Interactional Research

Into Problem-Based Learning

Edited by

Susan M. Bridges *and* Rintaro Imafuku

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Foreword

Judith Green
University of California, Santa Barbara

This collection, assembled by Susan Bridges and Rintaro Imafuku, addresses critical questions central to uncovering insider (emic) understandings of *how*, *in what ways*, *under what conditions*, and *with what consequences* students (and by extension, facilitators/instructors or teachers) develop opportunities for learning collectively and individually, in and over time, and across configurations of actors and intertextually tied events. By bringing together empirical qualitative research guided by different theoretical and epistemological perspectives, Bridges and Imafuku lay a foundation for addressing an overarching question: Why are qualitative approaches critical to researching problem-based learning (PBL) interactions? This collection of empirical research in different educational contexts (K–12 and higher education), viewed through differing theoretical and methodological lenses, lays a foundation for examining what each individual lens makes visible about emic understandings constructed by participants and what can be learned by going beyond any individual perspective or context. By exploring what each theoretical lens makes visible across the chapters and how the research was undertaken, readers have an opportunity to develop a transdisciplinary understanding of the complex factors that influence and support student learning, not from the focus of outcome measures but from the emic perspectives and understandings of the participants.

What is unique about this volume is that rather than focusing on describing different methodological perspectives at an abstract level, the editors have included articles that have a *common* goal of gaining insights

into "emic perspectives." This common goal creates the potential for constructing a deeper understanding of what each empirically grounded, theoretical, and methodological perspective contributes to developing a more holistic transdisciplinary understanding of *how inquiry-based lived experiences* support student learning in particular educational contexts within and across disciplines. This collection therefore makes visible what can be learned when different, *uncommon*, empirical-epistemological lenses address a common goal of exploring emic understandings developed by students as they participate in particular inquiry-based educational programs: problem-based earning, project-based learning, cooperative learning, and interdisciplinary professional education.

Each chapter presents an empirical research grounding for exploring the emic perspectives constructed interactionally in a particular educational setting. Each author/team of authors also makes transparent the logic of inquiry guiding the decisions of the problem of interest, the selection of a point of view (students, facilitators, teachers, and/or groups), the contexts of the study, the relationships among participants, the subject area, and the theoretical approach that guided the exploration of the problem-based/inquiry-based learning processes from emic perspective(s).

This collection makes visible *how* and *in what ways* the researchers in particular settings, seeking particular understandings of the emic perspectives of particular participants, developed theoretically and empirically grounded iterative, recursive, and nonlinear processes that supported them in studying complex and developing social, academic, interpersonal, and discursive ways of knowing, being, and engaging in inquiry-based processes collectively and individually within a collective. In bringing together these empirical studies, Bridges and Imafuku lay a foundation for exploring issues involved in examining *what constitutes emic understandings* or *perspectives* within and across times, settings, disciplines, and international as well as interdisciplinary contexts. The depth and transparency that the authors provide to make visible the theoretical basis of the study, the research logic, and the ways of constructing warranted accounts of particular emic phenomenon/a lay a foundation for developing a more holistic, transdisciplinary understanding of factors that influence student learning in problem-based/inquiry-based programs of study.

This volume therefore affords readers a unique opportunity not only to gain deep insights into particular forms of empirical qualitative research for studying emic or contextually bounded opportunities for learning, but also

to develop deeper, cross-disciplinary insights into challenges facing students in constructing understandings of the learning processes from particular lived experiences. When taken as a whole, this collection provides a basis for engaging in transdisciplinary dialogues about the potential sources, processes, and practices influencing *how* and *in what ways* students develop understandings of complex subjects in inquiry- or problem-based collective contexts. Individually and collectively, the chapters of this volume also direct researchers' attention to accounting for particular configurations of actors, intertextually tied cycles of activity, and disciplinary requirements that are all part of developing and engaging in learning opportunities within particular curricular designs and educational settings.

In the following discussion I propose a way of *reading across the chapters* ethnographically to support readers in identifying and constructing a more holistic understanding of the situated nature and epistemological processes guiding each study in this volume. This proposed approach is grounded in anthropological perspectives on ethnographic research (Green & Bridges, 2018) that have guided research on PBL undertaken by Bridges and colleagues. This approach is an adaptation of Heath and Street's (2008) principles for ethnographic inquiry, adapted here for exploring the inscribed arguments and processes within and across texts. As you read across the chapters, engage in

- suspending known categories from your own research in order to construct understandings of local and situated categories and referential meanings of actions being developed by participants and inscribed by the author(s);
- acknowledging differences between what you know and what the actor(s) (authors) in the context know based on what they inscribed and made transparent;
- identifying and constructing new ways of understanding (knowing) that are grounded in local and situated ways of knowing, being and doing the processes and practices of everyday life as articulated by particular participants within the study as inscribed by the author(s);
- developing ways of (re)presenting what is inscribed (i.e., known) by local actors (authors) and what you (as ethnographer/reader) learned from the contrastive analyses across chapters to explore how, and what, different forms of empirical qualitative analysis

made visible students' developing emic understandings of what constitutes learning in inquiry-based programs.

These principles are provided to support ongoing conversations about how emic perspectives are empirically constructed by researchers within and across differing epistemological perspectives as represented in this volume. By engaging in contrastive analyses within and across such perspectives, a more holistic and transdisciplinary understanding of the situated nature of learning and its consequences for particular students can be developed. These dialogues across perspectives have the potential to deepen understandings of the situated nature of learning-teaching relationships and knowledge constructed within particular times, events, and configurations of actors/participants. Thus, as Bridges and Imafuku have shown, the results of qualitative studies have the potential for informing facilitators' (instructors' or teachers') actions and the decisions of curriculum designers as they develop inquiry-based programs.

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EDITORS' INTRODUCTION

Why Focus on Interactions in Problem-Based Learning?

Susan M. Bridges
The University of Hong Kong
Rintaro Imafuku
Gifu University

This volume arose from an invitation by the editorial board of Purdue University Press to extend the work presented in the 2016 special issue (volume 10) of the *Interdisciplinary Journal of Problem-based Learning* (IJPBL). Our goal for both collections has been to contribute to the growing evidence base that is affording new insights into student experiences in problem-based learning (PBL) as an inquiry-led approach as it is coconstructed through dialogic, interactional processes. In curating and shaping this volume, we recognised important points of departure from the 2016 special issue and, indeed, since the genesis of PBL in medical education half a century ago. We note that the field of interactional studies in PBL is not only growing but, significantly, is addressing the key philosophical, curriculum design, and pedagogical issues facing many learning approaches in an era of complexity, change, and ubiquitous access to information.

Given its focus on dialogic approaches and collaborative inquiry, PBL is a logical field to explore from a situated perspective. Indeed, as Dolmans and Gijbels (2013) noted, it is important to investigate "how the different elements of a PBL environment can be optimized for what kind of student, under which conditions and why" (p. 217). Evensen and Hmelo-Silver's (2000) edited volume was one of the earliest attempts to create a compendium focussed on investigating the group meeting and self-directed learning in PBL in medical education and reported empirical studies drawing on self-reports, interviews, observations, and verbal protocols.

In this volume, contributors have further responded to our question: Why focus on interactions in PBL? In doing so, they have explored the key

themes of students' learning processes in PBL over time and across contexts, the nature of quality interactions in PBL tutorials (and how "quality" is achieved through talk and other modalities), facilitation processes, and the developing nature of PBL learner identity. In chapter 11, Savin-Baden's article (reproduced from Savin-Baden, 2016) provides a framework of four transdisciplinary threshold concepts in PBL that support transformations in understanding: liminality, scaffolding, pedagogical content knowledge, and pedagogical stance. If we adopt this as a metaframing for the studies in this volume, we can see how each study's focus on interactions in PBL contexts illustrates *liminality* by highlighting the moments of dissonance, conflict, or confusion that can generate transitions and transformations as conceptual epiphanies, new group norms and practices, and identity formulations. In terms of *scaffolding*, the studies on educational technologies and new digital information flows trace how new affordances are taken up by the facilitator and/or the PBL group, with analysis indicating the inherent PBL dilemmas related to the degrees of scaffolding necessary for learners across a variety of contexts. Shulman's notion of *pedagogic content knowledge* remains, in his own words (Shulman, 2018), a fuzzy term, but as Savin-Baden argues, it underlies the importance of PBL to identity formation. In the studies in this volume, this can be seen in relation to professional education but also in terms of identities grounded in disciplines, for example, gender and mathematics education. Perhaps central to the nuances of the interactional studies in this volume is the notion of *pedagogical stance*, as, by taking an emic perspective, we are able to gain textured insights into the actions of students and their facilitators within and across the PBL cycle of inquiry.

