was then drawn upon to provide a holistic perspective based on both social understanding of discourse and linguistic analysis (Caldas-Coulthard & Coulthard, 1996; Fairclough, 1995). By rooting the conceptual understanding of silence in spoken English interaction in CDA, the study extends the educational space to the social, cultural, and political dynamics of language use, not just limiting it to phonological, syntactic, and pragmatic domains (e.g. Kumaravadivelu, 2006; Markee, 2002; Norton, 1997; Pennycook, 1999).

The issue of silence is one important but under-researched issue to be addressed in PBL contexts. Halth-Cooper (2003) investigated tutors' experiences of facilitating PBL. Nonverbal communication was identified as one out of six themes but was reported by facilitators' brief perceptions rather than observational data. Remedios, Clarke, and Hawthorne (2009) investigated four "silent" students' PBL experience in an Australian university with two overseas-educated and two local Australians selected as "silent participants" in PBL tutorials. This previous work has highlighted the worthiness of the issue but, as noted above, no in-depth qualitative work has been done to date on students' silence in PBL tutorials in second-language learning contexts.

Tolerance of silence has been considered in many fields. A study by Wilkerson, Hafler, and Liu (1991) investigated what interactions characterized student-directed discussion and students' responses in PBL tutorials. Factors included tutors who questioned infrequently, provided limited information, tolerated silent periods, and smooth turn taking (Wilkerson et al., 1991). Jefferson (1989) originally proposed that the average timing for the toleration of silence for participants in naturally occurring conversations in English is around one second. Later studies indicated that the relative length of pauses is considered in light of the broader, language-specific context (Nakane, 2005; Sajavaara & Lehtonen, 1997). In environments with mixed language backgrounds and abilities, Carroll (2000) argued that long gaps in non-native speakers' turn-taking behavior cannot be attributed simply to a lack of language proficiency.

11.2 Methodology

11.2.1 Questions and Data

The study reported in this chapter is part of a larger research project on silence in spoken English interaction in PBL tutorials, which explores the role of silence for communication, learning, and identity in PBL tutorials at an EMI university in Asia. The research question addressed in this chapter was this: What are the roles of silence in spoken English interaction in PBL tutorials?

With a particular focus on roles of silence in spoken English interaction in PBL tutorials, a multimethod approach was necessary to ensure the trustworthiness of data collection, analysis, and interpretation (Bridges & Bartlett, 2009; Bridges, McGrath, Yiu, & Cheng, 2010; Louis, 1982 in Sturman, 1997). Multiple data collection methods (questionnaires, interviews, classroom observations, and stimulated recall), multiple data sources (questionnaires, fieldnotes, interview transcripts, audio-record of spoken discourse), and multiple analysis programs (SPSS, Soundscriber, and NVivo software) were used to collect and analyze experiential accounts of learners over the 1 year of their study at an EMI university in Asia.

Eight successive PBL tutorials were videotaped, and then significant episodes of silence in these tutorials were identified, edited, and extracted into one media file per tutorial. From the analytic perspective of CA (Sacks, Schegloff, & Jefferson, 1974), the significant episodes of silence within and between turns are mainly identified as

- silence between turns, which refers to instances when one student is involved in discussion and later withdraws, or one student is not involved in discussion but later is self-selected or nominated to talk; and
- silence within turns, which refers to instances when one student presents a piece of information and then stops talking and later continues to present.

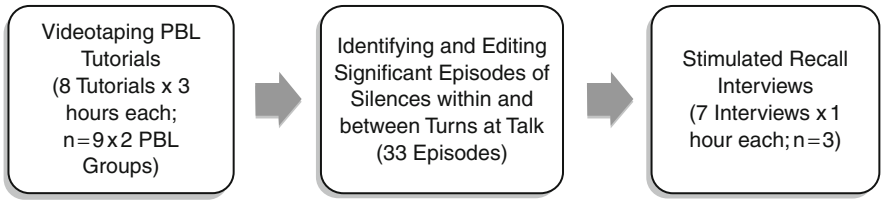

Fig. 11.1 Data collection process

Finally, three first-year undergraduate students volunteered to attend stimulated recall interviews during which they were given control of pause functions while viewing the edited excerpts and freely commenting on their own and their groups' communication processes (Gass & Mackey, 2000). The topic of silence was not introduced as a focus at the beginning of the recall session. These interviews were audio-recorded and transcribed. The process is shown in Fig. 11.1.

The analysis presented in this chapter mainly draws upon CDA focusing on one group of students' real-time interactions and uses thematic analysis focusing on two students' stimulated recall reflections, to explore both student practices and student perceptions of silence in PBL tutorials. In this CDA study of first-year dental PBL tutorials, interactional control, including turn taking, exchange structure, and topic control are the main features in PBL discourse to be examined (Fairclough, 1992). This allows insight into the actual process of classroom interaction.

11.2.2 The Research Context: PBL in Faculty of Dentistry at an EMI University in Asia

The case study reported here examined practices and perceptions of first-year undergraduate students from one discipline, dentistry, at an EMI university in Asia which has been recognized as having one of the closest models to "pure" PBL in dentistry (Winning & Townsend, 2007). The PBL process adopted is illustrated in Fig. 11.2:

Data presented in this chapter focuses on one set of participants from the larger study. The consenting tutorial group (8 students) and their facilitator were video-recorded four times during the second semester of their first year of

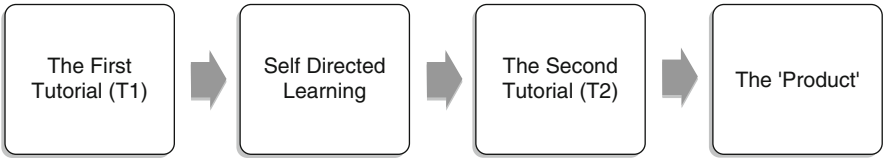

Fig. 11.2 PBL procedure

Table 11.1 PBL group A students' background

Name	Gender	Entrance pathway	Education background
Jessica	F	Non-JUPAS	First degree holder from a local university
Catherine	F	JUPAS	Local secondary school
Roy	M	Non-JUPAS	First degree holder from an overseas university
David	M	JUPAS	Local secondary school
Stephan	M	Non-JUPAS	Local secondary school
Joan	F	EAS	Local secondary school
William	M	JUPAS	Secondary school overseas
Julie	F	Non-JUPAS	Secondary school overseas
Facilitator	F	N/A	N/A

JUPAS denotes joint university programmes admissions system. JUPAS is the main route of application designed to assist local secondary school students to apply for admission to nine government-funded universities
EAS denotes early admission scheme. EAS is a subsystem of the JUPAS. It enables very able students to enter three universities one year earlier without sitting for the A-Level exams

undergraduate studies. The students knew each other previously but this was the first occasion in which they worked as one PBL group. The participants are referred to by pseudonyms throughout. Although these students were in the first year of their studies and had only completed one semester of PBL, they demonstrated a clear familiarity with the requirements and processes of PBL in the faculty. A brief summary of the participants and their backgrounds is provided in Table 11.1.

All participants' first language is Cantonese, but there were variations among students as shown in Table 11.1: different entrance pathways (e.g., JUPAS, non-JUPAS, EAS) and different educational backgrounds (e.g., local secondary schools, overseas secondary schools, first degree holders from a local university, and first degree holders from an overseas university). These variations among students may have impacted on the variability and complexity of spoken English during PBL tutorials in this EMI context. While not aiming to track this issue in detail here, it is worth noting that in an internationalized, EMI university in Asia, while students have obviously met threshold language requirements, they have experienced multiple tertiary entrance pathways and have had different English language acquisition backgrounds upon entry to first year studies. This study seeks to explore these diverse students' perceptions and practice of silence in spoken English interaction.

11.3 Analysis

The data analysis informs the different roles of silence in spoken English interaction in PBL tutorials at an EMI university in Asia. First, students' different perceptions of silence in PBL groups are indicated. Then, their practices of silence are presented in detail, using discourse-based analysis with stimulated recall interviews as reflective supplements.

11.3.1 Perceptions of Silence

In this Faculty of Dentistry, relatively silent students were readily identified by individuals themselves and by their group members.

> In groups, there are always one or two people who prefer to be more quiet about things. (Post-survey interview, 10/03/2009, William)

However, besides allowing for the casting of members as silent and seeing this reflected in tutorials, it was recognized that silence was, in fact, not unusual in the group discussion among group members in every tutorial.

> One of our group mates may ask questions then nobody knows how to answer it. This is quite usual actually, and it happens in every tutorial. (Post-survey interview, 13/02/2009, Stephan)

Later in the year, while watching the video playback of one tutorial, the same student offered some reasons for his own silence,

> I was sick during the week, so actually I didn't prepare anything except the sleeping issue. I couldn't contribute much before that topic, and that was why I kept quiet at very beginning of T2. (Stimulated Recall Interview, Problem 1.21 T2, 29/04/2009, William)

As participants of an educational community of practice, students inherently understood the "rules of the game" and how breaches would affect interactional dynamics, individual learning, and group learning. To engage in the PBL process, students need to be well prepared before the second tutorial (T2), so that they can make a contribution to group discussion. If students are not familiar with topics, they appear to verbally disengage in the discussion and remain silent, showing a reluctance to display knowledge gaps or lack of preparation. Another student from the same group, Stephan, also had a similar reflection on his own performance,

> If I prepare quite well in this part, I can just use my knowledge to answer others' judges and questions immediately. If I am not so sure about the topics, like thermodynamics, because I haven't got enough time (in self-directed learning period), then I won't speak much actually (in PBL tutorials). (Stimulated Recall Interview, Problem 1.21 T2, 27/04/2009, Stephan)

Students' reflections above indicated the obvious link between silence and lack of knowledge. If they perceive that they do not have anything to contribute as a knowledge display in the final tutorial, they do not speak. This finding is consistent with many other studies (e.g., Jackson, 2002; Nakane, 2005; Phillips, 1972), which found that Asian students who were reluctant to engage in discussion were influenced by contextual factors such as the topic in discussion. However, among this group of undergraduate students, silence was perceived and practiced in other ways. It may seem obvious that in PBL tutorials, as in many leaning contexts, students need silent time to listen, digest, judge information, and generate new ideas. From this lens, rather than being viewed as a

negative phenomenon, silence becomes a productive resource. Students' reflections below present how silence in spoken English interaction is used as a productive resource.

> If I do not prepare well, I try to learn from and listen from others, instead of speaking. (Stimulated Recall Interview, Problem, 1.21 T1, 27/04/2009, Stephan)

In PBL tutorials, Stephen reflected that he listened in the process of solving problems even if he remained silent in discussion. Judging the information while being silent was another productive way to participate in the group discussion:

> I was just digesting the information as we had two versions at that moment. (Stimulated Recall Problem, 1.21 T2, 27/04/2009, Stephan)

William's reflections further indicate that he considered himself still actively participating by other means, e.g., active thinking.

> I was thinking the proposal might not be reasonable. In my mind there was another theory. It might be wrong cause I hadn't proved it yet. When he told me that, it didn't make sense, so I was judging, just matching my knowledge. (Stimulated Recall Interview, Problem 1.21 T2, 29/04/2009, William)

Besides judging and integrating knowledge within personal mental constructs, William reflected that he tried to generate new ideas so that the group discussion could move forward.

> I was checking if there was any facts we've missed, so I could generate new ideas. (Stimulated Recall Interview, Problem 1.21 T1, 29/04/2009, William)

Besides listening and active thinking, students may keep silent in order to wait for peer feedback; find a chance to talk; or open the "floor" to others for better knowledge construction and group dynamics in the collaborative learning procedure. The extracts of one group tutorial and its associated stimulated recall interviews (Section 11.3.2) present how silence is used as a collaborative practice.

11.3.2 Practices of Silence

Extract 1 'Problem 1.21' T2 24/04/2009

In this second tutorial, students were discussing the last learning issue identified in the first tutorial (T1)—physiology of sleep. This extract presents William sharing his previous projects about sleep. The facilitator asked a question to the group (Turn 1) and William's response of "no" elicited different responses from group members. The long pause at Turn 2, David's question at Turn 3, and Stephan's hesitation indicate some confusion. After William took the extended turn at Turn 7 to share his previous research project, group members sought clarifications. William then took this as indication to elaborate and share his information further (Turn 19).

Turn	Participant	Content
1	Facilitator	So if you prescribe sleeping pills, what would happen? Should they produce serotonin?=
2	William	=No (3.0)
3	David	What? ((David looks directly at William))
4	Stephan	Hu::h::sleep.
5	William	We::ll let me share my research.
6	Stephan	Mm
7	William	Why do we feel we really should sleep? There are actually two (.) separate mechanisms to monitor. One is serotonin level. It develops continued concentration all the day, so (.) when it is low, you awaken (.) and (.) you continue to build up during the day. And as you keep awake, you keep developing until certain percentage level, then you feel really sleepy and you fall asleep. And during sleeping these chemicals will be broken down. So (.) after sleeping, the level is lower enough to be awoken. The second mechanism is melatonin. What is melatonin? It is actually another kind of hormone that promotes sleeping. It is in the deep production that is inhibited under sunlight, that is why you can rarely fall asleep under sunlight and easily fall asleep at night, because (.) daylight can inhibit the production of melatonin. So (.) serotonin is so called "biological clock," it is the biological clock we have been discussing. And melatonin is hu::h time and daylight dependent. And all these two mechanisms make the sleeping habit. (2.0)
8	David	How do you spell melatonin?
9	William	M-E-L-A-T-O-N-I-N
10	Facilitator	M-E-L-A-T-O-N-I-N
11	David	Accumulate?
12	William	Accumulate.
13	Facilitator	Does it have anything to do with the circadian rhythm?
14	Stephan	Sorry?
15	Facilitator	Circadian rhythm (2.0)
16	David	Circadian rhythm
17	Facilitator	Circadian rhythm is the biological clock. (2.0)
18	Stephan	So that is why (.) hu::h if you have awaken for a day, then your body has concentrated very high level of serotonin, then you (.) want to sleep very much. (2.0)
19	William	And perhaps the other mode of sleeping varies from person to person, from 5 to 10 h, so if you can fall asleep during lectures, that means you have sleep depression =
20	Stephan	= Sorry?

In this collaborative and scaffolding process, William answered the question (Turn 2), then remained silent (Turn 3 and 4), and later took turns to share the information (Turn 5–7). From the turn-taking pattern after his extended Turn 7, it would appear that William's participation in the ensuing turns was dependent upon the group's reaction to this display and so he offered clarification or elaboration based on peer feedback. If other group members would like to ask questions, William would share more information; if they were not interested in it, he would stop. As William reflected in stimulated recall interview,

> Actually I was waiting for someone, waiting for their speaking. Because I said "no," it seemed to surprise them, didn't it? Because David stopped talking, doesn't he? And the facilitator asked him if he is going to prescribe sleeping pills, if he is to prescribe serotonin. That might sound "yes" logically, but it doesn't. Then that might be a surprise to them. Maybe they would like to ask questions, if they are not interested, then don't talk, right? So if they want to know, I give them more information. Maybe they don't want to know, oh that is ok. (Stimulated Recall Interview, Problem 1.21 T2, 29/04/2009, William)

In response to David and Stephan's surprised responses (Turn 3 & 4), William was willing to share more information about sleeping (Turn 7). William further explained the reason why he waited for peer feedback in this discussion.

> It would be too deep for that. Because it is psychologically based, if you did not fancy psychology, you might not want to know about the mechanism of sleeping. (Stimulated Recall Interview, Problem 1.21 T2, 29/04/2009, William)

The stimulated recall interview prompted William to disclose the delicate tension of knowledge display turns with regard to extent and depth of information. Since he was concerned that other group members might not want to know psychological information, which was not related to the dental field, he reflected his hesitation to elaborate and these concerns of peer feedback seem to have influenced the turn-taking pattern and topic of the discussion from Turn 8–23. When other group members including the facilitator showed interest in this topic by asking questions (Turn 8, 13), seeking clarification (Turn 20), and digesting the information (Turn 11, 18), William then heard this as an invitation to share more information on the topic (Turn 19). Thus, silence is delicately employed here in the group learning process as a collaborative practice to wait for peer feedback in order to construct knowledge and scaffold group learning.

In this extract, William presented as being "a specialist" having specific knowledge about physiology of sleep and so the distribution of turn taking between William and other students was unequal. William was sure about the information and had supporting evidence, so he could take up authority and his group position was more powerful thereby giving him license to present the information. No other member took the opportunity in this exchange to challenge his knowledge and the rights of turn taking and topic control. Therefore, silence may also be regarded as a signal of shifting power relations in the learning process.

What is of interest here is how these processes are played out in small-group PBL as students worked collaboratively to construct knowledge in the process of understanding and seeking solutions to problems. It is also common in PBL tutorials that students may have different understandings of knowledge, and have different preferences topically with regard to learning issues:Which learning issues shall be identified? Which version of knowledge is correct? Silence is used as a platform for handling conflicting understandings so that students can think critically, recheck the information, and find the evidence to support their own statements. The extracts from the same group's second tutorial and the

same two students' stimulated reflection below reinforces how silence in spoken English interaction is used as a platform for handling conflict.

Extract 2 'Problem 1.21' T2 24/04/2009

Students discuss the learning issue "physiology of sleeping." In this extract, after Stephan and Jessica elaborate on the two main types of sleep (Turn 1 and 5), Stephan and William display different understandings of REM sleep and debate if there is movement in REM sleep. Eventually, their arguments promote the whole group to a better understanding of REM sleep.