The invited commentaries in the preface and the closing provide unique, "outsider" perspectives from an expert educational researcher (Green), on the one hand, and novice educational researchers (Verbeek and Maximo Chian) on the other. As editors, we trust that the etic and emic insights presented in this volume provide a platform for expanding and integrating interactional scholarship to extend the potential of PBL into its next 50 years.

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SECTION I

EMIC PERSPECTIVES OF PROBLEM-BASED LEARNING DYNAMICS THROUGH INTERACTIONAL RESEARCH

The studies presented in this section have adopted a variety of methodologies drawn from the larger traditions of educational ethnography, interactional sociolinguistics, and discourse analysis, which share an interest in examining the lived experiences of learning processes in situ. A shared theme across these chapters is an exploration of the sociocultural and sociocognitive dimensions of PBL, with researchers aiming to make visible the impact of the "social" on student and group learning. This is achieved through close examination of a range of PBL interactional processes across contexts and years of study. Foci range from exploring human interactions (peer, facilitator, group) to understanding how technologies are reshaping new formulations of PBL in its 50th decade.

To provide a broad framing for the field of interaction research in PBL, we open with Jin and Bridges's review of qualitative research in PBL, which, while restricted to studies in medical and health sciences education, indicates future directions relevant to a range of disciplines and educational contexts. The remaining studies can be viewed as building from these authors' closing call for further interactional studies to contribute textured understandings of PBL facilitation, assessment, and the new impact of educational technologies. The remainder of the chapters in this section contribute new perspectives through studies embracing ethnographic approaches to video analysis, introspective protocols such as stimulated recall interviews, and longitudinal qualitative studies using

discourse-based analytic approaches. Skinner and colleagues' exploration of students' views of social practices with respect to quietness and dominance in groups is illuminating in terms of how group roles and functions are negotiated and developed, while their ethnographic investigation of PBL group practices notes the dual nature of silence as either generative or negatively impacting learning and social interactions in PBL tutorials. Schettino's narrative analysis examines interactional aspects of adolescent female students' mathematics learning in "relational problem-based learning (RPBL)" and constructs I-Poems to identify developing empowerment and agency in problem-based mathematics learning. Svihla and Reeve's emic analysis of student–teacher interactions, field notes obtained from participant observation, and students' learning artifacts explores the agentive process of students' learning in a problem-framing activity within project-based instruction at a U.S. charter school. They demonstrate the power of codesign in PBL, which enables students to take ownership. Almajed and colleagues adopt a constructionist interpretive approach to examining collaborative learning, specifically in case-based discussions in dental education. Their study reinforces prior assertions about the generative and productive nature of sociocognitive "knowledge conflicts" in inquiry-based group discussions. Wiggins and colleagues draw upon discursive psychology to analyze interactions in the first tutorial of a new PBL group. Their study illustrates how students present themselves in a new interprofessional group learning setting and indicates implications for group and academic identity development through interactions. In their discourse-based study of PBL in Japan, Imafuku and colleagues examine student participation patterns in an interprofessional education (IPE) seminar. Their analysis of classroom interactions and stimulated recall interviews sheds light on what and how learners gain in terms of both their collaborative processes of knowledge coconstruction and managing conflict in IPE. In another discursive psychology study, Hendry, Wiggins, and Anderson's fine-grained microanalysis of students in situ provides a nuanced accounting of personal mobile phone use during PBL to examine the management of psychological issues in talk and text. McQuade and colleagues' conversation analysis (CA) study addresses the problematic issue of how students manage instances of social loafing in PBL groups and makes visible the social dimension of teaching and learning within the PBL process, including the resilience of PBL learner identity and interactional strategies in mitigating the issues raised as a result of social loafing.

Finally, Lai, Wong, and Bridges' interactional ethnography (IE) explores how students and their facilitator incorporate a screen-sharing presentation system in face-to-face PBL tutorials to reshape knowledge coconstruction processes in a blended learning environment. Their findings suggest that the use of educational technologies in PBL can expand not only the facilitators' repertoire of effective strategies for scaffolding learning but also student's active engagement.

As a whole, this section moves us into new and nuanced understandings of the role of interactional processes for collaboration and inquiry, which are central to the tenets of problem-based learning.

CHAPTER 1

Qualitative Research in Problem-Based Learning in Health Sciences Education

A Review

Jun Jin
University of Graz
Susan M. Bridges
The University of Hong Kong

INTRODUCTION

Problem-based learning (PBL) has had a profound impact on education worldwide. While its implementation has gradually extended from clinical to nonclinical disciplines (Lu, Bridges, & Hmelo-Silver, 2014), the majority of research studies in PBL have been conducted in health sciences educational contexts such as medicine (Schmidt, Vermeulen, & van der Molen, 2006) and dentistry (Winning & Townsend, 2007). This body of research has mainly emphasized quantitative investigations, with growing interest in mixed-methods approaches (Albanese & Mitchell, 1993; Berkson, 1993; Newman, 2003; Shin & Kim, 2013; Smits, Verbeek, & de Buisonjé, 2002; Vernon & Blake, 1993). This may be seen as a historical shift from positivist toward interpretivist designs. Indeed, the role of qualitative research in health sciences education has been increasingly acknowledged since the 2000s (Bligh & Anderson, 2000; Eva & Lingard, 2008), and its impact on the field in addressing new lines of inquiry is expanding.

Qualitative research aims to gain an understanding of people's experiences in the world and their perspectives in social situations. Merriam (1998) identified five central characteristics of qualitative research in education:

1. Understanding the phenomenon of interest from the participants' perspectives, not the researcher's;
2. Situating the researcher as the primary instrument for data collection and analysis;

3. Usually involving fieldwork;
4. Employing an inductive research strategy; and
5. Focusing on process, meaning, and understanding with the product of a qualitative study being richly descriptive (Merriam, 1998, p. 6).

As such, qualitative research aims to capture the complexities and subtleties of human thoughts and behaviors rather than measure population variables as in survey research (Cohen, Manion, & Morrison, 2000). Quantitative studies tend to select large samples in experimental designs, with randomized control trials viewed as a "gold standard," particularly in health sciences research. Their goal is to achieve an objective, generalizable representation of a phenomenon. Qualitative studies, on the other hand, are inclined to focus on small, nonrandom, and purposeful samples such as typical and atypical case studies to gain subjective, nuanced understandings.

Qualitative studies in PBL, compared to quantitative studies that mainly measure the effectiveness of PBL programs or curricula, primarily investigate the perceptions of participants and various practices within the PBL process. Some of the earlier qualitative studies in problem-based health sciences education drew on public health survey traditions to examine students' and facilitators' perceptions through open-ended questions in written questionnaires, focus group interviews, and other self-report approaches (e.g., Steinert, 2004; Virtanen, Kosunen, Holmberg-Marttila, & Virjo, 1999). Previous literature reviews of PBL in health sciences education have predominantly included these quantitative studies. For example, Koh, Khoo, and Wong's (2008) review focused on the effects of PBL on physician competency, while Polyzois, Claffey, and Mattheos's (2009) review investigated the benefits of PBL compared with conventional teaching.

Hmelo-Silver (2004) and Bridges, McGrath, and Whitehill (2012) noted that there were fewer empirical studies to investigate *what* and *how* students were learning in the PBL process. The potential for the relevance and utility of qualitative research in studies of PBL in health sciences education research is indicated, but no systematic work has been conducted to date to map trends in this relatively new field. Thus, it is timely to review this developing field and identify future directions in terms of both research focus and approach. This review therefore focuses on qualitative research studies in PBL in health sciences education, with a particular focus on current and emerging methodological trends. The key research question

addressed is: What are the current methodological trends in qualitative research studies in PBL in health sciences education?

As Chiriac (2008) suggested, a good literature review presents a critical synthesis of research articles, identifies knowledge, highlights gaps, and provides guidance, eventually offering a new perspective. For this literature review, the existing research studies of PBL in health sciences education were searched via online databases, and the results were synthesized. Research foci, methods, and findings are identified. Research gaps are indicated in terms of topics, study designs, and methodology in general. The implications for future research are discussed accordingly.

Methods

The screening process and classification of selected articles were guided by Cook and West's (2012) stepwise approach to conducting systematic reviews in medical education (Leung, Mok, & Wong, 2008; Polyzois, Claffey, & Mattheos, 2009), as presented below.

Screening Process

Two computerized databases were screened: the Educational Resources Information Center (ERIC) and PubMed. ERIC is a digital library of education literature, and PubMed includes peer-reviewed literature in health sciences education. Initial search terms were "problem-based learning," OR "PBL," AND "qualitative." Publications in the English language were selected. Following are the criteria for inclusion:

1. Original research was done within health sciences education between 2000 and 2015.
2. Empirical studies were conducted in real-life PBL classrooms.
3. The subjects of studies were students in health sciences education.
4. The research methods in the studies were solely qualitative.

The following were excluded:

1. Controlled or simulated study designs.
2. Mixed-methods (both quantitative and qualitative methods) studies.
3. Review studies.

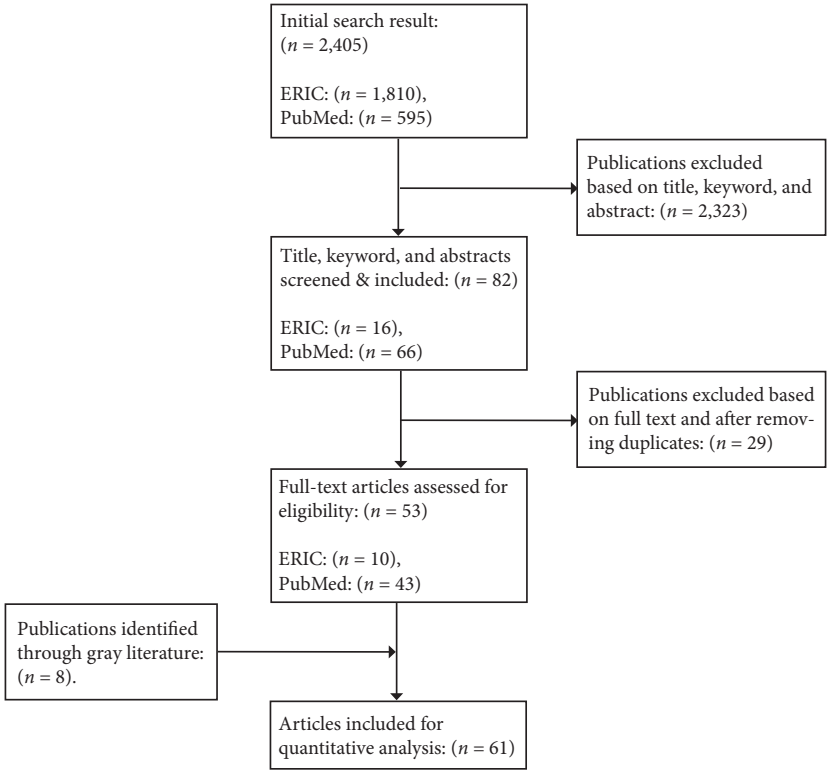

Figure 1.1 The process of literature searching and identification.

The process of literature searching and identification is presented in Figure 1.1. Precisely 2,405 journal articles were identified in the initial search. Titles, keywords, and abstracts of articles were then screened to refine results according to the above criteria for inclusion and exclusion. This screening process resulted in the selection of 82 publications that met the criteria for inclusion. Full-text articles were retrieved and assessed, while duplicates were removed. From there, 53 full-text articles were included for in-depth review. Cross-referencing uncovered eight additional qualitative research articles from the gray literature. Finally, 61 full-text articles were included for analysis.

Classification of Selected Articles

In order to address the research questions, the studies were classified according to research methodology. The coding categories were discussed

and confirmed by the research team. Based on the identified features of data sources and research methods in qualitative study designs (Denzin & Lincoln, 2000; Holliday, 2002; Merriam, 1998), four groups of studies were identified. These included self-reported studies using interview data (see Table 1.1), studies analyzing video recordings of PBL tutorials (see Table 1.2), introspective studies analyzing written reflections (see Table 1.3), and studies using multiple qualitative methods (see Table 1.4). Following Cook and West's (2012) approach, key information (i.e., author, year, research focus, subject, region, data sources, analytical approach, and main findings) for each article was included. The results were then analyzed and synthesized by narrative or quantitative pooling, examining themes of key information in the selected articles. The quality of these studies is not assessed, which is a limitation in this review process.

RESULTS

The number of recent qualitative research studies of PBL in health sciences education is small but growing, with 61 qualitative articles identified in the review period. Four main research issues in PBL were identified in the review period: (1) participants' experiences or perceptions, (2) facilitation, (3) assessment, and (4) educational technologies. Participants' experiences or perceptions of PBL have drawn the most research attention to date, while issues of facilitation, assessment, and educational technologies have been addressed to a lesser degree. Identified articles include self-reported studies using interview data (n = 29) (see Table 1.1); studies analyzing video recordings of PBL tutorials (n = 9) (see Table 1.2); introspective studies analyzing written reflections (n = 6) (see Table 1.3); and studies using multiple qualitative methods (n = 17) (see Table 1.4). Among these studies, the majority are perception studies, with only a limited number focused on the learning process of PBL or conducting interactional analysis. The following section reviews the research topics and findings of the 61 selected articles.

Participants' Experiences of PBL

While the self-reported and introspective studies in Tables 1.1 and 1.3 provided access to participants' reflections and insights into PBL by analyzing interviews and written reflections, all 9 studies in Table 1.2 drew upon analysis of video recordings to examine actual, real-time learning processes

TABLE 1.1 *Self-Reported Studies Using Interview Data*

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Chan et al. (2015)	Participants' perceptions of mobile device usage	Facilitators (n = 6) and undergraduate medical, dental, and speech and hearing sciences students (n = 44); Hong Kong	Interviews; focus groups	Grounded theory and a systematic coding procedure (Creswell, 2008; Sbaraini et al., 2011)	• Participants found mobile devices to be useful learning tools, yet they were aware of the potential distractions for students and negative effects on student learning.
Spiers et al. (2014)	Experience trajectories and satisfaction of graduates	Nursing graduates (n = 45); Canada	Interviews; focus groups	Thematic analysis (Charmaz, 2009); comparative matrix analysis (Draucker et al., 2007)	• Diverse levels of satisfaction are differing orientations to studying, The approach to understanding how students typically approach learning is strongly linked to perceptions of academic quality and program satisfaction in higher education research.
Landeen et al. (2013)	Perceptions of consistency among students and faculty in PBL	Nursing students (n = 16) and faculty (n = 13); Canada	Interviews; focus groups	Thematic analysis using Morse and Field's (1995) four intellectual processes	• Less-experienced students were more likely to describe consistency in terms of sameness and fairness. • More-experienced students and faculty had a higher tolerance for ambiguity and valued learning experiences adapted to students' learning needs.

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Cooper & Carver (2012)	Students' experience in PBL	Postgraduate students in mental health nursing (n = 30); UK	Focus group	Constant comparative method (Burnard, 1991)	• Participants had mainly positive experiences and gained a range of study and interpersonal skills. • There were initial anxieties, but participants increasingly gained confidence.
Green-Thompson et al. (2012)	Graduating students' reflections of a transforming medical curriculum	Graduating medical students (n = 35); South Africa	Individual and pair interviews; focus group s	Content analysis: Tesch's (1990, in Creswell, 2003) eight steps	• A number of areas need attention: ensuring that assessment is standardized; student support structures, and appropriate levels of teaching.
Gunn et al. (2012)	How skills gained through PBL are applied in practice	Physiotherapy placement supervision (n = 10); UK	Interviews	Thematic analysis (Braun & Clarke, 2006)	• The supervisors felt that PBL offered positive benefits for both student education and clinical practice. • There was evidence of the application of skills and attributes associated with PBL, including positive learning behaviors and a high level of motivation and self-direction.