Turn	Participant	Discussion
1	Stephan	We::ll sleep can be classified into two main types. (.) Non-rapid eye movement and rapid eye movement sleep= ((Jessica and Catherine are looking at their materials and William is looking at his laptop))
2	Jessica	= Um huh = ((looking at her books))
3	David	= Rapid eye movement. ((to Jessica))
4	Stephan	[Right]
5	Jessica	[So there is two] (.) yeah, one is slow wave sleep and one is REM sleep, REM sleep means rapid eye movement sleep.
6	David	Um huh, ok. ((to his own book))
7	Stephan	So slow wave sleep=
8	Facilitator	=Have you watched other people have REM? Have you ever seen=
9	William	=Yeah, I do.
10	Stephan	Yeah, wave a lot. ((Stephan is waving his hands))
11	Facilitator	[No, not moving a lot.]
12	William	[No, no.]
13	Roy	The eye:: [the eye::]
14	Stephan	[Huh?]
15	William	[No.] During REM sleep, you're technically paralyzed=
16	Stephan	=Really?=
17	William	=No movement. (9.0) ((every group member is checking the books or laptops))

In this extract, this group discussion is dominated by students, with the facilitator taking a traditional PBL "back seat" role. Agreement and disagreement are commonly displayed across students' turn taking. From the stimulated recall interview, while Stephan elaborates on the type of sleep (Turn 1), William did not agree. However he did not say anything but looked at his laptop to check his previous project in order to recheck the information and match his own knowledge. When watching this replayed on video, William reflected,

> What Stephan said is half right, half wrong, so I check my previous project work, to recheck and match my knowledge. (Stimulated Recall Interview, Problem 1.21 T2, 29/04/2009, William)

When Stephan and William had contradictory understandings of REM sleep (Turn 10–17), every group member verbally disengaged from the group

discussion for 9 seconds to conduct individual research by using mediating tools (Vygotsky, 1978)—books, notes, or online information—on their laptops (Turn 17), in order to find related information to make a judgment regarding whose statement is correct or sensible, as well as formulate the possible solutions. Stephan briefly expressed his doubt "really?" (Turn 16), but he didn't immediately argue with William. Instead, he checked his book. As Stephan reflected later,

> (I'm) completely lost. After I give this information out, then he is saying "no." So this is the point that I ask myself what's happening, if I have read something wrong? Or have I misinterpreted something? (.) Or anything else is happening? So I try to read the book to reassure myself if I'm correct. (Stimulated Recall Interview, Problem 1.21 T2, 27/04/2009, Stephan)

Here both William and Stephan remained silent to look for evidence in order to support their statements. Their stimulated recall interviews further confirmed that this silence was used as a productive resource within the tutorial. Other group members also looked for the information through mediated tools to make a judgment and formulate a possible solution (Turn 17). Such collective activity seems to have been undertaken as implicitly sanctioned which appears to indicate silence in the group discussion was acceptable.

Every group member discussed freely the issue of REM sleep and elaborated their different understandings, but we need to notice that delicate power relations were shifting over the discussion. Stephan was familiar with the topic, so he elaborated on the issue of sleeping first. Jessica had information, so she had the authority to take turns to confirm Stephan's information (Turn 2 and 5). William had completed a project on sleeping when he was in the high school, so he also felt empowered to take turns to display his disagreement (Turn 12 and 15). Knowledge plays an important role in this shifting of power relations in the PBL group. When there is a conflict between group members (Turn 10–17), silence provides students with enough time to rethink, recheck, or reconfirm their knowledge and information. The conflict may then be handled if group members can set up mutual understanding of that knowledge, and construct more concrete and trustworthy knowledge in that silent time.

In summary, based on the analysis above, students' practices and perceptions of silence may be categorized into five roles in PBL tutorials:

- silence as a verbal disengagement (e.g., lack of knowledge, non- preparation);
- silence as a productive resource (e.g., recalling long-term and short-term prior information, digesting information, information seeking, generating new ideas);
- silence as a collaborative practice (e.g., waiting for feedback);
- silence as a platform of handling conflicting understandings (e.g., thinking critically, rechecking the information, and finding supporting evidence)
- silence as a signal of shifting power relations (e.g., unequal turn-taking distribution, topic control)

These five roles of silence are separately identified, but it needs to be noted that they may overlap. For example, in both of the excerpts above, students remained silent due to a lack of knowledge, but at the same time they indicated that they used silence as a productive resource to digest other students' information or search information.

11.4 Discussion

Jaworski and Sachdev (2004) noted that the different valuation of talk and silence is that silence, when it is mentioned in terms of academic achievement, is usually perceived negatively much more often than positively while talk is never viewed negatively in the same context. However, the analysis above indicates that silence cannot be simply stereotyped as a negative phenomenon. The findings of this study indicate that even though "absence of sound" or "inaction" can routinely be observed in learning interactions, this silence can be portrayed as a means of communication, participation, and learning in the ongoing process of PBL. Halth-Cooper (2003) reported that tutors felt that students could actively participate when they did not actually speak in PBL tutorials. Remedios, Clarke, and Hawthorne (2009) investigated four silent PBL students' experience in an Australian university. They indicated that multiple constraints, including personal, contextual, and cultural factors, resulted in students' silence, and silence should not be viewed as lack of learning. These findings are confirmed in the PBL discourse and students' stimulated recall interview data in this study in an EMI context in Asia: silence is not merely a verbal disengagement in the group learning process, but importantly also a productive resource, a collaborative practice, a platform of handling conflict, and a signal of shifting power relations.

If we are to acknowledge that silence is co-constructed as a productive resource in ongoing negotiation of participation in the academic communication, we need to be aware of toleration levels for silence in spoken English interaction in PBL tutorials. Although tolerating silence for a long period may inhibit the learning process, or mean a considerable loss of fun and motivation in PBL (Bosse, Huwendiek, Skelin, Kirschfink, & Nikendei, 2010), it is valuable that facilitators and students allow or tolerate silence in the discussion before intervening in the group process. Thus, it is essential to realize the different roles of silence in the ongoing learning process and educate facilitators and students in understanding the roles of silence in PBL facilitation in order to better facilitate or participate in the learning process.

As noted in Section 11.1.3, the average timing in turn taking in natural conversation in English is around one second (Jefferson, 1989), but it appears that longer silent episodes may be acceptable in PBL tutorials. From the two tutorial transcriptions reported here, the range was between 2 and 9 s. In studies of didactic teaching approaches, Nakane (2005) recommended that allowing

longer wait-time after questioning could improve the participation of Japanese students. Rowe (1974) had earlier suggested that increasing wait-time in instruction from around 1 s to 3–5 s improved the quality of participation in the class. Therefore, both facilitators and students need to consider the wait-time in discussion according to the situated context, in order to promote knowledge construction and effective group dynamics.

Moreover, as noted in the introduction, communicative competence (Jackson, 2005), lack of opportunity to practice oral English (Jackson, 2005; Littlewood et al., 1996; Tang, 2007), and cultural differences (Flowerdew & Miller, 1995; Lee, 1999), have been the main factors identified as resulting in students' silence in interaction. However, the context of the current study did not support these three factors as main obstacles for students in PBL tutorials. This EMI university in Asia, as a prestigious international university with a multicultural and multilingual community, has affirmed the important role of language in education, and recommended that English should be the *lingua franca* for all formal and informal communication throughout the university. One aim of the pedagogical approaches in this undergraduate dental curriculum is to encourage effective oral communication, and this is particularly enacted in PBL tutorials. In this study, all of the group members were ethnic Chinese with various educational backgrounds, including immersion in pretertiary and tertiary education in English-dominant countries. Therefore, the lack of opportunity to practice oral English and cultural difference may not be main factors affecting Chinese students' silence in PBL tutorials in this second-language context. As discussed earlier, it can be dangerous to over-generalize Asian students' silence. This study has taken up the call to understand individuals in situated contexts rather than as members of a cultural group (e.g., Cheng, 2000; Kubota & Lehner, 2004). Other factors, such as knowledge (Zhou et al., 2005), identity (Duff, 2002), power relations (Leki, 2001; Morita, 2004), and interpersonal relations (Cheng, 2000; Kubota & Lehner, 2004; Wong, 2004) should be considered to more fully explore spoken English interaction in higher education.

In addition to the roles of silence, it may seem obvious for those familiar with PBL curricula that in the above data the facilitator took up the role of "guide" and students took up an "active learning" ethos. The facilitator did not dominate the group interaction by controlling the turn-taking exchanges but rather accepted the defined PBL role and relinquished interactional control to the group process, giving the "floor" to students and thereby enabling co-construction of knowledge. In this study, students dominated collaborative discussions, and their talk flowed freely while focusing on the main issues while shifting across a series of interconnected topics. This finding is not consistent with many research studies on Chinese students in higher education (e.g. Jones, 1999; Littlewood et al., 1996), which were inclined to stereotype them as reticent and even passive participants during discussions. Analysis of data from this study indicates these participants to be highly active co-constructors of knowledge in an English-medium context. These students were skilled at

collaboration and handling conflict among group members in order to construct knowledge, set up mutual understanding, and work toward understanding the problem, in a cooperative and supportive way.

11.5 Conclusions and Limitations

In summary, in this discourse-based study of first-year dental PBL tutorials, findings reinforce previous studies that small-group discussion in PBL opens opportunities for students' knowledge construction, skills development, language engagement, and group collaboration in the rich-language environment. Analysis focusing on the issue of silence in spoken English interaction indicates that students' silence performs specific roles in group communication and learning. Data analysis indicates that silence is perceived and practiced not merely as a verbal disengagement, but importantly also as a productive resource, a collaborative practice, a platform for handling conflicting understandings, and a signal of shifting power relations.

The implications of this research are that these perceptions and practices of silence in spoken English interaction are likely to affect group dynamics and knowledge construction in PBL tutorials, particularly given the high level of knowledge and communicative demand in small-group learning in multilingual contexts.

The small sample size might limit the generalizability in this study, but these findings may resonate with small-group learning in other contexts.

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References

Bosse, H. M., Huwendiek, S., Skelin, S., Kirschfink, M., & Nikendei, C. (2010). Interactive film scenes for tutor training in problem-based learning (PBL): Dealing with difficult situations. *BMC Medical Education, 10*, 52.

Braddock, R., Roberts, P., Zheng, C., & Guzman, T. (1995). *Survey on skill development in intercultural teaching of international students*. Macquarie Unversity, Asia Pacific Research Institute.

Bridges, S., & Bartlett, B. (2009). Moving teachers: Public texts and institutional power. In R. Fitzgerald & W. Housley (Eds.), *Media, policy and interaction* (pp. 185–203). Farnham: Ashgate.

Bridges, S., McGrath, C., Yiu, C. K. Y., & Cheng, S. S. (2010). 'Reassuring' during clinical examinations: Novice and expert talk in dentistry. *Journal of Asian Pacific Communication, 20*(2), 185–206.

Brown, A. L. (1995). The advancement of learning. *Educational Researcher, 23*(8), 4–12.

Brumenfeld, P. C., Marx, R. W., Soloway, E., & Krajcik, J. S. (1996). Learning with peers: From small group cooperation to collaborative communities. *Educational Researcher, 25* (8), 37–40.

Caldas-Coulthard, C. R., & Coulthard, M. (Eds.). (1996). *Texts and practics: Readings in critical discourse analysis*. London: Routledge.

Carroll, D. (2000). Precision timing in novice-to-novice L2 conversations. *Issues in Applied Linguistics, 11*, 67–110.

Chan, S. (1999). The Chinese learner – a question style. *Education and Training, 41*(6/7), 294–304.

Cheng, X. (2000). Asian students' reticence revisited. *System, 28*, 435–446.

Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Education Research, 64*, 1–35.

Dauenhauer, B. P. (1980). *Silence: The phenomenon and its ontological significance*. Bloomington: Indiana University Press.

DeGrave, W. S., Boshuizen, H. P. A., & Schmidt, H. G. (1996). Problem-based learning: Cognitive and metacognitive processes during problem analysis. *Instructional Science, 24*, 321–341.

Dillenbourg, P., Baker, M., Blaye, A., & O'Malley, C. (1995). The evolution of research on collaborative learning. In E. Spada & P. Reimann (Eds.), *Learning in humans and machine: Towards an interdisciplinary learning science* (pp. 189–211). Oxford: Elsevier.

Dolmans, D., Wolfhagen, I., & Van Der Vleuten, C. (1998). Motivational and cognitive processes influencing tutorial groups. *Academic Medicine, 73*(10), S22–S24.

Duff, P. A. (2002). The discursive co-construction of knowledge, identity, and difference: An ethnography of communication in the high school mainstream. *Applied Linguistics, 23*(3), 289–322.

Fairclough, N. (1992). *Discourse and social change*. Cambridge: Polity Press.

Fairclough, N. (1995). *Critical discourse analysis: Papers in the critical study of language*. London: Longman.

Flowerdew, J., & Miller, L. (1995). On the notion of culture in L2 lectures. *TESOL Quarterly, 29*, 345–373.

Gass, S. M., & Mackey, A. (2000). *Stimulated recall methodology in second language research*. Mahwah, NJ: Lawrence Erlbaum Associates.

Grice, P. (1989). *Studies in the way of words*. Cambridge, MA: Harvard University Press.

Halth-Cooper, M. (2003). An exploration of tutors' experiences of facilitating problem-based learning. Part 2-Implications for the facilitation of problem based learning. *Nurse Education Today, 23*(1), 65–75.

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

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *The Interdisciplinary Journal of Problem-Based Learning, 1*(1), 21–39.

Jackson, J. (2002). Reticence in second language case discussions: Anxiety and aspirations. *System, 30*, 65–84.

Jackson, J. (2005). An inter-university, cross-disciplinary analysis of business education: Perceptions of business faculty in Hong Kong. *English for Specific Purposes, 24*(3), 293–306.

Jaworski, A. (Ed.). (1997). *Silence: Interdisciplinary perspectives*. Berlin: Mouton de Gruyter.

Jaworski, A., & Sachdev, I. (2004). Teachers' beliefs about students' talk and silence: Constructing academic success and failure through metapragmatic comments. *Language Power and Social Process, 11*, 227–246.

Jefferson, G. (1989). Preliminary notes on a possible metric which provides for a 'standard maximum' silence of approximately one second in conversation. In P. Bull & R. Derek (Eds.), *Conversation: An interdisciplinary approach* (pp. 166–196). Clevedon: Multilingual Matters.

Jones, J. F. (1999). From silence to talk: Cross-cultural ideas on students' participation in academic group discussion. *English for special purposes, 18*(3), 243–259.
Kubota, R., & Lehner, A. (2004). Toward critical contrasting rhetoric. *Journal of Second Language Writing, 13*, 7–27.
Kumaravadivelu, B. (2006). TESOL methods: Changing tracks, challenging trends. *TESOL Quarterly, 40*(1), 59–81.
Lam, C. M. H. (2006). Reciprocal adjustment by host and sojourning groups: Mainland Chinese students in Hong Kong. In M. Byram & F. Anwei (Eds.), *Living and studying aboard: Research and practice* (pp. 91–107). Clevedon: Multilingual Matters.
Lee, C. (1999). Learning through tutorial discussion and learners's culture: Some preliminary observations from the views of Hong Kong Chinese tertiary students. *Language, Culture and Curriculum, 12*(3), 255–264.
Legg, M. (2007). From question to answer: The genre of the problem-based learning tutorial at the University of Hong Kong. *English for Special Purposes, 26*(3), 344–367.
Leki, I. (2001). 'A narrow thinking stytem': Nonnative-English-speaking stduents in group projects across the curriculum. *TESOL Quarterly, 35*(1), 39–66.
Littlewood, W., Liu, N.-F., & Yu, C. (1996). Hong Kong Tertiary Students' attitude and proficiency in spoken English. *RELC Journal, 27*(1), 70–88.
Louis, K. S. (1982). Multisite/multimethod studies: An introduction. *American Behavioral Scientist, 26*(1), 6–22.
Markee, N. (2002). Language in development [Special issue]. *TESOL Quarterly, 36*(3), 265–274.
Morita, N. (2004). Negotiating participation and identity in second language academic communities. *TESOL Quarterly, 38*(4), 673–603.
Nakane, I. (2005). Negotiating silence and speech in the classroom. *Multilingua, 24*, 75–100.
Newman, D. R., Johnson, C., Webb, B., & Cochrane, C. (1997). Evaluating the quality of learning in computer-supported co-coperative learning. *Journal of the American Society for Information Science (1986–1998), 48*(6), 484–495.
Norton, B. (1997). Language, identity, and the ownership of English. *TESOL Quarterly, 31*(3), 409–429.
Pennycook, A. (1999). Introduction: Critical approaches to TESOL [Speical issue]. *TESOL Quarterly, 33*(3), 329–348.
Phillips, S. (1972). Participant structures and communicative competence: Warm Springs children in community and classroom. In B. C. Courtney, P. J. Vera, & D. Hymes (Eds.), *Functions of language in the classroom* (pp. 370–394). Prospect Heights, IL: Waveland Press.
Remedios, L., Clarke, D., & Hawthorne, L. (2009). The silent participant in small group collaborative learning contexts. *Active Learning in Higher Education, 9*(3), 201–216.
Rowe, M. B. (1974). Pausing phenomena: Influence on the quality of instruction. *Journal of Psycholinguistic Research, 3*, 203–224.
Sacks, H., Schegloff, E., & Jefferson, G. (1974). Simplest systematics for organization of turn-taking for conversation. *Language, 50*(4), 696–735.
Sajavaara, K., & Lehtonen, J. (1997). The silent Finn revisited. In A. Jaworski (Ed.), *Silence: Interdisciplinary perspective* (pp. 263–283). Berlin: Mouton de Gruyter.
Saville-Troike, M. (1985). The place of silence in an integrated theory of communication. In D. Tannen & M. Saville-Trioke (Eds.), *Perspectives on silence* (pp. 3–18). Norwook, NJ: Ablex Publishing Corporation.
Sturman, A. (Ed.). (1997). *Case study methods*. Oxford: Elsevier.
Tang, P. (2007). *A profile of new full-time undergraduate students 2006–2007*. Hong Kong: The University of Hong Kong.
Van der Linden, J., Erkens, G., Schmidt, H. G., & Renshaw, P. (2000). Collaborative learning. In R. J. Simons, J. Van der Linden, & T. Duffy (Eds.), *New learning* (pp. 37–54). Dordrecht: Kluwer.