(*continued*)

TABLE 1.1 (*Continued*)

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Papinczak (2012)	Perceptions of job satisfaction	Year 1 & Year 2 tutors (n = 13); Australia	Focus groups	Constant comparison methods (Corbin & Strauss, 1990); refinement and validation based on Allen and Meyer's (1990) framework	• Supportive and compensatory nature of the collegial relationships were formed between casual tutors. • Role attenuation was a predominant perception because it related to dysfunctional groups and increasing student disengagement with PBL.
Singaram et al. (2011)	Collaborative heterogeneous PBL group learning	Year 2 medical students (n = 10) and facilitators (n = 11); South Africa	Focus groups	Open and axial coding (Strauss & Corbin, 1998)	• Collaborative heterogeneous learning has two sides that need to be balanced: ideology vs. practice.
Bearn & Chadwick (2010)	Students' experiences	Postgraduate orthodontic students (n = 12); UK	Interviews; focus groups	Inductive approach (nonspecified)	• PBL led to tensions both within the individuals and the group because of the conflict between valuing it and practical problems.
Lekalakala-Mokgele (2010)	Experiences of facilitators and students	Facilitators (n = 4 groups, 5–8 per group) and nurse students (n = 8 groups, 8–12 per group) in 4 universities; South Africa	Focus groups	Content analysis: Tesch's (1990) eight steps and Giorgi's (1970) basic steps	• The control of teaching and learning became a problem for the students. • Traditionally trained facilitators experienced difficulties.

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Midla & Coryell (2010)	PBL preparation for physician assistant faculty	Faculty members (n = 7) in 2 universities; USA	Interviews	Inductive approach (Creswell, 2003; Hitchcock & Hughes, 1995) and grounded theory (Strauss & Corbin, 1990)	• Issues addressed included facilitator outlook, previous experience, approaches that assisted in preparing faculty and students to teach and learn, academic resources, and the use of nonclinical tutors.
Papinczak (2010)	Perceptions of tutor evaluation	Tutors (n = 9) and medical students (n = 7); Australia	Interviews; focus groups	Inductive approach (Patton, 1990)	• PBL tutorial environment can create school-wide mistrust and confusion (tutor and student) on several levels.
Al Kadri et al. (2009)	Students' and teachers' perceptions of clinical assessment program	Teachers (n = 12) and health science students (n = 40); Saudi Arabia	Interviews; focus groups	Open coding and axial coding phases of grounded theory (Strauss, 1987)	• Assessment affects students' perceptions of learning and how they learn. • These effects are not uniformly positive.
Bollela et al. (2009)	Students and tutors' social representations of assessment	Tutors (n = 10) and medical students (n = 10); Brazil	Interviews	Content analysis using ALCESTE (Analyze Lexicale par Contexte d'un Ensamble de Segments de Texte) software	• Both students and tutors felt undertrained and lacked confidence in tutorial assessments.

(*continued*)

TABLE 1.1 (*Continued*)

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Barron et al. (2008)	A creative and visual trigger to stimulate student inquiry	Year 1 students (n = 75); Ireland	Focus groups	Content analysis (Burnard, 1991)	• Well designed, open ended, real life, and challenging "problems" or "triggers" are key elements to the success of PBL implementation. • One challenge is that the process is primarily controlled by lecturers.
Mete & Sari (2008)	Students' expectation from tutors and effects of tutors' behavior on students	Nursing students (n = 21); Turkey	Focus groups	Content analysis (Strauss & Corbin, 1990)	• Seven tutor characteristics were identified. • Tutors' behavior affected their motivation and success in PBL.
Shankar et al. (2007)	Student views on P-drug learning sessions, assessment, and small-group dynamics	Medical students (n = 12); Nepal	Focus groups	Inductive approach (nonspecified)	• The sessions on P-drugs should be continued and strengthened with modification and possible extension. • Sessions during the clinical years and internship training can be considered.
Goldie et al. (2007)	Medical tutors' and students' perspectives of professionalism in the early years	Tutors (n = 10) and student focus groups (n = 3); UK	Interviews; focus groups	Grid analysis (Knodel, 1993) and coding (Morgan, 1997)	• Reflection is integral to professional development. • Early clinical contact is an important part of the process of socialization. • Role models can contribute to students' learning and identity formation.

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Heading et al. (2007)	Using PBL in public health service–. based training	Public health trainees (n = 9) and staff (n = 10); Australia	Interviews	Inductive analysis (nonspecified)	• Collaboratively developed and delivered, experiential rural public health PBL was a positive learning experience for trainees in public health. • PBL appears to be suitable in rural and nonrural public health training settings.
White (2007)	Pedagogy and achievement of self-regulated learning goals	Medical students (n = 36); USA	Interviews	Thematic analysis (Miles & Huberman, 1994)	• PBL and traditional students described two very different medical school experiences. • The traditional students had a rougher transition from the classrooms to the clerkships.
Matthew-Maich et al. (2007)	PBL nurse education in a community of faculty development	Nursing staff (n = 30); Canada	Focus groups	Thematic analysis (Burnard, 1991; Sandelowski, 1995)	• Attests to the benefits of a collaborative faculty development program • Process will guide future faculty development, and promote mastery in PBL

(*continued*)

TABLE 1.1 (*Continued*)

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Fyrenius et al. (2007)	Students' conceptions of underlying principles	Medical students (n = 16); Sweden	Interviews	Phenomenography (Dahlgren & Fallsberg, 1991)	• A complex conception of underlying principles includes an ability to problemize phenomena beyond long causal reasoning chains, which is often rewarded.in traditional examinations and tests. • Keywords for problemized processing are as follows: comparisons, differences, similarities, conditions, context, relevance, multiple sampling, connections, and dependencies.
Visschers-Pleijers et al. (2006)	Student perceptions about the characteristics of an effective discussion	Year 1 and 2 medical students (n = 48); Netherlands	Focus groups	Deductive analysis based on van Boxtel's (2000) coding scheme and Mercer's (1996) modes of talk	• Students have clear ideas about what promotes effective discussions during the reporting phase. • Their PBL experience has provided them with some insights that are in line with theory and research on collaborative learning.
Wood (2006)	Views of the effectiveness of PBL	Mental health students (n = 14); UK	Focus groups	Content analysis (nonspecified)	• There is a need to carefully plan students' initial placement experiences and provide extra support at this stage. • There is a need to extend mentor preparation on the use of PBL in practice to ensure flexibility in the PBL process.

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Dornan et al. (2005)	How clinicians perceive their roles, and how closely those perceptions link to the curriculum they teach	General physicians (n = 14); UK	Focus groups	Phenomenological method (Moustakas, 1994)	• Third-year clinical teaching was described in terms that bore little relation to PBL. • Teachers placed great importance on the social dimension of professional learning. • Traditional apprenticeship is unsustainable under present-day conditions of practice.
Lohfeld et al. (2005)	Canadian residents' views on PBL	Medical residents and fellows (n = 17); Canada	Interviews	Thematic analysis (Addison, 1999)	• Medical residents are an underutilized source of information about undergraduate medical programs. • More emphasis on faculty development and upgrading health-care problems will improve PBL-based education.
O'Neill et al. (2003)	The views of preregistration house officers using critical incidents	Traditional course graduates(n = 24) and new course graduates (n = 23)	Interviews	Grounded Theory (Dunn & Hamilton, 1986; Glaser & Strauss, 1967; Miles & Huberman, 1994; Green, 1998; Strauss & Corbin, 1998)	• Graduates of the new, integrated curriculum seemed to be much better at dealing with uncertainty, knowing their personal limits, and asserting their right to support when they felt the limits had been reached. • Communication difficulties and emotional involvement remain major factors in students' transition to preregistration house officers PRHO.