Visschers-Pleijers, A. J. S. F., Dolmans, D. H. J. M., De Grave, W. S., Wolfhagen, H. A. P., Jacobs, J. A., & Van der Vleuten, C. P. M. (2006). Student perceptions about the characteristics of an effective discussion during the reporting phase in problem-based learning. *Medical Education, 40*(9), 924–931.

Visschers-Pleijers, A. J. S. F., Dolmans, D., de Leng, B., Wolfhagen, I., & van der Vleuten, C. (2006). Analysis of verbal interactions in tutorial groups: A process study. *Medical Teacher, 40*(2), 129–137.

Vye, N. J., Goldman, S. R., Voss, J. F., Hmelo, C., & Williams, S. (1997). Complex math problem-solving by individuals and dyads: When and why are two heads better than one? *Cognition and Instruction, 15*, 435–484.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press.

Wenger, E. (1998). *Communities of Practices: Learning, meaning and identity*. Cambridge: Cambridge University Press.

Wilkerson, L., Hafler, J. P., & Liu, P. A. (1991). A case study of student-directed discussion in four problem-based tutorial groups. *Academic Medicine, 66*(9), 79–81.

Winning, T., & Townsend, G. (2007). Problem-based learning in dental education: What's the evidence for and against... and is it worth the effort? *Australian Dental Journal, 52*(1), 2–9.

Wong, J. K. (2004). Are learning styles of Asian international students culturally or contextually based? *International Education Journal, 4*, 154–166.

Woodward-Kron, R., & Remedios, L. (2007). Classroom discourse in problem-based learning classrooms in the health science. *Australian Review of Applied Linguistics, 30*(1), 9.1–9.18.

Zhou, Y. R., Knoke, D., & Sakamoto, I. (2005). Rethinking silence in the classroom: Chinese students' experiences of sharing indigenous knowledge. *International Journal of Inclusive Education, 9*(3), 287–311.

Chapter 12
Getting on with Each Other: PBL Group Dynamics and Function

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12.1 Introduction

As clinical educators, we believe that problem-based learning (PBL) group dynamics are important because they underpin the collaborative learning and teamwork that prepares students for their clinical practice. The PBL small group is expected to support "the educational process; personal development for professional competence; [and] preparation for collaboration in professional teams" (Engel & Clarke, 1979, p. 78). It is the setting for the tutorial process, through which students collaboratively develop professional knowledge and problem-solving skills (Barrows, 1988; Engel & Clarke, 1979; Schmidt, 1989; Hmelo-Silver, 2004). Therefore, professional teamwork skills are an ideal outcome of PBL (Barrows, 2000; Boud & Feletti, 1991).

The importance of effective group dynamics is related to the constructivist and collaborative theoretical foundations of PBL. For example, PBL groups have been described as ideal constructivist learning environments due to their interactive nature (Savery & Duffy, 1995). Group discussion of problems increases the opportunities for prior knowledge to be drawn on, for cognitive elaboration (Schmidt, 1989, 1993), and for cognitive conflict, which stimulates motivation (Savery & Duffy, 1995; Schmidt, 1993). Also, the interpersonal processes of PBL groups are important for effective collaboration (Dolmans & Schmidt, 2006; Dolmans et al., 2005) and for students' enculturation to their future profession's ways of thinking and acting (Hmelo & Evensen, 2000; Loftus & Higgs, 2005).

Given the fundamental role of group dynamics in PBL, we have developed from the literature a profile of 'ideal' PBL group dynamics. Our conceptual ideal group includes a supportive and nonjudgemental 'emotional climate' (Tipping et al., 1995, p. 1051) that is a safe environment for learning (Barrows & Tamblyn, 1980). Group members should be cooperative and mutually

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supportive (Barrows & Tamblyn, 1980; Dolmans & Schmidt, 2006; Duek, 2000) and they ought to participate equitably in discussions (Barrows, 1988; Duek, 2000; Tipping et al., 1995). The conceptual ideal group ought to have a sense of team spirit or cohesion and members should feel responsible for group success (Barrows & Tamblyn, 1980; Duek, 2000; Dolmans & Schmidt, 2006; Tipping et al., 1995).

Investigations of group dynamics in health professions education have been a component of the PBL research agenda, often revealing that PBL groups in practice diverge from this conceptual ideal. For example, two studies using behavioural sciences criteria concerning effective groups reported noteworthy discrepancies between these criteria and the observed groups (Mpofu et al., 1998; Tipping et al., 1995). Further, the tutors and students gave divergent reports of group dynamics (Mpofu et al., 1998; Tipping et al., 1995) and in one study the observers' and the participants' reports also differed, leading to the conclusion that students were unable to evaluate their groups effectively (Tipping et al., 1995). The authors of both studies argued that it is important to elicit and understand students' experiences and understandings of group dynamics (Mpofu et al., 1998; Tipping et al., 1995).

Other researchers have drawn on tutors' and students' experiences to document problems in PBL groups (Hendry et al., 2003; Hitchcock & Anderson, 1997; Houlden et al., 2001). These investigations revealed that particular problems with group dynamics and processes were common across institutions and PBL settings. For example, issues such as dominance, passivity, interpersonal conflict and exclusion disrupted the equity of group processes (Hendry et al., 2003; Hitchcock & Anderson, 1997; Houlden et al., 2001). Consistent with an earlier report (Wilkerson et al., 1991), a recent study of group interactions and processes (Faidley et al., 2000) showed that groups could be tutor- or student-led, collaborative or dominated by a minority and not always equitable and conflict-free. Students performed perfunctory and limited reflection on their groups (Faidley et al., 2000), similar to the poor self-evaluation noted earlier by Tipping et al. (1995). Survey results in the Faidley et al. (2000) study showed a marked variation between groups in students' overall satisfaction with their group and varying levels of student satisfaction within some groups. In two ethnographic investigations of cross-cultural PBL groups in action, group dynamics were observed to be uneven and subject to dominance, exclusion and sometimes conflict (Duek, 2000; Remedios et al., 2008). The student interviews reported in these papers revealed different perceptions among group members about the nature and quality of their group's functioning, and showed that a range of personal, social and cultural factors influenced group dynamics (Duek, 2000; Remedios et al., 2008).

These research findings highlight the need to understand how students themselves interpret the dynamics of their PBL groups and the implications this has for PBL in clinical education. The study we discuss in this chapter was an ethnographic investigation of PBL groups that addressed the following research questions: What is the nature of PBL group dynamics for students?

How do students understand group dynamics to shape group function? To respond to the research questions, common features were drawn from students' accounts of their groups. We show how students described dynamics in terms of the interpersonal relationships and interactions between group members, and the resulting climate of the group as a whole. Then we show how students understood the way that group dynamics influenced how each group engaged in PBL tasks and so functioned as a work-team.

12.2 Methodology

The investigation was informed by social constructionist theory. The premise of constructionism is that '*all* meaningful reality, precisely as meaningful reality, is socially constructed' (Crotty, 1998, p. 55). Therefore, our concern was the meaning that PBL groups had for students, and we assumed that this was constructed through their activities and interactions. In keeping with this perspective, we undertook a naturalistic, qualitative investigation in the form of ethnography (Liamputtong & Ezzy, 2005). We designed a cross-site study in two dental schools with PBL-based curricula. The researcher (VS), who was not involved with teaching or assessing at either school, worked with students from day one of their first year in dentistry. The primary study took place in Australia and a smaller study in Ireland; each school has a 5-year programme and both curricula include a major component of PBL supported by other in-class learning experiences, such as laboratories and lectures. Ethics approval was granted by each institution. Australian groups were observed during the first semester (12 weeks) and students were interviewed in the second semester. Irish groups were observed throughout Michaelmas (first) term (10 weeks) and students were interviewed mid-term. The ongoing research and analysis was discussed regularly with the other authors (ABM, TW).

Participants were volunteer first-year undergraduate dental students, most school leavers, some with previous tertiary and/or work experience. Ages ranged from 17 to mid-30 with a modal age in both schools of 18. At both schools, students were randomly assigned to either participant or non-participant PBL groups; the composition of groups remained constant during the study. In Australia, four participant groups (in a total of 10 groups) were observed; three of the four were selected for confidential interview follow-up. In Ireland, two participant groups in a total of four were observed; students from both groups were invited for confidential interview follow-up. At each school, five students per group volunteered (Refer to Tables 12.1 and 12.2 for details of Australian and Irish interviewees, respectively).

VS observed each group for six complete PBL sessions over the semester/term and undertook informal observations with students between classes (e.g., accompanying students to the library). Field notes were written during PBL sessions and immediately after out-of-class activities. Individual interviews

Table 12.1 Australian interview participants

Participants	Total students	Local female	Local male	IS female	IS male
4 PBL groups observed	28	11	9	5	3
Interviewees[a], 5 from each observed group	15	7 Amy (S/L)[b] Angela Cathy (S/L) Diane (S/L) Julie (S/L) Paula Rosanne (S/L)	4 Bruce (S/L) Morgan Peter (S/L) Sam (S/L)	3 Alice (S/L) Carol (S/L) Ruth (S/L)	1 Martin (S/L)

[a]All names are pseudonyms
[b]S/L denotes school leaver on entry to dental school, others are mature-age entry or have transferred from another tertiary programme. 'Local' means Australian permanent resident; 'IS' means International Student, an overseas temporary student resident

Table 12.2 Irish interview participants

Participants	Total students	Local female	Local male	IS female	IS male
2 PBL groups observed	20	12	6	2	0
Interviewees[a], 5 from each observed group	10	5 Aileen (S/L)[b] Brigid (S/L) Deidre (S/L) Kerry (S/L) Maeve (S/L)	4 Brendan (S/L) Kevin (S/L) Hugh Liam (S/L)	1 Fiona (S/L)	

[a]All names are pseudonyms
[b]S/L denotes school leaver on entry to dental school, others are mature-age entry or have transferred from another tertiary programme. 'Local' means Republic of Ireland or UK permanent resident. 'IS' means International Student, an overseas temporary student resident

were semi-structured, recorded and professionally transcribed. Each student was asked to review his/her own transcript, amend it if desired and approve it for analysis. Data comprised typed-up observation field notes and student-approved interview transcripts. Data were analysed using an inductive analytical approach drawing on elements of grounded theory, by deriving themes and codes from the data and then linking them in explanatory concepts (Glaser & Strauss, 1967; Strauss & Corbin, 1994). For example, themes for student dynamics included (i) *Relationships*, which incorporated codes like *friendly*, *socially close* and *not close*; and (ii) *Interactions*, which incorporated codes like *helping, supporting* and *conflict*. These were used to relate the concept of *Group Climate* to *Group Function*.

12.3 Curriculum/PBL Context in Australia and Ireland

Both schools used the Maastricht 7-jump approach (Schmidt, 1989). In Australia, problems ran over 2 weeks, and students completed six problems in a semester. Australian groups had seven students and a facilitator. Each week the group nominated a scribe who recorded key information on a whiteboard. In Ireland, problems ran over 3 days, and each week students completed two and half problems. Irish groups had 10 students and a tutor. For each new problem, the group nominated a chair and secretary (the latter was a scribe). In Australia, students were expected to collaborate in class and also between classes on research and learning and produce a group report on their independent research; however, in Ireland, students were only required to collaborate in class; between classes they undertook research individually and no written work was required of groups. Australian students were assessed formatively with feedback by their tutor, and Irish students self-assessed for a PBL participation mark that contributed to 10% of their final grade for the year.

12.4 Group Stories from the Field

In this section we present the story of group dynamics in each of five PBL groups, three in Australia (code-named Blue, Red, Yellow) and two in Ireland (code-named Green, Purple). Pseudonyms are substituted for students' names. The account of the group stories is written in the first person singular to present both researcher's (VS) and students' experiences and perceptions. We show that each group had a unique set of interpersonal relationships that influenced group climate and function. From the separate group stories we illustrate how the social dimension shaped the work dimension in PBL groups.

12.4.1 Australian Blue Group: 'Different Wavelengths'

From the four observation groups, I chose Blue to interview because there was a coolness about the group that I could not interpret. Yet, PBL sessions seemed to proceed without conflict and whenever I spoke with the group they projected a team front. However, the five Blue interviewees described different and often contrasting experiences of group dynamics and perceptions of group function. They all portrayed Blue as unchanging after the brief, familiarising period when the group was new. Martin and Sam told me how friendly social relationships had enabled good working relationships and group function. In contrast, for Angela and Paula, poor social relationships disrupted group function. Alice described both of these aspects of Blue dynamics and function.

Both Martin and Sam used 'friendly' to describe the group and explained how this shaped it. Martin summarised Blue as 'a nice group, a nice collection of good characteristics', and Sam said 'Everyone fit well together'. They described an equitable and cooperative group, in which no one was 'shy' (Martin, Sam), 'it was all well balanced' (Martin) and 'no-one put down another person' (Sam). On the other hand, Angela and Paula said their conflict for leadership in PBL sessions had dominated their PBL group experience. Paula referred to '... a clash maybe in both Angela and I's personalities' and Angela said, 'Me and Paula always disagreed'. Paula believed PBL sessions were negatively affected by their poor relationship: 'It put strain on working with everyone because there was tension between us'. Paula also explained, 'I didn't really get along with the people in my group, they would not be people I would normally associate with socially'. Angela described the group climate as 'socially awkward' and explained this was due to her wariness about dominating discussions. Neither Martin nor Sam reported any conflict in Blue and both identified 'fun' and 'jokes' as positive aspects of Blue. Paula did not refer to fun, and Angela was disappointed by the lack of fun, 'I thought it would be a lot more fun because when I think group-work, I think fun'.

Alice's view of Blue links the disparate accounts into a complex picture. It is important to note that Alice was an International Student, which shaped her experience of PBL and the group. Alice said initially she was challenged by the contrast between her 'spoon-fed Asian schooling' and PBL, and she found speaking up difficult; however, she also said some Blue colleagues had supported her to speak, explaining, '... that's how you get friends'. This was a positive aspect of group dynamics for Alice, 'Once you get to know each other better, you can share your opinion because you are comfortable'. However, Alice noted, 'Some people didn't really like to be in the group, they just want to do the work, they don't care about the relationship'. Alice described this work-only focus as 'the sad thing' about Blue, 'We discuss more on the work and not really casual stuff, we do that once in a while, but it's not really like *friends*'.

All accounts of Blue group during out-of-class periods emphasised little contact or planning as key features of group function. However, judgements of Blue's success as a work-team varied. Martin and Sam, who expressed the most positive views of group dynamics, approved of Blue-group function. Martin explained, 'It was an easy working group, we enjoy it and do it the most convenient way'. Sam enjoyed his 'few commitments', compared to 'other groups who were much more rigid and had meetings and delegated tasks'. Angela said, 'We were quite laid back, happy because we knew it would fall into place'. However, she also called Blue 'unbalanced' due to the lack of workload planning. Alice, who saw Blue as fragmented when members were together, was disappointed with how Blue functioned between classes, 'My main issue with the work, we don't really do it together'. Paula, who had the most negative view of group dynamics, rated Blue function most poorly, calling the group 'un-united'. She told me 'We all weren't connected with each other, we never really communicated'. I had formed a similar impression of

non-engagement within the group; my field notes contained the following observation: 'I wasn't able to get a sense of what Blue group personality might be or even a sense of "groupness" or bonding about them'.

In summary, students' social experiences were the foundation for their work experiences of Blue: friendship supported engagement and absence of friendship underpinned disengagement.

12.4.2 Australian Red Group: 'We Became Functional'

I chose Red for interviews as they seemed to be organised and efficient and to other students they were a model group.

> Observation field notes, Semester 1
> My impression of Red as an organised, work-oriented group was reinforced by comments from other students about Red being a 'good group' and that they were really organised, e.g., a student from Blue referred to Red's organisation, 'We're a bad group, not like Julie's [i.e., Red] group'.

Red interviewees spoke of a major group development during the semester from negative to positive. Initially, Red struggled to function as a group because relationships were marred by the age difference between one older and six younger group members. Age was a barrier to rapport on both sides. Morgan, a mature-age student, highlighted the gap, 'The people I socialise with might not have the same level of intensity over what's on their iPod'. Differences in values and priorities created problems. For example, group members disagreed with Morgan over meetings and deadlines: the issue was work-life balance. Diane said, 'We got really annoyed, we said, "*Listen, we've got better things to do*" '. Rosanne explained, 'He's got his life, at home, with his family, his partner, whatever. We've got our life with our friends, it's different'. Morgan also found it frustrating working with people who had different priorities and values, 'People value their own free time more than they value the PBL experience'. Ruth, was an International Student (IS) who experienced Red from a similar perspective to IS Alice in Blue (refer Section 12.4.1), which Ruth also attributed to 'spoon-feeding' in her Asian education. However, Ruth told a story similar to that of other Red interviewees about the group's social and functional problems due to age differences. These difficulties were exacerbated by Morgan's efforts to lead the group. He explained that he used his experience to model good practice, 'Early on I tried to lead the group in order to empower them'. However this was interpreted differently: Ruth said '. . .he would want to take control of everything', while Diane felt that her input was 'shunned'. Students used words like 'annoyed' (Diane, Julie, Rosanne), 'frustrated' (Julie, Rosanne) and 'intimidated' (Julie, Rosanne, Ruth), to describe their reactions. Their words recalled my reaction to the first PBL session, when I noted that it would be interesting to see how the group developed, since, although he appeared 'well-intentioned', Morgan had 'dominated' the discussion.

Although Red was initially 'non-functional' (Morgan), these issues were eventually resolved. Julie explained how she confronted her colleagues on this problem: 'I thought it was important that the group become more cohesive and we worked well together, and I put it all forward because we weren't'. The group held a special meeting to negotiate a structured approach to group-work. Interviewees agreed unanimously that this was beneficial and members spoke to me with pride about their group's success. Julie called it '... a turning point', Diane believed that, 'what came out of it was really good', and Ruth said the group became more 'focussed' and 'organised'. Rosanne explained, '... then it was to a set agenda and everyone pulled their weight'. Morgan summarised progress: '... then we became reasonably good at what it was we were trying to do'.

A corollary was a positive change in group climate. Julie said, 'After that point it just sort of smoothed over slightly and we started working better, as a team'. The group became more cohesive because everyone could contribute: 'we all had a part to play' (Diane). Another issue addressed at the meeting was group relationships. Julie had proposed, 'Let's keep it just purely work-related rather than we're there with friends'. In the interest of getting the work done, Red developed functional, work-only relationships. Ruth explained that, 'because we weren't really friends outside classes, it was kind of a very formal interaction'. Diane called it '... just meeting up, not with strangers, but people that you don't generally hang out with'. So in Red, as in Blue, students' social experiences were the foundation for their work experiences but Red group addressed their difficulties. However, in spite of the group's work success, the four younger interviewees expressed regret about the lack of social rapport in their group.

12.4.3 Australian Yellow Group: 'We All Agree'

During observations I noted that there was a lot of talk and laughter in Yellow but mostly from a sub-group of four students, while the other three students were generally quieter. I selected Yellow for interview to explore this further. All five interviewees said that Yellow was cooperative and conflict-free. Interviewees described Yellow dynamics and function as similar in class and out of class and mostly constant over the course of the semester.

Interviewees Amy, Cathy and Peter were part of the talkative sub-group for whom social interactions blended with and sometimes overtook work discussions. Amy said, 'We were quite close with the people that we did our PBLs with, it turned into a real social affair and I think it was the combinations of people'. Yellow climate was described as relaxed, fun and free of conflict. For Cathy, 'It was a happy, friendly atmosphere, there were no disagreements'. Peter said, 'I was pretty happy to be in that group, we all seemed to cooperate pretty well, no disagreements, just jokes and things like that, it was good fun'. One of the 'quiet' students, Bruce, did not refer to friendship, but he evaluated Yellow climate and function positively. Bruce spoke of 'fun' interactions during

PBL sessions, and described Yellow as '... laidback, because we don't argue with each other'. Bruce explained that his quietness was partly his personality and partly his choice.

However, Carol, an International Student, had a different experience of Yellow:

> Carol: Sometimes I was embarrassed because I couldn't one hundred percent enjoy the discussion. This was because some of the others were close and friendly all the time and with PBL I got nervous, maybe this was because I wasn't close friends with the group.

When I asked if she meant she couldn't enjoy the work or social discussion, she replied 'Both'. Carol told me (and I had noted this), that the local students unintentionally excluded her; they spoke rapidly and left no time or breaks for her to enter the discussion. However, they were unaware of their role in Carol's quietness, and attributed it to her personality and a problem with English (Cathy said 'Even in the first session we knew she was a quiet one') and they tried to include her in the group. Peter explained how they would periodically 'stop and actually ask the more passive people for their input' and Amy said that Peter used humour to involve Carol.

In spite of this 'iceberg' social problem, group members engaged and had a sense of reciprocity as a work unit. Carol said a feature of the group was '...supporting and helping each other'. Cathy explained, 'Researching as a group, everybody was really helpful'. Peter told me that when it came to turn-taking at writing the group report, 'We all trusted each other to fulfil their role when it came to that time'. Bruce explained, 'You could be really lazy if it wasn't your turn but when it did come to your turn everyone was actually quite hard-working'. Members could depend on each other: Carol said 'We knew somebody would come up with something'. Both Cathy and Amy used the word 'rely' in connection with group-work in Yellow. To conclude, despite general goodwill among members, Yellow was a site of social exclusion for at least one member. However, this goodwill generated a climate of support and trust for Yellow as a work unit.

12.4.4 Irish Green Group: 'The Loud Group'

PBL sessions in Green were very noisy. There was a lot of laughter and each week the same students spoke and the same three or four students said little. One of the students in Green said to me one day, 'We're the loud group'. All five interviewees from Green group associated the nature of interpersonal relationships with group climate and function but not all members' experiences were positive. Four female interviewees had positive experiences of Green. As in Australia, students described an initial period when 'people were shy and nervous because they weren't comfortable' (Aileen). However, Kerry said, 'Once you get to know each other it's better'. These four interviewees perceived that in Green everyone could freely express their views, which I was interested

to hear because I noted that while three of them (Aileen, Brigid and Fiona) generally spoke up, one (Kerry) usually said much less. Kerry told me, 'It's like sitting down with a group of friends and discussing something'. Fiona said Green had a 'friendly environment'. Students said group members were willing to help each other by explaining. As Fiona said, 'It's good, it's nice, when you don't understand something the others in the group will actually explain'. Brigid attributed this support to Green being 'a really nice group'. However, the only male interviewee, Liam, was a social outsider. He also wanted to establish social rapport and feel comfortable about participating but this did not happen. Liam said he was apprehensive about contributing because of the group climate. He described it as 'cliquey' and said 'it makes me feel uncomfortable', which was the reason for his non-participation: 'That's why I stay out of it now and I've barely been saying anything'.

In summary, the social dynamics of Green group shaped its work function. Students who enjoyed positive social relationships also engaged readily in group PBL discussions. However, the student who felt socially ostracised did not engage in work discussions and he believed that group function in PBL was disrupted by the social alliances in the group.

12.4.5 Irish Purple Group: 'We Get Along Well'

The mood in Purple was generally upbeat, and although there was uneven participation, there was not the sense of rowdiness that I had noted in Green. The pattern of climate development in Purple was similar to Green, except none of my interviewees positioned themselves as a social outsider, although one student (Maeve) described herself as quiet and shy. All five interviewees said the key features of Purple dynamics were getting along with each other and enjoying working in that particular group. Students appeared to be comfortable and the mood was usually light-hearted. Only Deidre, who was one of the most vocal members, spoke of any initial awkwardness in 'the new group'. Of group relationships, Kevin told me 'We get along well' and Maeve said 'Everyone gets along really well and no one thinks little of anyone else in the group'. Hugh described Purple as 'a friendly bunch' and concluded, 'I'm happy with my group'. Brendan said he found it 'enjoyable' being part of Purple. Deidre said 'I *do* really like our group, I couldn't imagine being in a different group'. Purple interviewees also described a cooperative environment in which members endeavoured to help each other. Maeve said that, 'If I don't understand it, I'm going to get someone in our group to explain it to me when we are all talking about it'. Hugh explained that 'It's great because they're actually, in a way they're kind of teaching me as well'. Brendan also enjoyed helping his colleagues, 'It's like the reward of being a teacher'. As observer, I sensed Purple had readily become a team. Students engaged in PBL group discussions, encouraged each other to join in and took turns at explaining material.

In summary, the relationship between dynamics and function and the social and the work aspects of Purple group was similar to that of Green group: social relationships determined working interactions and influenced how group members engaged during PBL discussions.

12.5 Discussion

Based on this picture of group dynamics and function in Australia and Ireland, in this section we describe a model of an ideal student group with respect to (i) group climate and relationships and (ii) team spirit and engagement. We discuss this student group model in relation to other research findings and the ideal group dynamics (the 'conceptual ideal group') that we presented in the introduction. Then we provide an explanation for student group dynamics that draws on functional group theory. Finally, we consider the limitations of the study and some implications for practice with respect to student development activities.

The Australian and Irish students preferred groups to have a supportive social climate for PBL. This ideal group climate arose from friendly group relationships, which were important because if members felt socially comfortable with colleagues they could speak out about the PBL problem, share their opinions and contribute to discussions; otherwise they felt intimidated. Students also valued a cooperative, conflict-free group for PBL, which interviewees described as being helpful and not having disagreements; cooperation and absence of conflict were also associated with social ease. The ideal climate was also illustrated when students spoke of its opposite, using terms like uncomfortable, tense or lacking fun; these aspects of group climate were related to being not socially close. If students were unable to establish friendships, or at least some social rapport, this disrupted the working climate.

Other researchers have reported that students value a comfortable and supportive group climate. The emotional climate of the group (support, cooperation and acceptance) has been identified as an important part of PBL groups in a number of studies with junior medical students (Tipping et al., 1995; Virtanen et al., 1999; Willis et al., 2002). Students wanted a safe environment free from fear of feeling 'stupid' (Virtanen et al., 1999, p. 272). Junior medical students who described the 'essential characteristics' of PBL, frequently included in their lists 'group getting on' and 'good group dynamics' (Maudsley et al., 2008, p. 439). None of these studies addressed the social aspect of the group in depth. In a study with mature PBL students, who were academics and also doctoral and masters students, participants also expressed a desire for a 'safe' environment (Cockrell et al., 2000). However, among these more experienced students, this was driven by the need to form effective learning teams rather than for personal comfort (Cockrell et al., 2000). Little has been reported about the social element or interpersonal relationships in PBL groups apart

from a few unelaborated references to personality differences being a type of group problem (de Grave et al., 2001; Hendry et al., 2003; Hitchcock & Anderson, 1997). No other studies to date have explored interpersonal relationships in PBL groups.

Our students' ideal and our conceptual ideal groups have similar climates but quite different rationales. The conceptually ideal climate matches the students' ideal in a number of respects: it is a supportive, safe atmosphere, free of judgement, which allows open expression. For example, Barrows and Tamblyn (1980, p. 73) said that no one would be 'censured, criticized or marked down for making naïve or "dumb" statements'. However, a distinct difference was that, for the students, 'safety' meant social comfort, whereas from the theoretical perspective safety was intended to optimise the PBL process and problem investigation. A further difference was the notion in the students' ideal of an enjoyable climate and fun in learning, which is not part of our conceptually ideal group climate. The literature has little to say about how this ideal group climate is achieved, or about ideal group relationships. Only Barrows (1988) has explicitly emphasised the importance of relationships. He made the point that learning to think and behave as novice professionals involved learning to establish professional working relationships.

> [Students] must learn to deal with interpersonal dynamics throughout their professional careers as they will inevitably have to work with people with whom they may not naturally get along well (Barrows, 1988, p. 12).

Barrows' conception of professional group relationships is comparable to the later sociocultural ideal of the PBL group as a site of professional enculturation (Hmelo & Evensen, 2000; Loftus & Higgs, 2005), in which the development of professional relationships between group members is implicit. This is markedly different from the understandings that the Australian and Irish students had of group relationships; for them, the issue of getting along was more a personal than a professional matter. The distinct difference between the students' ideal and our conceptual ideal is particularly illustrated by one group in our study. On the surface, Red group in Australia was more like the conceptual ideal of a professional work-group: after some interpersonal and work-related dysfunction, the group developed work-only relationships and became functional. However, the younger members were disappointed at having to operate under these 'purely work-related' conditions.

Team spirit was also an important feature of group dynamics. In our students' ideal group, team spirit was associated with belonging, which was expressed as happiness or liking one's particular group, and it underpinned group members' engagement as a work-team. A sense of belonging was expressed by students who related well to their group colleagues, while those who experienced social friction did not speak of belonging or sharing the group spirit. This is illustrated by the majority of local students whose friendship underpinned their bonding (in Yellow, Green and Purple) and by those few students for whom interpersonal difficulties led to their being outsiders (in Blue,

Red and Green). It was also the case for the three Australian International Students. One IS (in Blue) bonded socially with some group colleagues and had a sense of belonging, but the other two ISs (in Red and Yellow) did not integrate socially. So, although they were part of the work team they felt excluded from complete (i.e. work *and* social) belonging to the group. The social nature of team spirit in the student groups was also emphasised by the case of Red group in Australia. Although cohesion (as group pride) developed in the absence of friendships it was a disappointing substitute for social belonging. The team spirit of each Australian group also shaped members' commitment to each other out of class. Blue group had a form of limited commitment requiring minimal obligation, Red had a sense of collective work-based responsibility for the group's success, and Yellow team spirit was based on interpersonal goodwill and commitment.

A similar result concerning the link between team spirit and the social dimension of PBL groups has been reported by Faidley et al. (2000) in their investigation of group processes. In their study, the group with the highest overall satisfaction rating had the highest rating of commitment and accountability and the lowest level of conflict; the opposite held true for the group with the lowest satisfaction rating. Observations of each group suggested that the highly satisfied group had positive interpersonal relationships, while the least satisfied group was dominated by interpersonal tension between two members. Faidley et al. (2000, p. 127) concluded 'that it might be the tension created by the conflict between the two dominant male members of the group that contributed to dissatisfaction with the process'.

Regarding team spirit, the surface form in both the students' and our conceptual ideals are similar, however, the underlying rationale is different (as was the case for group climate). The theoretical ideal of team spirit comes from collaborative learning theory, which has been applied to PBL: team spirit or 'cohesion' is described as commitment or bonding between group members for its own sake (Dolmans & Schmidt, 2006; Dolmans et al., 2005). That is, theoretical cohesion means that members are committed to the group for the group's task success, regardless of the social nature of the group. In contrast, the students' ideal group developed team spirit or cohesion because members had bonded socially. In fact, our investigation showed that for the young undergraduate dental students in the study, the line between the group social climate and working cohesion was indistinct. It is possible that they brought to tertiary education school-based expectations of working in friendship groups.

To explain the discrepancies between the students' ideal and our conceptual ideal group, we suggest that students construct their PBL groups using a lay form of functional group theory. Functional theory aims to explain or predict group success or failure and the cornerstones of the approach are that groups actively work towards goals and that this can be evaluated (Poole et al., 2004). Group goals can either include the group's task or they may be 'social-emotional' and so oriented towards meeting members' needs (Wittenbaum et al., 2004, p. 19). The relationship between process and goals is described as

the sum of inputs and outputs, which include task, environment and group composition, structure and cohesiveness, while outputs include task achievement, leadership and satisfaction with group outcomes (Poole et al., 2004; Wittenbaum et al., 2004). This relationship is understood to be linear, so that inputs influence group interactions and this influences group success (Wittenbaum et al., 2004).

The Australian and Irish groups were goal oriented in that they had to undertake PBL activities. However, groups also had the social-emotional goal of providing support to group members. The functional input factors, group composition and cohesiveness were embedded in students' explanations of their groups. Students' understanding of group composition as an explanatory concept was deterministic in that composition, or particular combinations of member personalities, determined group cohesiveness (via the social relationships in the group). To evaluate group performance in functional theory, normative standards are usually adopted on the basis of a 'rational model', and often relate to the efficiency or effectiveness of the group (Wittenbaum et al., 2004, p. 19). Students used both normative and personal standards to evaluate their groups. Normative standards referred to the group's performance as a work team in relation to the goal of being a PBL group. Yet individual students also evaluated their group using personal standards in relation to the extent to which it supported them or satisfied their social-emotional needs. This latter evaluation ultimately shaped their experience of their PBL group and PBL because of the fact that the work unit developed out of the social unit.

The socioemotional aspect of the group has implications for how we implement PBL. The social dimension of any group is considered necessary for providing a sense of 'emotional involvement' and enjoyment for members (Knowles & Knowles cited in Jaques & Salmon, 2007, p. 32). Psychodynamic theory acknowledges the importance of the emotional aspect of groups in meeting members' needs (Poole et al., 2004). From this perspective, an important positive function for the small group to fulfil is to enable member belonging (Jaques & Salmon, 2007). However, group theorists recommend that the social and task dimensions ought to be in dynamic equilibrium according to the group's needs at any time (Jaques & Salmon, 2007; Johnson & Johnson, 2006). Yet, for undergraduate students (many of whom were young school leavers), the social dimension of the group and friendship and enjoyment were of primary importance, sometimes at the expense of task dimension success. Further, the social alliances that can form on the basis of members liking or disliking each other can lead to members agreeing or disagreeing with others on the basis of friendships rather than reason (Jaques & Salmon, 2007; Johnson & Johnson, 2006). This can be a double-edged sword leading to harmony and/or conflict. In a highly cohesive friendship group, the resulting 'groupthink' means that constructive conflicts are avoided to preserve harmony (Wittenbaum et al., 2004, p. 25), which is incompatible with the constructivist basis of PBL. This is

inconsistent with the view of some students in this study, for whom a hallmark of a good group was 'no disagreements'.