(*continued*)

TABLE 1.1 (*Continued*)

Author & year	Research focus	Subject & region	Data sources	Analytical approach	Main findings
Prince et al. (2000)	Students' perceptions and attitudes regarding this transition in undergraduate medical training	Fifth-year medical students (n = 20)	Focus groups	Thematic analysis (nonspecified)	• Students have difficulty bridging the gap between the theoretical and clinical phase of the curriculum, as well as applying theoretical knowledge in clinical practice. • In the clinical phase their learning changes from passive acquisition of knowledge to more active learning.
Treloar et al. (2000)	Factors affecting progress of Australian and international students in a PBL medical course	Medical students (n = 30); Australia	Interviews; focus groups	Thematic analysis (nonspecified)	• Positive and negative experiences related to the course structure were identified by students • Students' experiences demonstrated a relationship between sense of "belongingness" to the medical school community, participation in learning opportunities and progress through the course

TABLE 1.2 *Studies Analyzing Video Recordings of PBL Tutorials*

Author & year	Research focus	Subject & context	Data sources	Analytical approach	Main findings
Lu & Chan (2015)	Whether paper and video triggers stimulate different social and cognitive processes	Year 2 medical students and their facilitator (n = 11); Hong Kong	Videotaping of PBL tutorials	Inductive and deductive analysis (Kamin et al., 2001)	• Students who used video triggers put more effort into communicating their understanding of the problem and relevant knowledge than students who used paper triggers.
Aarnio et al. (2014)	How tutor facilitation helps students to collaboratively resolve conflicts on knowledge	Medical and dental tutors (n = 3), first-year medical students (n = 23), and dental students (n = 10); Finland	Videotaping of PBL tutorials	Defining and detecting the conflict and tutor intervention episodes in the video; categories were identified	• Tutors often intervened by confirming what the students had said or by giving explanations. • Tutors gave more explanations during knowledge conflicts.
Hmelo-Silver (2013)	The learning space in a PBL tutorial led by an expert facilitator	Year 2 medical students (n = 5); USA	Videotaping of PBL tutorials	Content analysis (Hmelo-Silver & Barrows, 2008)	• Much of students' talk is focused on related conceptual spaces. • A substantial amount of the overall learning space is engaged in the group discussion.

(*continued*)

TABLE 1.2 (*Continued*)

Author & year	Research focus	Subject & context	Data sources	Analytical approach	Main findings
Yew & Schmidt (2009)	Evidence for constructive, self-regulatory, and collaborative processes	Year 1 health science students (n = 5); Singapore	Audio recording of PBL tutorials and SDL	Episodic coding scheme (van Boxtel, 2000)	• PBL encourages students toward constructive, self-directed, and collaborative learning activities. • The proportions of interaction for constructive processes were less compared to those for collaborative and self-directed activities.
Clouston (2007)	Exploring methods of analyzing talk in PBL tutorials	Health-care students (n = 9) and tutor (n = 1); UK	Videotaping of PBL tutorials	Discourse analysis (Fairclough, 1995; Silverman, 2001) and conversation analysis (Psathas, 1995; Sacks, 1984, 1992)	• Discourse and conversation analysis can enable an understanding of how effective problem-based learning communication is constructed.
Woodward-Kron & Remedios (2007)	Classroom discourse in PBL classrooms in the health sciences	Year 1 medical students; Australia	Videotaping of PBL tutorials	Discourse analysis (Eggins & Slade, 1997)	• Students draw on linguistic resources to coconstruct and negotiate knowledge, as well as show how the tutor, with minimal strategic interventions, scaffolds students' learning • The PBL environment can be a challenging one for students whose cultural and linguistic backgrounds differ.

Author & year	Research focus	Subject & context	Data sources	Analytical approach	Main findings
Legg (2007)	The genre of PBL tutorial	Year 1 medical students (n = 48); Hong Kong	Videotaping of PBL tutorials	Genre analysis (Eggins & Slade, 1997)	• A consistent structure was identified in all the tutorials: – 3 compulsory and 3 optional stages; and – 2 overall macro moves.
Hmelo-Silver & Barrows (2006).	To understand the goals and strategies of an expert facilitator in support of collaborative learning	Year 3 medical students (n = 5); USA	Videotaping of PBL tutorials	Interaction analysis (Jordan & Henderson, 1995)	• An expert facilitator has a repertoire of strategies that can be adapted to meet the goals of PBL.
Visschers-Pleijers et al. (2004)	Exploration of a method to analyze group interactions in problem-based learning	Year 1 medical students (n = 2 group) and Year 2 medical students (n-1 group); Netherlands	Videotaping of PBL tutorials	Episodic coding scheme (van Boxtel, 2000)	• Cognitive interactions were identified in the tutorial groups. • Transcript analysis supported identification of coconstructions.

TABLE 1.3. *Introspective Studies Analyzing Written Reflections*

Author & year	Research focus	Subject & context	Data sources	Analytical approach	Main findings
L'Ecuyer et al. (2015)	Effectiveness of PBL in preparing students for interprofessional collaborative practice	Undergraduate nursing students (n = 81); USA	Reflective assignments	Content analysis (Kolb, 1984; Eyler & Giles, 1999)	• PBL is an effective method for teaching interprofessional collaboration skills to nursing students.
Rowe (2012)	Use of assisted performance within an online social network to develop reflective reasoning	Year 3 & 4 physiotherapy students (n = 70); South Africa	Reflective blog posts within the network	Deductive approach based on the Theory of Assisted Performance (Tharp & Gallimore, 1991)	• Online social networks can be used to facilitate reflective reasoning in clinical contexts. • Careful facilitation using sound pedagogy is still necessary.
Larin et al. (2010)	Students' perceptions of PBL in a transitional doctoral program	Physical therapy students (n = 63); USA	Reflective journals	Inductive approach (Creswell, 2007)	• A single PBL course within the curriculum was well accepted by students. • Students appreciated the benefits of learning in a group.
Hendry (2009)	Tutors' conceptions of their development as tutors	Tutors (n = 29); Australia	Written responses	Inductive approach (Åkerlind, 2007)	• Four conceptions of the PBL tutor role were identified. • There was homogeneity in the relations between levels of sophistication.

Author & year	Research focus	Subject & context	Data sources	Analytical approach	Main findings
Lin (2005)	Medical students' perception of good PBL tutors	Tutors (n = 29) and undergraduate medical students (n = 49); Taiwan	Tutor evaluation forms	Deductive approach (De Grave et al., 1999)	• Students valued personality aspects of a tutor, an area that had been neglected in previous studies.
Solomon & Crowe (2001)	Perceptions of student peer tutors	Physiotherapy students (n = 59); UK	Reflective journals	Open-coding technique (Strauss & Corbin, 1990)	• Students struggled with basic facilitation skills and had difficulty separating the role of student from that of tutor. • Students developed strategies to allow them to succeed, were able to evaluate their performance in a positive light, and appeared to value their tutoring experience

TABLE 1.4. *Studies Using Multiple Qualitative Methods*

Author & year	Research focus	Subject & context	Data source	Analytical approach	Main findings
Skinner et al. (2015)	Students' understandings of the purpose and value of PBL groups for their learning	Year 1 undergraduate dental students; Australia & Ireland	Classroom observations; interviews	Ethnography using inductive thematic method (Liamputtong & Ezzy, 2005) based on a grounded theory approach (Charmaz, 2000)	• Students constructed PBL as individual knowledge gain and group purpose as information gathering and exchange. • Few students acknowledged the learning potential of group processes. • Group value depended on assessment and curriculum context.
Jin et al. (2015)	Role of online searching during PBL tutorials	2 PBL groups of Year 1 undergraduate students in medicine and dentistry (n = 19); Hong Kong	Video and audio recordings of PBL tutorials; stimulated recall interviews	Interactional ethnography (Green, Dixon, & Zaharlick, 2003; Rex, 2006); Thematic analysis (Monrouxe, Rees, & Hu, 2011; Ritchie & Spencer, 1994)	• Use of students' personal mobile devices with online searching capacity is considered a dynamic pedagogically and socially constructed process. • Online searching during the PBL process was identified as a "site-of-struggle" for first-year undergraduates.
Imafuku et al. (2014)	The processes of collective knowledge construction in Japanese students in PBL tutorials	Year 3 students from medicine, dentistry, and pharmacy (n = 12); Year 2 students (n = 6) from nursing, occupational therapy, and physiotherapy; Japan	Videotaping of PBL tutorials; e-portfolio	Ethnographic case study using classroom discourse analysis (Tsui, 1994; Eggins & Slade, 1997); thematic coding of e-portfolio (Strauss & Corbin, 1998)	• Two patterns of knowledge construction were identified: (a) coconstructions between students from different disciplines and (b) elaborations between students from the same discipline.

Author & year	Research focus	Subject & context	Data source	Analytical approach	Main findings
Lee et al. (2013)	Tutors' behavior in facilitating group dynamics	Tutorial groups from various medical disciplines (n = 40); Taiwan	Videotaping of PBL tutorials and tutors' explanations of their interventions	Grounded theory and constant comparative method (Pope et al., 2000)	• Tutors' intentions of their interventions were identified as: (a) iteration of PBL principles, (b) delegation of responsibility to the students, (c) creation of a good discussion forum, and (d) the generation of a good learning atmosphere.
Paige & Smith (2013)	Faculty participation in PBL	Nurse faculties (n = 50); US	Interviews and observation	Interpretive phenomenological analysis (Smith, et al., 2009)	• Epistemic doubt happens when action and intent toward PBL teaching perspective do not match underlying beliefs.
Anderson & Reid (2012)	Students' perceptions of a PBL scenario	Year 1 dental nurse students (n = 21); UK	Open-ended questionnaires regarding students' perceptions	Inductive approach (Braun & Clarke, 2006; Silverman, 2005)	• PBL could be valuable in the acquisition of deep knowledge and improved patient care. • There were concerns about confidence in PBL sessions and a need for improved feedback.
Frambach et al. (2012)	How culture challenges SDL	Year 1 & 3 medical students (n = 56), tutors (n = 17), and curriculum leaders (n = 15); Middle East, Hong Kong, and Netherlands	Interviews; observations; document analysis; contextual information	Thematic approach using template analysis (King, 2004)	• Cultural factors can pose a challenge to the application of PBL in non-Western settings. • Contextual factors can inhibit or enhance SDL.

(*continued*)

TABLE 1.4 (*Continued*)

Author & year	Research focus	Subject & context	Data source	Analytical approach	Main findings
Lee et al. (2009)	When a problem-based learning tutor decides to intervene	Medical tutors (n = 8); Taiwan	Videotaping of PBL tutorials; stimulated recall	Grounded theory, constant comparative method (Pope, et al., 2000)	• Identified 3 types of tutor interventions: (a) tutorial group process; (b) quality of discussion; and (c) quality and quantity of the materials discussed
Moore (2009)	Lecturer as facilitator within PBL context	Nursing lecturers (n = 12); UK	Observations; interviews; memo writing	Open coding and constant comparative analysis (Boychuk, 2004; Corbin, 1986; Glaser & Strauss, 1967)	• Personal pedagogical beliefs and values influenced lecturers' interpretations and applications of their roles as facilitators
Cooke & Matarasso (2005)	Promoting reflection in mental health nursing practice	Student (n = 1); Australia	written analysis of 5 cases; interviews	Thematic analysis (nonspecified)	• The case illustrated the students' reflections on the theme of "hope" for the clients and identified three obstacles. • Reflective learning strategies can be incorporated in on- and off-campus learning environments.
Schoenfeld-Tacher et al. (2005)	Whether and how the introduction of a new technology (WebCT) influenced faculty teaching styles while facilitating in PBL	Clinical sciences faculty members (n = 9); USA	Observations; interviews	Inductive approach (Schwandt, 2001)	• There was no direct evidence to suggest use of WebCT affected teaching behaviors. • All facilitators showed a moderate increase in comfort with the technology during the semester, and one participant showed remarkable gains in technology skills.

Author & year	Research focus	Subject & context	Data source	Analytical approach	Main findings
Valaitis et al. (2005)	Students' views about learning and group process in the online environment	Undergraduate nursing and midwifery students and graduate students in a neonatal nurse practitioner program (n = 22) and tutors (n = 30); Canada	Individual written reflections; focus groups	Constant comparison approach (Lincoln & Gube, 1985)	• Conducting PBL online is feasible. • Students felt that it increased their flexibility for learning, enhanced their ability to deeply process content, and provided access to valuable learning resources. • Students experienced a period of adaptation to the online environment, perceived a heavy workload, and had difficulties making group decisions online.
Bland (2004)	Teaching statistics to medical students using PBL	Medical schools using PBL (n = 10); Australia	Interviews; emails	Thematic analysis (specified)	• Difficulties in implementing an integrated approach were identified; however, not integrating is detrimental to statistics and research methods teaching, requisite for evidence-based medicine.
Lloyd-Jones & Hak (2004)	The experience and practice of students entering a PBL medical undergraduate course and to identify contributory social, curricular, and contextual factors	Two successive cohorts of Year 1 medical students; UK	Participant observation; interviews and focus groups; survey; documentary analysis	Inductive approach (Mammersley & Atkinson, 1995)	• Student learning was socially agreed upon among the peer group and directed by faculty-given resources.

(*continued*)

TABLE 1.4 (*Continued*)

Author & year	Research focus	Subject & context	Data source	Analytical approach	Main findings
Ryan et al. (2004)	Evaluation of an online clinical reasoning guide	Year 3 medical students (n = 53) and clinical tutors (n = 6); Australia	Video documentation; Interviews	Inductive approach for video data (nonspecified); deductive approach for interview questions (nonspecified)	• The guide was used as an effective tool for augmenting the PBL process in clinical settings and promoting the development of clinical reasoning • Tool prompted critical thinking re: own, colleagues', and other clinicians' reasoning processes.
Darvill (2003)	Experience of diplomat student nurses and their PBL facilitators during a cultural awareness module	Student nurses (n = 20) and their lecturers (n = 4); UK	Participant observations; Focus groups; Student-diary summaries; Student evaluation	Thematic analysis (Burnard, 1991; Dey, 1993); pattern matching (Morse, 1994; Stake, 1994; Yin, 1994)	• Undergoing PBL as a teaching and learning strategy had positive outcomes for the students. • Challenges in the transition to a PBL strategy from the perspective of the students and lecturers were identified.
Solomon et al. (2003)	Students' perceptions of their learning through participation in an interprofessional problem-based course on rehabilitation and HIV	Senior-level students from the occupational therapy, physiotherapy, medical, nursing, and social work programs (n = 9), tutors (n = 2), resource tutors (n = 2); Canada	Journals; interviews	Open-coding technique (Strauss & Corbin, 1998)	• Students gained an appreciation of the roles of others and developed a sense of confidence through justifying their professional roles. • Students were able to increase the breadth and depth of their learning and also gained a rehabilitation perspective.

in PBL, and 9 of the 17 studies in Table 1.4 have used mixed qualitative methods to explore a more textured, nuanced picture of participants' experiences or perceptions in PBL (e.g., Anderson & Reid, 2012; Bland, 2004). These studies had different research foci in terms of participants' experiences or perceptions of PBL, including

- the dynamics of PBL tutorials (Cooper & Carver, 2012; Woodward-Kron & Remedios, 2007);
- clinical practice in a PBL curriculum (e.g., Heading, Fuller, Lyle, & Madden, 2007; Shankar, Palaian, Gyawali, Mishra, & Mohan, 2007);
- PBL curriculum in general (e.g., Bearn & Chadwick, 2010; Green-Thompson et al., 2012; Landeen, Jewiss, Vajoczki, & Vine, 2013; Spiers et al., 2014);
- the bridging or transitioning between classroom theory and clinical practice (e.g., Gunn, Hunter, & Haas, 2012; Prince, van de Wiel, Scherpbier, van der Vleuten, & Boshuizen, 2000); and
- comparison of traditional classrooms with PBL curricula (e.g., O'Neill, Jones, Willis, & McArdle, 2003; White, 2007).

The majority of these studies elicited student perceptions (e.g., Larin, Buccieri, & Wessel, 2010; L'Ecuyer, Pole, & Leander, 2015; Solomon & Crowe, 2001), with the remainder providing insights from both students/trainees and facilitators/staff (e.g., Landeen et al., 2013; Lekalakala-Mokgele, 2010), in addition to graduates (e.g., Lohfeld, Neville, & Norman, 2005; O'Neill et al., 2003; Spiers et al., 2014). The emerging body of research using video recordings and transcripts (Clouston, 2007; Legg, 2007; Visschers-Pleijers, Dolmans, Wolfhagen, & van der Vleuten, 2004; Woodward-Kron & Remedios, 2007; Yew & Schmidt, 2009) has begun to examine real-time interactional processes more closely to better understand the learning dynamic as it evolves within contexts and over the duration of a tutorial or problem cycle.