This study is an account of the meaning of PBL group dynamics and function for first-year dental students in two schools and focused on students' accounts of group relationships, climate and engagement. However, as with all research, it is a partial account and it is silent on other aspects of groups and so raises issues for further investigation. For example, we did not explore culture in depth and did not address gender. We also did not address student or group outcomes or attempt to relate engagement to outcomes. Further, we only considered students' constructions of group dynamics; we did not address how tutors and other staff and the wider culture in each school contributed to groups.

Nonetheless, the study raises important issues for implementing PBL in clinical education and for how we develop staff and students. Our study illustrated how poor social integration in groups was related to poor working engagement among first-year undergraduate students. Given the crucial role of the social and interpersonal dimension of group dynamics in group function, it is important that PBL tutors and students are able to understand and manage the interpersonal aspect of groups. The central issue is that young undergraduate students need to be explicitly supported to establish professional working relationships in teams. While it is outside the scope of this chapter to provide detailed practice suggestions, key aspects that should be addressed include team-building and personal development activities before groups start working on PBL problems, followed by PBL problems that also address professional interpersonal relationships and communication; group activities that address the socially constructed imbalances in groups and link this to the knowledge, skills and understanding required by an effective health professional, including cross-cultural awareness activities; and sessions that address leadership and what leaders do, linked to professional situations. The findings also highlight the ongoing sociocultural role of the tutor in explicitly modelling professional relationships and behaviour. Although health professions education curricula are often crowded, overlooking this aspect of PBL groups could jeopardise the ability of the groups to become effective professional teams.

12.6 Conclusion

Through these group stories we have shown that the social element of PBL groups was very important for first-year undergraduate students. Their groups were primarily social units that subsequently became work units, and for this reason, the social relationships shaped the group climate and team spirit, which influenced how students engaged and worked together in PBL. We have shown that students operated with understandings of group dynamics that were inconsistent with the theoretical underpinnings of PBL groups. Therefore, we suggest

that, to maximise students' personal, professional and academic experience from PBL groups, young undergraduate students need to be assisted to develop or even change their concepts of teams so that PBL groups can engage effectively in PBL.

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References

Barrows, H. S. (1988). *The tutorial process*. Springfield, IL: Southern Illinois University.

Barrows, H. S. (2000). *Problem-based learning applied to medical education*. Springfield, IL: Southern Illinois University.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning*. New York: Springer.

Boud, D., & Feletti, G. I. (1991). Introduction. In D. Boud & G. I. Feletti (Eds.), *The challenge of problem-based learning* (pp. 13–20). London: Kogan Page Limited.

Cockrell, K., Caplow, J. A., & 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.

Crotty, M. (1998). *The foundations of social research*. Crows Nest, NSW: Allen & Unwin.

de Grave, W. S., Dolmans, D. H. J. M., & van der Vleuten, C. P. M. (2001). Student perceptions about the occurrence of critical incidents in the tutorial group. *Medical Teacher, 23*(1), 49–54.

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

Dolmans, D. H. J. M., & Schmidt, H. G. (2006). What do we know about cognitive and motivational effects of small group tutorials in problem-based learning? *Advances in Health Sciences Education, 11*(4), 321–336.

Duek, J. (2000). Whose group is it, anyway? Equity of student discourse in problem-based learning (PBL). In C. E. Hmelo & D. H. Evensen (Eds.), *Problem-based learning: A research perspective on learning interactions* (pp. 75–108). Mahwah, NJ: Lawrence Erlbaum Associates.

Engel, C. E., & Clarke, R. M. (1979). Medical education with a difference. *Programmed Learning and Education Technology, 16*(1), 70–87.

Faidley, J., Evensen, D. H., Salisbury-Glennon, J., Glenn, J., & Hmelo, C. E. (2000). How are we doing? Methods of assessing group processing in a problem-based learning context. In C. E. Hmelo & D. H. Evensen (Eds.), *Problem-based learning: A research perspective on learning interactions* (pp. 109–138). Mahwah, NJ: Lawrence Erlbaum Associates.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine Publishing.

Hendry, G. D., Ryan, G., & Harris, J. (2003). Group problems in problem-based learning. *Medical Teacher, 25*(6), 609–615.

Hitchcock, M. A., & Anderson, A. S. (1997). Dealing with dysfunctional tutorial groups. *Teaching and Learning in Medicine, 9*(1), 19–24.

Hmelo, C. E., & Evensen, D. H. (2000). Introduction. In C. E. Hmelo & D. H. Evensen (Eds.), *Problem-based learning: A research perspective on learning interactions* (pp. 1–18). Mahwah, NJ: Lawrence Erlbaum Associates.

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

Houlden, R. L., Collier, C. P., Frid, P. J., John, S. L., & Pross, H. (2001). Problems identified by tutors in a hybrid problem-based learning curriculum. *Academic Medicine, 76*(1), 81.

Jaques, D., & Salmon, G. (2007). *Learning in groups* (4th ed.). London and New York: Routledge.

Johnson, D. W., & Johnson, F. P. (2006). *Joining together* (9th ed.). Boston: Allyn and Bacon.

Liamputtong, P., & Ezzy, D. (2005). *Qualitative research methods*. Melbourne, VIC: Oxford University Press.

Loftus, S., & Higgs, J. (2005). Reconceptualising problem-based learning in a Vygotskian framework: Focus on health professional education. *A Multi-disciplinary Journal, 7*(1), 1–14.

Maudsley, G., Williams, E. M. I., & Taylor, D. C. M. (2008). Problem-based learning at the receiving end: A 'mixed methods' study of junior medical students' perspectives. *Advances in Health Sciences Education, 13*(4), 435–451.

Mpofu, D. J. S., Das, M., Stewart, T., Dunn, E., & Schmidt, H. (1998). Perceptions of group dynamics in problem-based learning sessions: A time to reflect on group issues. *Medical Teacher, 20*(5), 421–427.

Poole, M. S., Hollingshead, A. B., McGrath, J. E., Moreland, R. L., & Rohrbaugh J. (2004). Interdisciplinary perspectives on small groups. *Small Group Research, 35*(1), 3–16.

Remedios, L., Clarke, D., & Hawthorne, L. (2008). The silent participant in small group collaborative learning contexts. *Active Learning in Higher Education, 9*(3), 201–216.

Savery, J. R., & Duffy, T. M. (1995). Problem-based learning: An instructional model and its constructivist framework. *Educational Technology, 135*(5), 31–38.

Schmidt, H. G. (1989). The rationale behind problem-based learning. In H. G. Schmidt, M. J. Lipkin, M. W. de Vries, & J. M. Greep (Eds.), *New directions for medical education* (pp. 105–111). New York: Springer.

Schmidt, H. G. (1993). Foundations of problem-based learning: Some explanatory notes. *Medical Education, 27*(5), 422–432.

Strauss, A., & Corbin, J. (1994). Grounded theory methodology: An overview. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 273–285). Thousand Oaks, CA: Sage.

Tipping, J., Freeman, R. F., & Rachlis, A. R. (1995). Using faculty and student perceptions of group dynamics to develop recommendations for PBL training. *Academic Medicine, 70* (11), 1050–1052.

Virtanen, P. J., Kosunen, E. A. L., Holmberg-Marttila, D. M. H., & Virjo, I. O. (1999). What happens in PBL tutorial sessions? Analysis of medical students' written accounts. *Medical Teacher,* 21(3), 270–276.

Wilkerson, L., Hafler, J. P., & Liu, P. (1991). A case study of student-directed discussion in four problem-based tutorial groups. *Academic Medicine, 66*(9), S79–S81.

Willis, S. C., Jones, A., Bundy, C., Burdett, K., Whitehouse, C. R., & O'Neill, P. A. (2002). Small-group work and assessment in a PBL curriculum: A qualitative and quantitative evaluation of student perceptions of the process of working in small groups and its assessment. *Medical Teacher, 24*(5), 495–501.

Wittenbaum, G. M., Hollingshead, A. B., Paulus, P. B., Hirokawa, R. Y., Ancona, D. G., Peterson, R. S., Jehn, K. A., & Yoon, K. (2004). The functional perspective as a lens for understanding groups. *Small Group Research, 35*(1), 17–43.

Chapter 13
PBL Tutorials in a Hybrid Curriculum: Opportunities and Challenges

Sigrid Harendza, Olaf Kuhnigk, Franziska Puttnies, and Sven Anders

13.1 Introduction

Problem-based learning (PBL) appears to have a large and potentially long-lasting impact on self-directed learning, which is a required skill in the medical profession (Norman & Schmidt, 1992). Furthermore, students learning in PBL curricula have been reported to show better clinical performances during clerkships (Distlehorst, Dawson, Robbs, & Barrows, 2005) and acquire better psychosocial competencies compared with students from a conventional medical school (Schmidt, Vermeulen, & van der Molen, 2006). Meanwhile, problem-based tutorials have been widely applied in medical education, either as part of problem-based curricula or as a teaching format in hybrid curricula (Kinkade, 2005). Especially in hybrid PBL programs the quality of student learning seems to depend on PBL tutors being effective in their role (Dolmans, Gijselaers, Moust, de Grave, Wolfhagen, & van der Vleuten, 2002). Other factors like the importance of PBL as part of a hybrid curriculum, the structure of the PBL case and its alignment with the rest of the curriculum, and the assessment of PBL have also been identified as being important for the quality of PBL in a hybrid medical curriculum (Chan, 2009).

It is well described that PBL groups facilitated by effective tutors function well and therefore have high levels of academic achievement (Schmidt & Moust, 1995). In this study, three tutor qualities correlated with good tutorial group functioning, increased students' self-study time, and improved marks in end-of-unit tests: the possession of a suitable knowledge base, a willingness to become involved with students in an authentic way, and the skill to express oneself in a language understood by students. A recent study demonstrated that faculty development programs may need to engage tutors in thinking about how they develop as teachers, and in particular to encourage them to solicit their own face-to-face student feedback to help them to become more effective in their

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tutorial role (Hendry, 2009). Another study showed that novice tutors valued discussions with a mentor before and after tutorial sessions, and learned about tutoring by storytelling (Jung, Tryssenaar, & Wikins, 2005).

13.2 Learning Outcome of PBL Groups

A couple of years ago the use of qualitative studies of problem-based tutorials was proposed because they could help to elucidate the factors that contribute to the desired and successful outcomes of PBL groups (Hak & Maguire, 2000). However, a recent study demonstrated that students' self- and peer-assessment alone may not be an accurate measure of the PBL tutorial process (Machado, Machado, Grec, Bollela, & Vieira, 2008). In this study, the peer- and self-assessment marks were quite reliable but not very valid for the assessment of the tutorial process, because they were consistently greater than the tutors' scores. It has also been demonstrated that the tutor's performance has a direct influence on tutorial group functioning (van Berkel & Schmidt, 2000). For instance, non-medical tutors were observed to facilitate the group process more often than medical tutors, since the medical tutors set out to raise students' awareness by using questioning techniques, whereas the non-medical tutors expected students to question each other (Gilkison, 2003). Hence, a closer look at tutors' performances and at the structure and process of PBL tutorials seems to be necessary when the learning outcome of PBL groups is evaluated.

13.3 The Structure and Process of PBL Tutorials

PBL tutorials are generally introduced within the context of a defined core curriculum (hybrid or non-hybrid). Usually, paper-based PBL scenarios form the content basis of the PBL tutorial and ensure that all students are exposed to the same problems as a starting point of the learning experience. Modified techniques have also been introduced with "real" patients being used as the stimulus for learning (Dammers, Spencer, & Thomas, 2001). A typical PBL tutorial consists of a group of students (usually 8–10) and a tutor, who facilitates the session (Wood, 2005). The length of time and number of sessions that a group stays together with each other and with individual tutors varies between institutions (Segouin et al., 2007; Matsui et al., 2007; Conolly & Seneque, 1999). Tutorial rooms should be available in sufficient number and equipped with suitable materials (e.g., flip charts, whiteboards) to record the proceedings of each session (Davis & Harden, 1999).

At the beginning of each session students select a chair and a "scribe" to record the discussion and the learning objectives. Sometimes the role of a "time keeper" is assigned separately. The outline of PBL tutorials is often modeled on

Table 13.1 The seven steps in PBL

Step	Task for students and the tutor
1	Students, working in a group, clarify the text of the problem scenario
2	Students define the problem
3	Brainstorming is used to identify explanations for phenomena observed in the problem scenario
4	The group reaches interim conclusions about the problem
5	The group formulates the learning objectives
6	Students work independently for 1 week to achieve learning outcomes
7	The student group reconvenes to discuss the learning objectives to monitor the acquired knowledge

Source: Adapted from Davis and Harden (1999)

the Maastricht "seven jump" process (Table 13.1) (Davis & Harden, 1999), but its format of seven steps is sometimes shortened. At the start of the session, depending on the trigger material, the chair or another student reads out the scenario. After unfamiliar terms are clarified (step 1) problems are discussed and defined (step 2). "Brainstorming" follows (step 3) including suggestions of possible explanations on the basis of prior knowledge. In step 4, steps 2 and 3 are reviewed and explanations are arranged into tentative solutions. Then the group formulates consensual learning objectives (step 5). The sessions usually ends with a short "flashlight" evaluation round on group process and content which is followed by a phase of private study, mostly 1 week (step 6). At the beginning of the next session or in a separate session, the group shares the results of the private study regarding all learning objectives agreed on in the previous session (step 7). The discussion of learning objectives covers a wide range from free talks to power point presentations and handouts depending on the agreement within the individual tutorial group.

13.4 The Role of a PBL Tutor

While the primary role of a PBL tutor is to ensure students' engagement in self-directed learning within the tutorial setting as a facilitator and guide, he or she should also be able to identify issues within or outside the tutorial setting that impact on learning (Chan, 2008). Other studies confirm that contextual factors, such as case features and structure of a curriculum, have an impact on the way tutors behave in the PBL group (Gijselaers, 1997; Dolmans, Wolfhagen, & van der Vleuten, 1996). Several tutor evaluation instruments have been described in the literature. De Grave (de Grave, Dolmans, & van der Vleuten, 1998) and Dolmans (Dolmans, Wolfhagen, Scherpbier, & van der Vleuten, 2003) developed and validated tutor evaluation questionnaires in which students are asked to rate the performance of the tutor on several dimensions. These questionnaires produced reliable and valid data if at least six student responses were available for one tutor. However, the instruments are quite long, and if students

are asked on a regular basis to evaluate their tutorials, they become "tired" of filling out these questionnaires. Hence, a new instrument consisting of only 11 statements covering five dimensions (active learning, self-directed learning, contextual learning, collaborative learning, and intrapersonal behavior) was developed with good validity and reliability regarding the desired parameters (Dolmans & Ginns, 2005).

Early studies suggest that students need a minimum level of structure in order to profit from PBL tutorials (Schmidt, 1994). This structure was either provided through prior knowledge by the participating students, or offered by the environment in the form of relevant cues. If prior knowledge fell short, or if the environment lacked structure, students returned to their tutors for help and direction. Under those conditions, students who were guided by a subject-matter expert tutor benefited more than students guided by a non-expert staff tutor or student tutor. Besides a tutor's subject-matter knowledge, his/her ability to communicate with students in an informal way, coupled with an empathic attitude that enabled the tutor to encourage student learning by creating an atmosphere in which open exchange of ideas is facilitated, was found to improve the learning outcome of PBL tutorials (Schmidt & Moust, 1995).

Since the role of the tutor is seen as critical to the success of PBL tutorials and since the above-mentioned skills seem to play an important role for this success, tutor training programs and continuous feedback from tutor mentors have been recommended (Des Marchais, & Chaput, 1997; Pinto, Rendas, & Gamboa, 2001). Since training PBL tutors seems to be a crucial component of successful curriculum change (Farmer, 2004) it has encouraged other authors to publish tips for successful group facilitation (Azer, 2005). PBL training programs should focus on the particular specifics of PBL tutorials within a certain curriculum and can reach from an emphasis of the tutor being a discussion leader rather than a facilitator (Shields et al., 2007) to instructional films about difficult PBL situations (Skelin et al., 2008). However, the most effective way to help teachers to become effective PBL tutors may be to require their participation in not just tutor trainings but in a systematic program of academic development (Steinert et al., 2006).

13.5 PBL in the Hamburg Hybrid Curriculum

At the Medical School of Hamburg University, problem-based tutorials were introduced in the clinical years three to five of a 6-year hybrid curriculum as part of an extensive reform of the undergraduate curriculum implemented in 2004 according to a new licensure policy in Germany (van den Bussche et al., 2005). This policy required among structural changes of the medical curriculum also changes in pedagogy, i.e., introduction of PBL (Bundesministerium für Gesundheit und Soziale Sicherheit, 2002). The curricular initiative in Hamburg

involved the implementation of a new hybrid curriculum framework organized around academic years with trimesters, and not around semesters as before. Each year consists of six rotating thematic blocks of 12 weeks each that address certain clinical issues from an integrative perspective. These six thematic blocks (e.g., "Psychosocial medicine" or "Operative medicine") plus one additional elective block have to be accomplished in 3 years (van den Bussche et al., 2005). They are offered as modules, which may be taken in free order. Each block aims to foster student-centered learning, and offers course content from a multidisciplinary and integrated perspective. Weekly PBL tutorials lasting 120 min per session were introduced as a new type of teaching format in combination with seminars, bedside-teaching, practical exercises on the ward, and lectures on differential diagnoses; 10 or 11 PBL cases per thematic block were discussed in groups consisting of 10 students and one staff tutor following the "seven jump" model. The first hour of the tutorial was to be spent on discussing the learning objectives of the previous' week's case and the second hour was to be used for working on a new case. All teachers involved in working as PBL tutors when the new curriculum was implemented in 2004 underwent a 3-h faculty development training course before teaching a tutorial in this new curriculum in Hamburg. Per academic year a total of 2475 PBL tutorials takes place. Students receive an introduction to PBL and to the "seven jump" method in the first week of every thematic block.

13.6 Evaluation of PBL Tutorials in Hamburg's Hybrid Curriculum

At the end of each thematic block students regularly evaluate their courses online. Since their introduction, PBL tutorials are mostly rated slightly higher than the average evaluation of all courses within each thematic block. However, it was noted that evaluations of PBL tutorials differed greatly between individual groups even within the same thematic block. Hence, we decided to develop an audit program to evaluate the PBL tutorials introduced in the new hybrid curriculum in Hamburg with a special focus on structure and process of the PBL tutorials and the role of the tutor. The objectives for this study were to determine whether PBL tutorials were performed as intended by the curricular planners and whether there are factors that correlate with the perception and success of PBL tutorials from the students' views.

Since audits have been demonstrated to be a helpful instrument for measuring student engagement in health profession settings (O'Malley et al., 2003) and since students' and faculty ratings have been shown to produce valid and reliable results (Albanese et al., 1991), we engaged 13 faculty and four student raters in this study. To gain a broad picture from different perspectives on the PBL tutorials, three evaluation questionnaires were developed: one for the auditors, one for the participating students in the audited PBL tutorials, and one for the tutor of the audited groups. The instruments were developed in several steps

(O'Malley et al., 2003) including a literature search on PBL evaluation and collecting information from the curricular planning group in Hamburg. The concepts of the questionnaires were evaluated by a team of three medical educators and the final concept was discussed in a focus group involving all auditors, students, and faculty (Albanese et al., 1991). All auditors received 2 h of training and the audition instrument was piloted for inter-rater reliability.

The auditors were asked to observe structural and organizational items (e.g., equipment of the room, number of students in the group, duration of the PBL tutorial, clothing of the tutor), group processes (e.g., use of the "seven jump", behavior of the tutor, observation of feedback rules), and content management (e.g., time management, discussion of learning objectives).

The participating students of the groups that were audited gave their sociodemographic data, information on their own participation within the group, and information on their impression of the tutor's behavior. They were also asked to put the correct numbers on the "seven steps" that were given in an incorrect order in their questionnaire.

The participating tutors of the same groups were asked about their age and gender, their field of medical expertise, whether they participated in the tutor training, the number of years they already worked as PBL tutors, items about their impression of the student group, and items about their motivation for PBL in general.

At the start of one trimester in the year 2007, the PBL groups from all thematic blocks were informed about the audit. Ten groups per thematic block (a total of 60 groups including 495 students) were randomly chosen to be audited. Two weeks before the audit, the chosen groups were informed that the audit would take place and they were reminded of this again 1 week before the audit. All audits took place in the middle of the term so that the new groups had some time to get acquainted with each other and to develop a work pattern. Questionnaires included binary answers, selections between several given answers, and estimates on a six-point Likert scale (1 = I strongly disagree to 6 = I strongly agree). Open commentaries could also be given. Correlations between tutors' answers and auditors' observations were calculated for four students' ratings on items which we consider very relevant for successful learning experiences with PBL groups: (1) I feel comfortable within my PBL group, (2) I am satisfied with my PBL tutor, (3) I benefit from my PBL tutorial, (4) My tutor serves as a role model for me.

13.7 Outcomes of the Analysis Regarding Structure and Process

The outcomes in this section were of particular interest to the organizers of the curriculum since they yielded an important feedback, whether the PBL tutorials were performed according to curricular goals and standards agreed on in the planning phase.

The number of participating students in each group at the time of the audit ranged from 4 to 22. This wide range is surprising since the number of 10 students was clearly defined in the planning and every student receives an individual timetable at the start of the trimester to find his or her respective group. In 18% of the audited groups more than the 10 students originally included in the group by the curricular planners attended the PBL tutorial (Fig. 13.1). The open commentaries gave some clues as to why there was nevertheless such a broad range of participants. Some students had not been taking part in their assigned group because they purposely had entered another group to study with their friends. They had apparently not bothered to look for somebody to swap groups with to keep the number of participants steady or had not been told by the tutor to do so. In other cases the number of students in a group was higher than planned when groups were joined because one tutor was busy with a clinical task and had asked another tutor to take over his or her group. Reduced numbers of participants were either seen when students had left the group to study in another group (see above) or when students had taken a day off. According to study regulations at our faculty students are allowed not to attend up to 15% of the mandatory course time.

Regarding the equipment of rooms used for PBL tutorials, this study revealed that 35% of the rooms did not have enough tables for the students to place their study materials (notepad, papers, books, pens). No flip charts or white boards were found in 26% of the rooms and when they were present, no appropriate amounts of paper, pens, or board markers were found in 25%. Apparently, responsibility of the maintenance of rooms and their equipment was not assigned clearly enough, although the tutors were informed—when PBL tutorials were first introduced—to report lack of material so that the rooms could be properly equipped. Even though the lack of the above-mentioned items was noted the auditors observed no signals from the group or the respective tutor to improve the room's situation for the next session.

Time management was discovered to be problematic in several respects. The tutor did not arrive in time to start the PBL tutorial at the scheduled time in 12.3% of the audited groups whereas the students did not arrive in time in 47.3% of the audited tutorials. We consider this very noticeable since it was

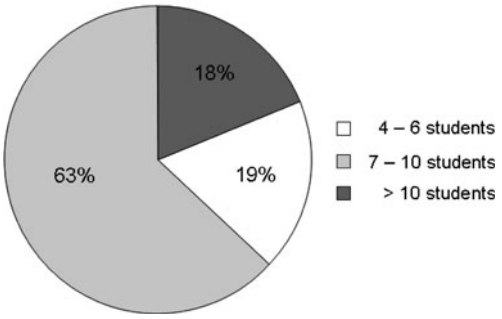

Fig. 13.1 Number of participating students per PBL tutorial group

announced twice to the students and the tutors that an audit would take place on this particular day. Furthermore, the open commentaries revealed that one tutor was beeped repeatedly during the tutorial and left the group three times to attend to other tasks. In another case the PBL tutorial did not take place at all because the tutor was on call and had not organized a substitute tutor. And last but not least, one group had never met their assigned tutor until mid term and only been tutored by substitutes. Even though the curricular assignment for a PBL tutorial comprised a timeframe of 120 min, the duration of the audited PBL tutorials revealed a mean of approximately 80 min (20–120 min). Two-thirds of the 80 min were used to discuss the new case and only one-third (i.e., approximately 25 min) was spent on average on the discussion of the learning objectives (Fig. 13.2).

Learning objectives of the PBL case from the previous week (step 7) were not discussed at all in 13% of the audited groups. Complete discussion of all learning objectives a group had agreed on in the week before took place only in 64% of the groups. Also, the number of learning objectives differed widely between the groups (0–10). When students were asked how often they used self-study time to work on the learning objectives their group had agreed on, the majority of students revealed, that they only worked every other or every third week on learning objectives during their self-study time (Fig. 13.3).

In more than two-thirds of the groups the learning objectives were discussed by the students without using books or handouts, which is the desired technique in our curriculum so the students can use the tutorial to check whether they have really learned the content. In also two-thirds of the groups, the tutor provided additional content/knowledge information when learning objectives were discussed whereas, according to the tutor instructions, he or she only has the task

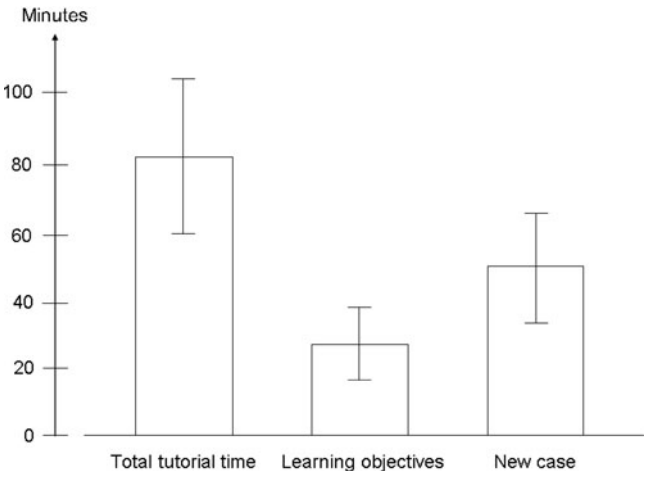

Fig. 13.2 Average tutorial time and time spent on discussing the learning objects or the new case

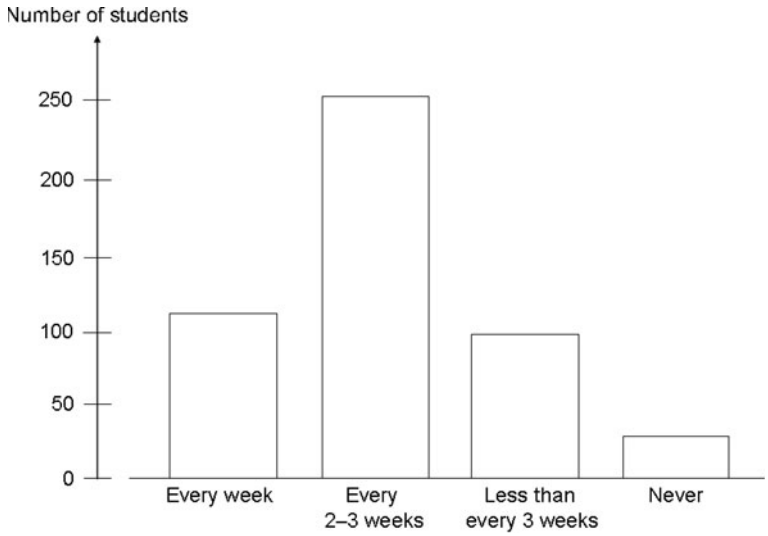

Fig. 13.3 Frequency of students' self-study time spent on learning objectives

of a facilitator and not of an expert information provider. While these results of deviation from the original PBL tutorial concept despite the extensive information provided for students and tutors were surprising to us, the most disturbing result of the students' questionnaires was that only 14% presented a correct numbering of the seven steps which were outlined in incorrect order in their questionnaire. If the "seven jump" concept is not familiar to the students and not reinforced by the tutors, this may explain some of the other results which are not according to the PBL concept, but it shows on the other hand that the positive rating of PBL by the students in their end-of-term evaluation as mentioned above does not necessarily have anything to do with the correct exertion of this learning concept.

13.8 Outcomes of the Analysis Regarding Tutors' Characteristics

When tutors were changing frequently, students' scores for the first three of the four investigated statements (see Section 13.5) were much lower compared with those from students who had only one permanent tutor. This is an important finding because it might influence the planning of PBL tutorials in general in the future. It also underscores that a PBL group needs to build a stable working relationship with its tutor to improve group dynamics and learning outcomes. This is often—besides tutorial skills and content expertise—also linked to personality traits (Stephen, Harry, & Philippe, 1985) or teaching styles (Leung, Lue, & Lee, 2003). Therefore, a teaching style inventory will also be a useful

instrument for curriculum directors for the recruitment of tutors and to increase their self-awareness on certain aspects of personality and PBL teaching.

Quite surprisingly, the score for statement 3 ("I benefit from my PBL tutorial") was remarkably lower when students were tutored by a female staff member (female: 3.41 ± 1.33 versus male 3.95 ± 1.37) whereas no difference was found for the other three statements when correlated with the tutor's gender. The question of the tutor's—and students'—gender has been studied extensively in the past. It has been demonstrated in a study on group dynamics that in PBL tutorials, female students sought the facilitation by expert tutors, who would fill in their knowledge gaps with the appropriate content (Mpofu, Das, Stewart, Dunn, & Schmidt, 1998). One could argue that this pattern might also be valid in the opposite direction and that with the socialization of male staff members usually being in the leading positions in medicine, there could be a subconscious influence that one benefits more from the content experience of a male tutor. On the other end of the scale, it has been found that there was significantly higher group performance in female compared with male student-led PBL tutorials even though achievements in exams were comparable (Kassab, Abu-Hijleh, Al-Shboul, & Hamdy, 2005).

When tutors were wearing hospital clothing, students' scores for statement 1 ("I feel comfortable within my PBL group") were lower compared with groups who were tutored by staff wearing their personal clothes (4.54 ± 1.32 versus 5.05 ± 0.95). No notable difference was found for the other three statements. Since the PBL tutorials usually take place in the early afternoon, many staff members probably wear their hospital clothing during the course since they have to attend to clinical matters before and after tutoring. To our knowledge, this possible item to influence PBL group dynamics has not been studied to date. However, apparently it should be taken into account as far as creating a positive atmosphere in the group is concerned. It did not have any negative effects on the item "I am satisfied with my PBL tutor" yet it seems to have an effect on keeping a certain "emotional" distance as far as the factor of "feeling comfortable" is concerned.

The age of the tutors had an unexpected impact on the four statements. The greatest difference was found between the age groups 26–30 years compared to 51–60 years, where all statements scored higher on the Likert scale when the tutors' age was 26–30 years (statement 1: 5.03 ± 0.99 versus 3.77 ± 1.57, statement 2: 5.34 ± 0.92 versus 3.06 ± 1.69, statement 3: 3.84 ± 1.35 versus 3.2 ± 1.51, statement 4: 3.45 ± 1.36 versus 2.37 ± 1.49). However, Likert scale ratings of those in age group 26–30 years, age groups 31–40 and 41–50 were similar. Since we did not find any data on tutors' age and satisfaction with or learning outcome of PBL tutorials in the literature, we can only speculate that students might subconsciously assume that older tutors might have difficulties with new didactic concepts and hence evaluation results drop. Even though it is known that students' perceptions can differ from tutors' perceptions (Das, Mpofu, Dunn, & Lanphear, 1998) our results could still mean that older tutors

indeed do have difficulties with PBL as a new didactic concept which requires different teaching approaches from the ones they are used to and a more intense faculty development program paying special attention to these facts could bridge this gap.

13.9 Lessons Learned?

The amazing difference in number of participating students in each PBL group (4 to 22) was not due to insufficient planning—number of participants was scheduled by the faculty—but either due to lack of understanding of the concept of PBL tutorials or lack of responsibility by tutors and students to be the carriers of this concept. Although research results are not unanimous regarding the size of a tutorial group, it is generally believed that the ideal number of participating students in a PBL tutorial is six to eight (Barrows & Tamblyn, 1980). PBL tutorials with larger groups (20 to 21 students) can work using a different teaching approach but then the concept also needs to be fully understood by all participants and carried out by enthusiastic tutors (Kingsbury & Lymn, 2008). Furthermore, the smaller number of tutors needed in this concept could lead to only engaging volunteer tutors with "a belief in the philosophy of PBL" which would further impact on the success of the PBL process. However, even though it has been demonstrated that group dynamics as well as learning processes are drastically influenced by an increase in tutorial group size (Dolmans, van den Hurk, Wolfhagen, & van der Vleuten, 1996), the number of students in tutorial groups in some medical schools pursuing PBL curricula rose well above the recommended number of six to eight, with increasing numbers of medical school beginners and lack of mutual increase in funding (Moust, van Berkel, & Schmidt, 2005). The fact that the student number in the tutorial groups of our curriculum was found to differ greatly despite sufficient resources might be related to the fact that in a PBL hybrid curriculum starting in the third year of medical school, students are not well enough aware of the importance of the didactic concept (including group size) of PBL after 2 years of a conventional curriculum. Tutor responsibility to reinforce the desired student number—that has been assigned to them—in their tutorial group could be supported by a continuous faculty development program focusing on the impact of group size on learning success.

The observation that learning objectives were not formulated or their discussion took only half the amount of time that is usually set aside for this step in the PBL tutorial underscores the observation made by other studies that groups take shortcuts in the learning process (Bransford, Brown, & Cocking, 1999). This does not seem to be a problem particular to a hybrid curriculum alone but is relevant in mere PBL curricula as well (Houlden, Collier, Frid, Jon, & Pross, 2001). Skipping the brainstorming and elaboration phase, students do not elaborate based on their prior knowledge, which is an important condition for structuring knowledge; therefore the acquisition of new information will be

less efficient (Bransford, Brown, & Cocking, 1999). Tutors need to be aware of these basic cognitive concepts to be in the position to offer the needed support within the learning environment of the tutorial group. Furthermore, students—especially in a hybrid curriculum where they are not exposed to the underlying ideas of PBL from the very beginning—should receive training in PBL skills, e.g., working in small groups, chairing a meeting, working with the "seven jump" procedure, and giving each other feedback. Deep understanding of the constructivist, contextualist, and cooperative aspects of PBL by the students and their effects of these on learning seem to be even more important than extensive skills training (Moust et al., 2005).

Our findings imply that besides content and facilitation expertise, the tutor needs to develop a sense of responsibility for the support of the whole concept, including structure and process matters like checking the number of participants, feeling responsible for needed equipment, and taking care of good time management for the whole tutorial. This can be partially achieved by a tutor-training program where tutors should be also given information about the institution's educational strategy and the curriculum so that they can help students to understand the learning objectives of individual modules in the context of the curriculum as a whole (Wood, 2005).