Among these qualitative studies, the findings have indicated the generally positive effects of PBL and its impact on student learning (e.g., Anderson & Reid, 2012; Gunn et al., 2012; Larin et al., 2010; O'Neill et al., 2003; Visschers-Pleijers, Dolmans, de Leng, Wolfhagen, & van der Vleuten, 2006; White, 2007). Studies have also noted some challenges in illustrating potential conflicts between ideology and classroom practice in

PBL (Bearn & Chadwick, 2010; Singaram, van der Vleuten, & Stevens, 2011; Treloar et al., 2000) and between the theoretical and clinical phases of the curriculum (Prince et al., 2000). Others have indicated difficulties in implementing an integrated approach (Bland, 2004), in addition to cultural tensions in the application of PBL in non-Western settings (Frambach, Driessen, Chan, & van der Vleuten, 2012).

Facilitation

Qualitative studies examining issues related to facilitation included explorations of

- facilitators' PBL preparation (e.g., Midla & Coryell, 2010),
- facilitators' roles (e.g., Dornan, Hadfield, Brown, Boshuizen, & Scherpbier, 2005; Hendry, 2009; Lin, 2005; Mete & Sari, 2008),
- the role of lecturer as facilitator (Moore, 2009),
- facilitators' interventions (Lee, Lin, & Lin, 2013; Lee, Lin, Tsou, Shiau, & Lin 2009),
- faculty development (e.g., Matthew-Maich et al., 2007) and job satisfaction (e.g., Papinczak, 2010), and
- perceptions of tutors' evaluations (e.g., Papinczak, 2012).

There is agreement that facilitators play an important role in PBL (Mete & Sari, 2008), with faculty development increasingly attracting qualitative researchers' attention. For example, Mete and Sari (2008) examined students' expectations of facilitators and the effects of facilitators' behavior as perceived by students. They used content analysis to classify individual facilitator characteristics and the behaviors that affect students' motivation and success in PBL. In Midla and Coryell's (2010) study, five factors related to facilitators' preparation for a PBL program were identified: facilitators' outlook, previous experiences, approaches, academic resources, and the use of nonclinical tutors. Lin (2005) investigated medical students' perceptions of good PBL tutors in Taiwan and indicated that students value the personality aspects of a tutor, which had been neglected in previous studies. Using video recordings of PBL tutorials and facilitators' stimulated recall, Lee et al. (2009) and Lee et al. (2013) explored facilitators' interventions in PBL tutorials. They identified a number of contextual situations, as well as facilitators' intentions for their interventions in facilitating group dynamics (Lee et al., 2013; Lee et al., 2009).

Assessment

Only two studies in Table 1.1 focused on the issue of assessment (Al Kadri, Al-Moamary, & van der Vleuten, 2009; Bollela, Gabarra, da Costa, & Lima, 2009). Al Kadri et al. (2009) conducted interviews and focus groups to investigate students' and teachers' perceptions of the clinical assessment program. They found that assessment affects students' perceptions of learning and the ways in which they learn in PBL, but these effects are not uniformly positive. Bollela et al. (2009) also conducted interviews to explore students' and tutors' social representations of assessment and found that students and tutors perceive that their training of tutorial assessment is inadequate and they are not confident in the assessment.

Educational Technologies

Qualitative studies of educational technologies in PBL have focused on how the innovations have impacted the PBL process. These include the incorporation of visual triggers for problem scenarios (Barron, Lambert, Conlon, & Harrington, 2008), mobile devices (Chan et al., 2015), online social networks (Rowe, 2012), online searching (Jin, Bridges, Botelho, & Chan, 2015), a learning management system (LMS; Schoenfeld-Tacher, Bright, McConnell, Marley, & Kogan, 2005), online guides (Ryan, Dolling, & Barnet, 2004), and a purpose-designed online environment (Valaitis, Sword, Jones, & Hodges, 2005). There was a general agreement that educational technologies were useful learning tools in PBL to enhance learning and teaching (Barron et al., 2008), facilitate reflective reasoning in clinical contexts (Rowe, 2012), increase flexibility for learning, and enhance students' ability to deeply process content (Valaitis et al., 2005). The findings also indicated some difficulties and challenges, such as potential distractions in PBL tutorials (Chan et al., 2015), the demand for new facilitation strategies in new environments (Rowe, 2012), impacts on workload, and difficulties in negotiating decisions in online environments (Valaitis et al., 2005).

DISCUSSION AND IMPLICATIONS

The systematic search yielded 61 articles that met the search criteria in the two databases from 2000 to 2015. Although meeting the criteria of being solely qualitative studies, the majority were self-report, participant perception designs. Given that health sciences educational research has

grown from the positivistic paradigms more familiar to the life sciences and is particularly influenced by public health surveying approaches, the initial, survey-based foray into qualitative approaches is a logical extension. Ethnographically oriented studies examining learning artifacts and records such as video recordings of classroom interactions were fewer in number, but their increasing presence indicates a growing methodological trend in the field. This recent interest in ethnographic, discourse-based qualitative research designs in PBL addresses questions related to *processes* rather than *perceptions*. This is, we would argue, a logical evolution of the field, particularly given PBL's philosophical focus on learning processes. The research foci of the 61 articles, current practices of methodology—including strategies of inquiry, data sources, and analytical approaches—and research sites are identified, analyzed, and discussed below.

Research Foci

Participants' experiences or perceptions of PBL have drawn the most qualitative research attention to date, so the issues of facilitation, assessments, and educational technologies need to be explored further. In addition, it is of critical importance to contribute further interactional data and analysis on PBL in action (Bridges, Botelho, Green, & Chau, 2012) due to a perceived lack of studies of what and how students are learning (Hmelo-Silver, 2004; Prosser, 2004). Investigating collaboration or participation patterns and processes can allow researchers to understand better how learning is occurring and under which circumstances interaction can effectively support and be supported in the PBL process (Dillenbourg, Baker, Blaye, & O'Malley, 1995; Prosser, 2004; Visschers-Pleijers et al., 2006;). Theoretically, while most of the qualitative studies explored PBL from a cognitive perspective, those papers introducing sociocultural and critical perspectives illustrate how such theoretical orientations can foster research designs that provide novel and insightful understandings of PBL in social practice at macro and micro levels. Further, examining PBL from a sociocultural perspective can provide insights into how subjects interact through assisted performance in specific social, historical, and cultural contexts (Lantolf, 2000; Vygotsky, 1978). A critical perspective draws on poststructuralist and postmodernist notions of social identity and power (Gibson, 1986; Rogers, 2004) and holds potential to explore how these impact student group dynamics, knowledge construction, and analytic skills development within the PBL process. There is also scope to explore

the larger curriculum design and management levels of a PBL curriculum design (Bridges, Yiu, & Botelho, 2016) from a critical perspective.

Strategies of Inquiry

In delineating the key elements of qualitative research, it is essential to be aware of strategies of inquiry (Creswell, 2007, 2013; Denzin & Lincoln, 2011). Denzin and Lincoln (2011) noted that these strategies of inquiry included case studies, ethnographies, phenomenological and ethnomethodological approaches, life histories, historical methods, action research, and clinical research. Creswell (2013) emphasized five qualitative approaches: narrative research, phenomenology, grounded theory, ethnography, and case study. A few of the educational studies included in this literature review have been explicit about their orienting theoretical framework or strategy of inquiry, such as the use of ethnography (Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014) and grounded theory (Lee et al., 2009; O'Neill et al., 2003). Although study designs are well established and presented, the majority of the studies identified have not clearly indicated the strategies of inquiry, particularly in terms of a framing theoretical perspective. As future investigations are planned and conducted, more in-depth considerations of methodological framing and choice of research strategy should be clearly identified.