Yet apart from the traditional roles of information disseminator and evaluator, faculty development can increase the self-awareness in participants that the PBL tutor also needs to take the roles of a parent, a professional consultant, a confidant, a coach, a guide, a mentor, a model, and a mediator seriously to cover the full range of his task successfully (Wilkerson & Hundert, 1991; Maudsley, 1999). When a tutor is willing to take these roles seriously, improvement in the management of structure and process matters might lead to even better learning outcomes and greater contentedness of the students. These also play an important role in the success of PBL tutorials even though they might not become obvious in the usual student evaluation.

Furthermore, if tutors are sufficiently trained and develop enthusiasm in being successful in their role and in their support of PBL as a didactic concept, this might help to overcome students' uncertainty about the concept—like not being able to put the seven steps in the correct order or coming up with a very high number of learning objectives they will not be able to study within 1 week. It has also been shown that tutors' experience with particular cases, whether through case development or clinical practice, supports the learning outcome of the students (Eagle, Harasym, & Mandin, 1992; Regehr et al., 1995). This suggests that it might help the PBL concept and learning outcomes, if experienced and motivated PBL tutors remain in their role for longer than one term to further develop their skills and to improve students' learning. Especially in a hybrid curriculum, a clear conceptual framework is needed to guide teachers and students to ensure that the goals of self-directed and independent learning are understood and interpreted in a consistent way to help achieve the intended goals of PBL (Miflin, Campbell, & Price, 2000).

Surprisingly, tutor characteristics like gender, age, clothing, and consistency of teaching a group correlated with different aspects of students' evaluation. It can only be speculated whether and how these factors influence students' perception of the PBL tutorial, but our data certainly raise the need for certain awareness that these factors might play a role for a successful learning outcome. These items need to be taken into account when planning a curriculum and assigning the teachers to their teaching units. Making the transition from a more traditional teaching role to that of a PBL tutor is inherently difficult as new skill must be acquired and multiple roles redefined (Hitchcock & Mylona, 2000). At the same time, awareness for gender, age, and clothing related influences on PBL tutorials should be raised in the teachers, which might help them to settle into their new teaching roles or even to address these matters with their tutorial group.

It should not have needed mentioning, but regarding our data, the curricular planners or organizers could help to improve the PBL tutorial process if they took care of appropriate furnishing of the rooms used for PBL tutorials and of unrequested supply with the needed materials (i.e., flip chart, paper, pens, etc.,). If because of a great number of rooms it seems to be difficult to organize this centrally, means can be developed to have somebody take over the responsibility, for instance the tutor or one student of each group, to care for the facilities in time before each PBL tutorial.

Our findings highlight the need for tutors, students, and curricular planners to regularly review the PBL tutorial process and group dynamics within the tutorial setting. Besides tutor training, students in a hybrid curriculum might also benefit from a training to get accustomed with the PBL tutorial methodology. Tutorial principles could be taught even with non-medical cases to release students from context pressure. Confronting students on a regular basis with their learning experiences and progress and to constantly refresh the theoretical ideas that underlie PBL will help them to accept the responsibility for their self-directed learning processes and the underlying framework. Among other factors, appropriate permanent faculty development seems to be a key factor to support staff with the acquisition of new skills needed to become successful PBL tutors and to grant motivated support for PBL as a didactic method. Using PBL in a hybrid curriculum can be very rewarding for tutors and students when its risks and difficulties are foreseen and tackled.

References

Albanese, M., Schuldt, S., Case, D., & Brown, D. (1991). The validity of lecturer ratings by students and trained observers. *Academic Medicine, 66*, 26–28.

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

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning, an approach to medical education*. New York: Springer.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bundesministerium für Gesundheit und Soziale Sicherheit. (2002). *Approbationsordnung für Ärzte vom 27. Juni 2002, Bundesgesetzblatt Teil I Nr. 44*. Retreived from http://www.hamburg.de/contentblob/124122/data/approbationsordnung.pdf

Chan, L. C. (2008). The role of a PBL tutor: A personal perspective. *Kaohsiung Journal of Medical Sciences, 24*, S34–S38.

Chan, L. C. (2009). Factors affecting the quality of problem-based learning in a hybrid medical curriculum. *Kaohsiung Journal of Medical Sciences, 25*, 254–257.

Conolly, C., & Seneque, M. (1999). Evaluating PBL in a multilingual student population. *Medical Education, 33*, 738–744.

Dammers, J., Spencer, J., & Thomas, M. (2001). Using real patients in problem-based learning: Students' comments on the value of using real, as opposed to paper cases, in a problem-based learning module in general practice. *Medical Education, 35*, 27–35.

Das, M., Mpofu, D., Dunn, E., & Lanphear, J. H. (1998). Self and tutor evaluations in problem-based learning tutorials: Is there a relationship? *Medical Education, 32*, 411–418.

Davis, M. H., & Harden, R. M. (1999). AMEE medical education guide no. 15: Problem-based learning: A practical guide. *Medical Teacher, 21*, 130–140.

de Grave, W. S., Dolmans, D. H. J. M., & van der Vleuten, C. P. M. (1998). Tutor intervention profile: Reliablitiy and validity. *Medical Education, 32*, 262–268.

Des Marchais, J. E., & Chaput, M. (1997). A comprehensive continuous preclinical PBL tutor training system. *Teaching and Learning in Medicine, 9*, 66–72.

Distlehorst, L. H., Dawson, E., Robbs, R. S., & Barrows, H. S. (2005). Problem-based learning outcomes: The glass half-full. *Academic Medicine, 80*, 294–299.

Dolmans, D., van den Hurk, M., Wolfhagen, I., & van der Vleuten, C. (1996). Limiting tutorial-group size. *Academic medicine, 71*, 4a.

Dolmans, D. H. J. M., Gijselaers, W., Moust, J. H. C., de Grave, W. S., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2002). Trends in research on the tutor in problem-based learning: Conclusions and implications for educational practice and research. *Medical Teacher, 24*, 173–180.

Dolmans, D. H. J. M., & Ginns, P. (2005). A short questionnaire to evaluate the effectiveness of tutors in PBL: Validity and reliability. *Medical Teacher, 27*, 534–538.

Dolmans, D. H. J. M., Wolfhagen, H. A. P., Scherpbier, A. J. J. A., & van der Vleuten, C. P. M. (2003). Development of an instrument to evaluate the effectiveness of teachers in guiding small groups. *Higher Education, 46*, 431–446.

Dolmans, D. H. J. M., Wolfhagen, H. A. P., & van der Vleuten, C. P. M. (1996). Long-term stability of tutor performances. *Academic Medicine, 71*, 1344–1347.

Eagle, C. J., Harasym, P. H., & Mandin, H. (1992). Effects of tutors with case expertise on problem-based learning issues. *Academic Medicine, 67*, 464–469.

Farmer, E. A. (2004). Faculty development for problem-based learning. *European Journal of Dental Education, 8*, 59–66.

Gijselaers, W. H. (1997). Effects of contextual factors on tutor behavior. *Teaching and Learning in Medicine, 9*, 116–124.

Gilkison, A. (2003). Techniques used by 'expert' and 'non-expert' tutors to facilitate problem-based learning tutorials in an undergraduate medical curriculum. *Medical Education, 37*, 6–14.

Hak, T., & Maguire, P. (2000). Group process: The black box of studies on problem-based learning. *Academic Medicine, 75*, 769–772.

Hendry, G. D. (2009). Problem-based learning tutors' conceptions of their development as tutors. *Medical Teacher, 31*, 145–150.

Hitchcock, M., & Mylona, Z. (2000). Teaching faculty to conduct problem-based learning. *Teaching and Learning in Medicine, 12*, 52–57.

Houlden, R. J., Collier, C. P., Frid, P. J., Jon, S. L., & Pross, H. (2001). Problems identified by tutors in a hybrid problem-based learning curriculum. *Academic Medicine, 76*, 81.

Jung, B., Tryssenaar, J., & Wikins, S. (2005). Becoming a tutor: Exploring the learning experiences and needs of novice tutors in a PBL programme. *Medical Teacher, 27*, 606–612.

Kassab, S., Abu-Hijleh, M., Al-Shboul, Q., & Hamdy, H. (2005). Gender-related differences in learning in student-led PBL tutorials. *Education for Health Journal, 18*, 272–282.

Kingsbury, M. P., & Lymn, J. S. (2008). Problem-based learning and larger student groups: Mutually exclusive or compatible concepts – A pilot study. *BMC Medical Education, 8*, 35–44.

Kinkade, S. (2005). A snapshot of the status of problem-based learning in U.S. medical schools (2003–2004). *Academic Medicine, 80*, 300–301.

Leung, K. K., Lue, B. H., & Lee, M. B. (2003). Development of a teaching style inventory for tutor evaluation in problem-based learning. *Medical Education, 37*, 410–416.

Machado, J. L. M., Machado, V. M. P., Grec, W., Bollela, V. R., & Vieira, J. E. (2008). Self- and peer assessment may not be an accurate measure of PBL tutorial process. *BMC Medical Education, 8*, 55–60.

Matsui, K., Ishihara, S., Suganuma, T., Sato, Y., Tang, A. C., Fukui, Y. et al. (2007). Characteristics of PBL graduates. *Annals Academic of Medicine Singapore, 36*, 67–71.

Maudsley, G. (1999). Roles and responsibilities of the problem-based learning tutor in the undergraduate medical curriculum. *British Medical Journal, 318*, 657–661.

Miflin, B. M., Campbell, C. B., & Price, D. A. (2000). A conceptual framework to guide the development of self-directed, lifelong learning in problem-based medical curricula. *Medical Education, 34*, 299–306.

Moust, J. H. C., van Berkel, H. J. M., & Schmidt, H. G. (2005). Signs of erosion: Reflections on three decades of problem-based learning at Maastricht University. *Higher Education, 50*, 665–683.

Mpofu, D. J. S., Das, M., Stewart, T., Dunn, E., & Schmidt, H. (1998). Perceptions of group dynamics in problem-based learning sessions: A time to reflect on group issues. *Medical Teacher, 20*, 421–427.

Norman, G. R., & Schmidt, H. G. (1992). The psychological basis of problem-based learning: A review of the evidence. *Academic Medicine, 67*, 557–565.

O'Malley, K. J., Moran, B. J., Hoidet, P., Seidel, C. L., Schneider, V., Morgan, R. O., et al. (2003). Validation of an observation instrument for measuring student engagement in health professions setting. *Evaluation & the Health Professions, 26*, 86–103.

Pinto, P., Rendas, A., & Gamboa, T. (2001). Tutors' performance evaluation: A feedback tool for the PBL process. *Medical Teacher, 23*, 289–294.

Regehr, G., Martin, J., Hutchison, C., Murnaghan, J., Cusimano, M., & Reznick, R. (1995). The effect of tutors' content expertise on student learning, group process and participant satisfaction in a problem-based learning curriculum. *Teaching and Learning in Medicine, 7*, 225–232.

Schmidt, H. G. (1994). Resolving inconsistencies in tutor expertise research: Does lack of structure cause students to seek tutor guidance? *Academic Medicine, 69*, 656–662.

Schmidt, H. G., & Moust, J. H. (1995). What makes a tutor effective? A structural-equations modelling approach to learning in problem-based curricula. *Academic Medicine, 70*, 708–714.

Schmidt, H. G., Vermeulen, L., & van der Molen, H. T. (2006) Longterm effects of problem-based learning: A comparison of competencies acquired by graduates of a problem-based and a conventional medical school. *Medical Education, 40*, 562–567.

Segouin, C., Jouquan, J., Hodges, B., Bréchat, P. H., David, S., Maillard, D., et al. (2007). Country report: Medical Education in France. *Medical Education, 41*, 295–301.

Shields, H. M., Guss, D., Somers, S. C., Kerfoot, B. P., Mandell, B. S., Travassos, W. J., et al. (2007). A faculty development program to train tutors to be discussion leaders rather than facilitators. *Academic Medicine, 87*, 486–492.

Skelin, S., Huwendiek, S., Nikendei, C., Dieter, P., Kirschfink, M., & Bosse, H. M. (2008). The good PBL tutor – to be or not to be: Instructional films for tutors. *Z Evid Fortbild Qual Gesundhwes, 102*, 634–640.

Steinert, Y., Mann, K., Centeno, A., Dolmans, D., Spencer, J., Gelula, M., et al. (2006). A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education: BEME Guide No. 8. *Medical Teacher, 28*, 497–526.

Stephen, E., Harry, G. M., & Philippe, J. R. (1985). Personality, classroom behaviour, and student ratings of college teaching effectiveness: A path analysis. *Journal of Educational Psychology, 77*, 394–407.

van Berkel, H. J. M., & Schmidt, H. G. (2000). Motivation to commit oneself as a determinant of achievement in problem-based learning. *Higher Education, 40*, 231–242.

van den Bussche, H., Anders, S., Ehrhardt, M., Göttsche, T., Hüneke, B., Kohlschütter, A., et al. (2005). Lohnt sich eine Reform der klinischen Ausbildung? – Die Qualität des Hamburger Curriculums unter der alten und der neuen Approbationsordnung im Vergleich. *Z Evid Fortbild Qual Gesundhwes, 99*, 419–423.

Wilkerson, L., & Hundert, E. M. (1991). Becoming a problem-based tutor: Increasing self-awareness through faculty development. In D. Boud & G. Feletti (Eds), *The challenge of problem-based learning* (pp. 159–171). New York: St Martin's Press.

Wood, D. F. (2005). ABC of learning and teaching in medicine – Problem based learning. *British Medical Journal, 326*, 328–330.

Part V
Conclusion

Chapter 14
The Next Generation: Research Directions in PBL

Susan Bridges, Tara L. Whitehill, and Colman McGrath

This edited volume was conceived as an attempt to share recent scholarship investigating our understandings and implementations of problem-based learning (PBL) in clinical education. Globally, we are witnessing a rapid shift in the way higher education perceives itself and how it is perceived by society. Social theorists have asked us to consider society in the era of 'liquid modernity' (Baumann, 2000), characterized by uncertainty, continuous risk and shifting loyalties and trust. Liquidity is evident not only in our desktop designs but our views of time and knowledge as we have come to expect instant access to information on demand. In terms of higher education, the impact of these social changes can be described as an educational 'climate change' signalled by fundamental shifts in the way we perceive knowledge and learning (Goodyear & Ellis, 2010). First, our conception of knowledge is moving from inert and fragmented knowledge to a notion of working knowledge. Second, the focus is moving from an individualistic model of the learner to one of learning communities. Third, the teaching dynamic is changing from teacher-directed to learner-managed learning. This logically forces a shift from learning experiences that focus on content and presentation, i.e., information transmission and presentation pedagogies, to those that focus on student activity through the design of learning tasks and environments and the provision of tools for individual and collaborative work.

As higher education moves to respond to this forecast for educational climate change by adopting active, learner-centred, outcomes-based instructional approaches that promote deep learning strategies (Biggs, 1999), PBL curriculum designers may be feeling somewhat reassured. The social constructivist theoretical groundings of PBL that focus on supporting the learner in the process of individual and group knowledge construction remain highly relevant. Indeed, given the oft cited knowledge explosion afforded by increased

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technological access, as noted in the preface to this volume, the educational rationale for PBL may be even more cogent today than when the approach originated over 40 years ago.

Given the rise of new educational technologies, one could argue that PBL is also facing a climate change. As this volume's chapters examining the role of educational technologies in PBL indicate, Net Generation learners, otherwise referred to as 'tech savvy' students, and their facilitators are moving into the next generation of blended learning in PBL (Bridges, Botelho, & Tsang, 2010) by accessing, reviewing and synthesizing knowledge via educational technologies both within face-to-face tutorials as well as in the self-directed learning phase of the problem cycle (Bridges, Dyson, & Corbet, 2009). The next generation of PBL curriculum designers in clinical education is building on the initial principles of the traditional PBL tutorial process (Barrows, 1986; Davis & Harden, 1999; Schmidt, 1989) to adapt to changing programmes, students and technologies.

As PBL practitioners and educational researchers reviewing studies on PBL to date, we have noted a subtle but significant shift in not only curriculum design but also research approaches. Initial research naturally sought to provide empirical data to justify PBL in comparison with traditional, lecture-based curricula. There was also the critical dimension of examining 'how well' students were achieving learning outcomes through PBL. The first issue can now be considered moot. As an inquiry-based approach, PBL has been found to be socially and academically relevant to higher education. Indeed, much work now has been on introducing the approach to secondary schooling. Good teachers will always be interested in gaining the best from their students through the learning experiences that they design, so research into student learning outcomes will remain a key focus of attention. However, in higher education, specifically in clinical areas with the longest experience in PBL, we believe that the research agenda has matured to shift from justifying 'why' PBL to investigating 'how' students and faculty are engaging in clinical education.

Chapters in this collection have drawn on studies that examine PBL from its theoretical background to studies reporting empirical research into practice undertaken by academic staff actively engaged in evaluation and researching the programmes they develop. The volume draws on a wide range of experience in terms of geography, discipline areas and length of PBL implementation. Geographically, this volume represents work from Australia, Canada, Germany, Hong Kong, Japan, Sweden and the USA. The discipline areas encompass traditional areas such as dentistry, medicine, biology/pharmacology, speech and language pathology as well as some interdisciplinary approaches such as Imafuku's study on first-year health sciences in Japan or Howe and Schnabel's dentistry/design collaboration between Australia and Hong Kong. The curricula described here also embrace a range of experience from decades since implementation to more recent curriculum reform and innovation. This collection has not only actively explored the effects of PBL

on student learning experiences and outcomes but has also begun to explore how aspects such as content integration, educational technologies and inter-professional learning are reconfiguring approaches to PBL for clinical education.

Methodologically, the volume has shared traditional and new methodologies in higher education research. While volumes on PBL, to date, have tended towards descriptive accounts geared towards providing advice for teachers intending to adopt PBL at course or programme level, this collection has taken a strong research focus reflecting a renewed interest in higher education on the scholarship of teaching and learning. Historically, we have noted that, due to the research backgrounds of scholars in clinical education and the initial need to establish PBL as a viable approach, many empirical studies focused on resolving debates surrounding 'why PBL', aiming to justify the adoption of PBL in clinical education. As expressed earlier, this volume has sought to capitalize on the growing body of empirical research on PBL evaluations but has also sought to move the paradigm forward by including studies that reflect the growing body of empirical research on 'how PBL'. The latter have drawn on both evaluative data to explore the attainment of student learning outcomes, including achievement of graduate attributes, as well as discourse-based studies on PBL-in-action. The focus of this volume, therefore, has been twofold – research-driven and embracing new methodologies to explore how we can support student learning in PBL courses and programmes.

In their chapter framing the relationship between PBL and educational theory, Hmelo-Silver and Eberbach have highlighted some under-researched areas in PBL. These include investigating collaboration in terms of sustained lifelong learning; the relationship between intrinsic motivation and sustaining productive dispositions in clinical practice; as well as the role of cultural tools, specifically educational technologies, in achieving the goals of PBL.

In moving the PBL research agenda forward beyond this volume, we also envisage potential research in the areas of student learning outcomes (particularly in the area of graduate attributes, including clinical competences), new research methodologies and staff development.

14.1 Examining Graduate Outcomes

To date, many studies have focused on the first-year experience and the transition into problem-based programmes. Relatively few have explored the issue of graduate outcomes. With current global trends in clinical education to redefine graduate competencies for the 'safe beginner', it is important to understand how PBL programmes can contribute to the achievement of such competencies. We are pleased to present current approaches to this issue in the opening chapters (2, 3, 4, 5 and 6) of this volume where researchers share findings on studies that explore how student learning outcomes, graduate attributes and professional

competencies are developed in problem-based programmes. Toulouse et al. (Chapter 2) have reflected on the notion of consequential validity and the influence of both PBL and the assessment processes on graduates in their careers in science. Shuler (Chapter 3) has drawn on a body of longitudinal data to evaluate improved achievement of PBL students in the basic sciences domain of the National Board Dental Examination (NBDE). Samuelsson et al.'s (Chapter 4) cross-institutional survey of both specific and general competencies in two PBL Swedish Speech Language Pathology (SLP) programmes found that graduates who have had more experience of PBL rate their general competencies higher than the graduates who have not used PBL throughout the curriculum. They also noted that the students from both the PBL-throughout and the semi-PBL curricula rated themselves high on many specific competencies. Now that PBL has more than 'come of age', there is scope for more work in this area of student learning outcomes, particularly comparative and longitudinal studies.

14.2 Methodological Directions

Much of the early research on PBL focused on comparisons between PBL and traditional curricula, particularly in medical schools. Such studies tended to employ primarily quantitative methods of analysis, for example, using student achievement on external assessment measures such as standardized national professional exams, learning styles, etc. Quantitative outcome measures facilitate comparison to be made between different settings and are often considered as being more amenable to inform evidence-based practice. However, it is important to determine the validity (content, face, construct and criterion validity) as well as reliability (internal and test-retest) of such outcome measures. Unfortunately, this has not always been the case and outcome measures have often been developed in an 'ad hoc' approach without appropriate psychometric testing to validate them. Another issue is the cross-cultural adaptation of the outcome assessment measures for use in different linguistic and cultural settings. To date the issue of cross-cultural adaption of structured quantitative assessment measures has not been explored to any great extent. Furthermore, it is not simply the quantitative assessment of outcomes that is important but also how the PBL process (and other factors) influence outcomes. Fortunately, today with advances in statistical modelling, it is now possible to verify conceptual and theoretical dimensions of PBL through PATH analyses/Structural Equation Modelling (e.g., Everitt & Dunn, 1991) and to decipher the specific pathways to the key outcomes of PBL. Nevertheless, it should be borne in mind that quantitative methods, with their focus on group differences, may not be able to capture data or trends of interest and value. More recently, researchers have combined quantitative and qualitative methods of inquiry in order to provide a

more comprehensive picture of the PBL process or student learning outcomes (for example, Stokes, MacKinnon, & Whitehill, 1997; Winning, Chapter 5; O'Toole, Chapter 6).

Certainly, studies to date have been reassuring in establishing that PBL is 'working' in terms of knowledge acquisition but at issue is how we obtain empirical evidence on the 'soft' areas that we as educators often intuitively know are working. An avenue for research directions is in developing the use of recent innovations in qualitative methodologies to build on the robust and now widely accepted use of reflective interviews and grounded theory analysis (see Skinner et al., Chapter 12). In the age of the 'linguistic turn', researchers in clinical education are also drawing on a wider variety of research methods, particularly those loosely grouped under the title of 'discourse analysis'. Narrative approaches can facilitate greater reflection and emic or 'insider' perspectives on learning (see Toulouse et al., Chapter 2). Ethnographic approaches are being used by proponents arguing for richer, in-depth analysis or 'thick descriptions' (Geertz, 1973) to explore various aspects of the PBL tutorial as it is enacted in *real time*. Data collection from this paradigm includes video and audio recordings of the tutorial process with a multiplicity of analytic lenses being applied. Bridges et al. (Chapter 7) use an interactional ethnographic (IE) approach to investigate student learning and learning activity, with a particular focus on independent and online learning in a third-year dental PBL group. This relatively new and under-used (at least in PBL research) methodological approach offers exciting new developments as it is applied to PBL. Other areas of related research interest include the relationships between language and its link to conceptual development and disciplinary knowledge as well as group dynamics and their effect upon the learning process. For example, work by Skinner et al. (Chapter 12) found that PBL groups initally formed as a 'social unit' and subsequently became a 'work unit' indicating implications for student induction into PBL programmes.

Cognitive approaches have also contributed to the types of interview transcripts that we can analyse. Stimulated recall protocols, for example, afford insights into task performance (Bridges & Bartlett, 2009) and have been used in a few PBL studies both in this volume and elsewhere (Remedios, Clarke, & Hawthorne, 2008). Imafuku's (Chaper 10) study of first-year Japanese medical students' learning processes applied analysis of stimulated recall transcripts within a mixed-method design to investigate their socialisation process into the new academic community. One finding was that although the PBL environment can be a challenging one for first-year students, it can also provide an opportunity to autonomously develop their generic skills.

The possible analytic lenses applied to such transcripts may include critical discourse (CDA) and conversation analysis (CA), to name but a few. Jin's (Chapter 11) analysis of silence in PBL group interactions drew upon both CA and CDA and indicated that silence can be perceived and practised as a productive resource, a collaborative practice, a platform for handling conflicting understandings and a signal of shifting power relations in PBL tutorials.

Also engaging with discourse-based approaches is the work of Chan et al. (Chapter 9) who examined coded transcript units to better understand the implications of the effects of new technologies on the PBL process, in this case, video triggers in second-year medicine.

Chapters in this volume have also indicated how expanding the use of mixed or complementary methodological approaches can be employed to further unravel the multiple variables at play in a learning environment, especially one as rich as PBL. Typically, this manifests in the use of qualitative data such as interviews or observational field notes to provide a more textured layer to analyse the trends indicated in quantitative data. Howe and Schnabel (Chapter 8), for example, adopted a mixed method approach to examine another area of educational teachnology – online social networking. Their study of an interprofessional PBL project indicated that the application of such technologies supported the blurring of disciplinary, professional, institutional and national boundaries whilst achieving student learning outcomes. Harendza et al. (Chapter 13) used calibrated observations and survey data to examine the role of tutors in PBL group dynamics with recommendations for staff development.

As noted above, we see great potential in partnering approaches such as pre-post-test design of surveys and validated scales with analysis of interview and/or ethnographic data to provide greater insights into the PBL process and to evaluate curriculum innovations.

14.3 Staff Development

Another area for future research is that of staff development. In the field of PBL staff development in higher education, work to date has remained mainly descriptive focusing on initial tutor training, with relatively little research on continuing staff development (see for example, Hmelo-Silver & Barrows, 2006). Also, we see possibilities for research exploring the effectiveness of new approaches to staff induction and professional development. An additional area worthy of attention is exploring issues related to tutor judgement both within the tutorial process, in terms of in situ decision making, as well as when assessing student performance. In terms of ongoing quality assurance, the issues of reliability of facilitator feedback and consistency in standards are as increasingly relevant for PBL as for any other higher education programme. The greater tension for PBL may be in the assessment of 'process' such as the quality of contributions to the group rather than the standard measurement of student 'products' such as written assignments or exams. There is, therefore, much more work that can be undertaken to investigate both innovations to the delivery of staff development for PBL facilitators as well as studies exploring facilitator effectiveness.

14.4 Conclusion

We trust that, by the end of this collection, readers have gained some further insights into the directions current clinical educators are taking as they move educational practice and research into PBL forward to the next generation. In reflecting on this body of work, we have noted that these educator/researchers have moved beyond the original research question of justifying PBL as a valid learning approach and are finding new and innovative ways to explore the questions higher education is asking of all curricula and learning experiences – how and how well are students achieving the learning outcomes we plan and enact?

References

Barrows, H. S. (1986). A taxonomy of problem-based learning-methods. *Medical Education, 20*(6), 481–486.

Baumann, Z. (2000). *Liquid modernity*. Cambridge: Polity.

Biggs, J. (1999). *Teaching for quality learning at university*. Buckingham, UK: SHRE and Open University Press.

Bridges, S. M., & Bartlett, B. (2009). Moving teachers: Public texts and institutional power. In R. Fitzgerald & W. Housley (Eds.), *Media, policy and interaction* (pp. 185–203). Farnham: Ashgate.

Bridges, S. M., Botelho, M. G., & Tsang, P. C. S. (2010). PBL.2.0: Blended learning for an interactive, problem-based pedagogy. *Medical Education, 44*, 1131.

Bridges, S. M., Dyson, J. E., & Corbet, E. F. (2009). Blended learning, knowledge co-construction and undergraduate group work. *Medical Education, 43*, 490–491.

Davis, M. H., & Harden, R. M. (1999). Problem-based learning: A practical guide. *Medical Teacher, 20*(2), 317–322.

Everitt, B. S., & Dunn, G. (1991). *Applied multivariate data analysis*. London: Edward Arnold.

Geertz, C. (1973). Thick description: Toward an interpretive theory of culture. In C. Geertz (Ed.), *The interpretation of cultures: Selected essays* (pp. 3–30). New York: Basic Books.

Goodyear, P., & Ellis, R. (2010). Expanding conceptions of study, context and educational design. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for the digital age: How learners shape their own experiences* (pp. 100–113). New York: Routledge.

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based Learning, 1*, 21–39.

Remedios, L., Clarke, D., & Hawthorne, L. (2008). The silent participant in small group collaborative learning contexts. *Active Learning in Higher Education, 9*(3), 201–216.

Schmidt, H. G. (1989). The rationale behind problem-based learning. In H. G. Schmidt, M. J. Lipkin, M. W. De Vries, & J. M. Greep (Eds.), *New directions for medical education* (pp. 105–111). New York: Springer.

Stokes, S. F., MacKinnon, M., & Whitehill, T. L. (1997). Students' experiences of PBL: Journal and questionnaire analysis. *The Austrian Journal for Higher Education, 27*(1), 161–179.

Appendix A
Translated Questionnaire: Speech and Language Pathology Education and Professional Life

Tick the box for the selected answers. Print clearly!

Thank you for your participation!

Background

1. Sex: □ Female □ Male

2. Year of birth: □ -60 □ 61-70 □ 71-80 □ 81 --

3. Admitted to education year:_____

4. When did you graduate? Year_____

5. Where did you go through your education? Place_____

6. Have you taken out your professional license? □ Yes □ No

7. What was your main occupation, the second half of XXXX?

Permanent employee	Replacement	Master or research	Other, what?
□	□	□	□

S. Bridges et al. (eds.), *Problem-Based Learning in Clinical Education*, Innovation and Change in Professional Education 8, DOI 10.1007/978-94-007-2515-7,

Speech and Language Pathology Competences

9. How do you consider that your knowledge of basic education met the requirements placed on you as a professional SLP?

	Very inadequate	Inadequate	Adequate	Satisfactory	Very satisfactory
Language Impairment in Children	□	□	□	□	□
Neurologopedics	□	□	□	□	□
Voice disorders	□	□	□	□	□
Dyslexia	□	□	□	□	□
Stuttering	□	□	□	□	□
Cleft lip and palate	□	□	□	□	□
Laryngectomy	□	□	□	□	□
Other	□	□	□	□	□

what?_____

Tasks (this question is answered by all in employment)

10. To what extent does your current work demand that you are able to

	Not at all				Very much
Capture history	□	□	□	□	□
Assess status	□	□	□	□	□
Independently carry out the consultation	□	□	□	□	□
Write records	□	□	□	□	□
Write referrals	□	□	□	□	□
Write certificates	□	□	□	□	□
Lead the work	□	□	□	□	□
Work in team with other professional groups	□	□	□	□	□
Supervise	□	□	□	□	□
Be responsible for decisions on patients	□	□	□	□	□
Independently solve problems	□	□	□	□	□
Think critically	□	□	□	□	□
Argue and convince	□	□	□	□	□
Explain for laymen	□	□	□	□	□
Use IT for collection, process or analysis of information	□	□	□	□	□
Foersee need for change	□	□	□	□	□
Carry out changes	□	□	□	□	□

Follow the development of the field of speech and language pathology	□	□	□	□	□
Critically analyze new logopedic facts	□	□	□	□	□
Interpret social situations	□	□	□	□	□
Understand different cultures	□	□	□	□	□
Identify and analyze ethical problems	□	□	□	□	□
Build an international perspective	□	□	□	□	□
Overview the health care system	□	□	□	□	□
Work in preventive health care	□	□	□	□	□
Apply laws and regulations	□	□	□	□	□
Health care economics	□	□	□	□	□
Know the difference between men and women as regards health and sickness	□	□	□	□	□
Make written presentations	□	□	□	□	□
Make oral presentations	□	□	□	□	□
Write articles/surveys/promemorias	□	□	□	□	□
Communicate in English	□	□	□	□	□
Other. What?_____	□	□	□	□	□

Pedagogical Organization of the Education

Important parts of speech and language pathology education require great commitment of the students in joint activities. Special forms are PBL and the case methodology.

12. Have you been working with PBL? □Yes □No

	Not at all				Very much
If yes, did you experience that PBL was beneficial for your learning?	□	□	□	□	□

In what ways?

_____

_____

_____

_____

Have you been working with case-methodology? □Yes □No

	Not at all				Very much
If yes, did you experience that case-methodology was beneficial to your learning?	□	□	□	□	□

In what ways?

_____

_____

_____

_____

13. General point of views on the pedagogical forms that were used in the education

_____

_____

_____

_____

14. To what extent do you think that the examinations focused on knowledge that you need in your professional life?

Not at all				Very much
□	□	□	□	□

General Benefits of the Speech and Language Pathology Education

15. Do your working experiences comply with the picture you had of the profession during the education?

Not at all				Very much
□	□	□	□	□

16. If the image corresponds poorly, which is the most important difference?

_____

_____

_____

_____

17. To what extent do you consider that your education has provided tools to influence your work?

Not at all				Completely
□	□	□	□	□

18. Would you have chosen to become a speech and language pathologist today? □ Yes □ No □ Do not know

19. If you have answered no or do not know, what is the main reason?

_____
_____
_____
_____
_____

20. Within which of the following sectors do you wish to work in 10 years?

Municipality	County	Research	Education	Other, what?
□	□	□	□	□

Strengths/weaknesses in your Speech and Language Pathology Education

21. Set strengths in your education which have not come out in your previous answers!

_____
_____
_____
_____
_____

22. Set weaknesses in your education which have not come out in your previous answers!

_____
_____
_____
_____
_____

23 Other comments

_____
_____
_____
_____
_____

Thank you for your participation!

Appendix B
Transcription Conventions

F	Facilitator
Ss	Students
.	Certainty, completion (typically falling tone)
,	Continuing intonation
?	Rising or questioning intonation
!	Exclamatory utterance (emphatic intonation)
↑	Rising intonation
↓	Falling intonation
(1.2)	Elapsed time by tenths of seconds[a]
(.)	A brief interval (± a tenth of a second) between utterances
[	The point of overlap onset
]	The point at which two overlapping utterances end
((word))	Transcriber's descriptions
=	No break or gap; latched talk
:	Prolongation of the immediately prior sound (more colons indicate greater length)
WORD	Especially loud sounds relative to the surrounding talk
°word°	The sounds are softer than the surrounding talk
(word)	Parenthesized words are especially dubious
word	Some form of stress, via pitch and/or amplitude
A-B-C-D	Spelling out letters of a word

See Jefferson (2004) and Sacks et al. (1974)

[a] *Note*: Chapter 7 displays this information in the form of time-stamps (e.g., 0:00:01.2)

References

Jefferson, G. (2004). Glossary of transcript symbols with an introduction. In G. H. Lerner (Ed.), *Conversation analysis: Studies from the first generation* (pp. 13–23). Philadelphia: John Benjamins.

Sacks, H., Schegloff, E., & Jefferson, G. (1974). Simplest systematics for organization of turn-taking for conversation. *Language, 50*(4), 696–735.

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