Data Sources

Most of the reviewed studies (see Tables 1.1 and 1.3) have investigated PBL through interviews, focus groups, and reflective journals/blogs, which are readily accessible means of exploring participants' viewpoints while emphasizing the social situatedness of the research (Kvale, 1996). By using self-report data, these studies have enabled participants to share personal insights into PBL in terms of what they perceived that they (a) knew (knowledge or information), (b) liked or disliked (values and preferences), and (c) thought (attitudes and beliefs) (Tuckman, 1972). A limitation is the bias that is inherent in self-reporting (Hmelo-Silver, 2004). Other records, such as real-time audio and video recordings of PBL in situ, especially when combined with stimulated recall, have the potential to be more powerful in detecting participants' practices and thinking processes. Audiovisual recordings in educational research have "the capacity for completeness of analysis and comprehensiveness of material, reducing the dependence on prior interpretation by the researcher" (Cohen et al., 2007, p. 407).

Thirteen of the 61 studies identified in this review (e.g., Aarnio, Lindblom-Ylänne, Nieminen, & Pyörälä, 2014; Clouston, 2007; Lee et al., 2013; Lee et al., 2009; Legg, 2007; Visschers-Pleijers et al., 2004; Woodward-Kron & Remedios, 2007; Yew & Schmidt, 2009) have used video recordings as a record for analysis. Visschers-Pleijers et al. (2004) indicated that group interaction in PBL is easier to elicit from analysis of transcripts of video-recorded PBL tutorials. Only 3 of the 61 studies (e.g., Jin et al., 2015; Lee et al., 2013; Lee et al., 2009) used stimulated recall of video as an additional think-aloud protocol. In one of the earlier applications in PBL research, De Grave, Boshuizen, and Schmidt (1996) noted that the stimulated recall approach provided detailed and unique information about hypothesis evaluation and meta-reasoning during PBL discussions and argued that the process of conceptual change by students can be made visible. They suggested that the stimulated recall method was sensitive for detecting conceptual change during problem analysis. There is potential for further studies to adopt these sources.

Analytical Approaches

Historically, thematic analysis of qualitative records using inductive and deductive approaches (Glaser & Strauss, 1967; Marshall & Rossman, 1995) has been well accepted by researchers interested in categorizing accounts or aspects of accounts. This was found to be the predominant approach adopted in the studies yielded by this systematic review. A major benefit of this approach is the ability to organize and classify large amounts of text (documents, transcripts, open-ended written responses, etc.), including video records. Specialist coding software can support thematic coding across large datasets. However, it is worthwhile to note the potential of other analytical approaches, from discourse-based approaches to analysis of recordings made in educational contexts. In this literature review, only a limited number of studies used alternative analytical approaches such as discourse analysis (Clouston, 2007; Imafuku et al., 2014; Legg, 2007; Woodward-Kron, & Remedios, 2007), interaction analysis (Hmelo-Silver & Barrows, 2006), and interactional ethnography (Jin et al., 2015). Clouston (2007) suggested that discourse analysis and conversation analysis could enable an understanding of how effective PBL communication is constructed. He argued that by analyzing patterns of group communication and considering how participants give meaning to PBL talk, problem-solving sequences and facilitation devices can be highlighted.

Likewise, Legg's (2007) application of genre analysis illustrated how the approach can assist in identifying consistent learning discourse patterns and structures in PBL tutorials. Thematic and discourse-based approaches to analysis differ in terms of purpose, units, and levels of analysis of the phenomena under examination. Such analytic approaches have strong potential to broaden our understanding of PBL processes.

Research Sites

While noting that the body of qualitative research in PBL has been growing, it was evident in this review that few studies have addressed PBL in non-Western contexts (Imafuku et al. 2014; Lee et al., 2013; Lee, et al., 2009; Lin, 2005) or in second- or foreign-language contexts (e.g., Chan et al., 2015; Jin et al., 2015; Legg, 2007; Lu & Chan, 2015; Yew & Schmidt, 2009). As a discursive process whereby meaning is negotiated and collaboratively constructed through language, the PBL context is inherently demanding on students' linguistic and communicative repertoires. As Frederiksen (1999) noted, PBL is unique in that it "requires the students to engage in interactive task-oriented dialogue" in which "participants must be able to understand the reasoning process as it is unfolding through the discourse of interaction" (p. 136). Although the studies listed above have revealed the communicative demands of PBL, more work needs to be undertaken to examine how diverse or non-Western learners in internationalized higher educational institutions participate in learning activities that require high levels of both domain knowledge and language skills.

CONCLUSIONS

The results of this literature review indicate that since 2000 there has been a small but growing adoption of qualitative approaches in research studies examining PBL in health sciences education. As Denzin and Lincoln (2011) indicated, the future of qualitative research is "to concede the unexpected but recognize both what is new and what is the same old experience" (p. 696). This chapter has mapped current practices in qualitative studies in PBL and indicated new directions. The authors encourage PBL researchers to explore these "new" research orientations and methodologies to further examine the "old" question of *how* students learn in PBL.

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CHAPTER 2

Another Piece of the "Silence in PBL" Puzzle

Students' Explanations of Dominance and Quietness as Complementary Group Roles

Vicki J. Skinner
University of Adelaide
Annette Braunack-Mayer
University of Wollongong
Tracey A. Winning
University of Adelaide

INTRODUCTION

Collaborative learning, which is a central element of problem-based learning (PBL), places demands on students, such as contributing to group discussions. These expectations arise from various conceptual frameworks, which specify that collaborative learning requires a number of ideal group practices and dynamics. Group practices that are ideal for collaborative learning include discussing and negotiating, while ideal group dynamics include cooperation and mutual engagement (Bruffee, 1999; Johnson & Johnson, 2009; Slavin, 1996). Therefore, an accepted PBL principle is that to promote collaborative learning, all group members should actively and equally participate in group discussions (Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005; Hmelo-Silver, 2004; Savery & Duffy, 1995). The implication of this principle is that uneven participation and silence from some students is incompatible with the goals and processes of PBL.

This principle has been investigated by research into student and tutor views. Numerous studies of PBL group function and dynamics have reported that students believe all group members are obliged to contribute to group discussions (Dolmans, Wolfhagen, & van der Vleuten, 1998; Nieminen, Sauri, & Lonka, 2006; Virtanen, Kosunen, Holmberg-Marttila, & Virjo, 1999; Willis, Jones, Bundy, Burdett, Whitehouse, & O'Neill, 2002). Similarly, investigations of tutors' and students' views of issues in

PBL group dynamics have identified quiet or dominating students as both problematic *and* frequently encountered in PBL (Hendry, Ryan, & Harris, 2003; Houlden, Collier, Frid, John, & Pross, 2001). Further, both tutors and students have considered that dominating students impede learning, and while neither tutors nor students considered that silent students were detrimental to learning, both groups reported that silent students were a burden on the PBL group (Hendry et al., 2003). In one study, quietness and dominance were framed as "individual dysfunctional behaviour" (Hendry et al., 2003, pp. 614–615). The authors suggested a range of possible reasons for the behaviour, such as personality, confidence, and cultural or personal learning preferences (Hendry et al., 2003, pp. 614–615). The notable point about this strand of research is that PBL group members' dominance and silence were regarded as being due to individual factors, that is, factors that students had brought *into* the PBL group.

However, the specific issue of silence and dominance in PBL has been reinterpreted as a result of naturalistic studies of the workings of PBL. Investigators using sociocultural and discourse-based approaches have explained how silence in PBL can be an active rather than passive aspect of collaboration and learning (Imafuku, 2012; Jin, 2012; Remedios, Clarke, & Hawthorne, 2008a, 2008b). It has been suggested that students opt for silent behavior due to complex interacting personal and social factors (Imafuku, 2012; Remedios et al., 2008b). Further, dominant students themselves have explained their own behavior in social and constructive, positive terms, such as contributing to the group by providing guidance or leadership (Duek, 2000; Faidley, Evensen, Salisbury-Glennon, Glenn, & Hmelo, 2000; Imafuku, 2012). It has been suggested that dominance in PBL may also occur when students, who may be more familiar with valuing speaking as ideal classroom behavior, have not yet become socialized to the value of listening in PBL discussions (Imafuku, 2012; Remedios et al., 2008a).

These sociocultural studies have illustrated the complexity and the purposes of dominance and silence during collaborative learning in PBL for dominant and silent students. However, we don't fully understand the social practices that can produce silence and dominance in PBL groups. This chapter arises from a study that aimed to explain the social construction of PBL groups, including the role composition of the group and its impact on group function. The research questions for the study were: *How did students describe and explain the development of their PBL groups?* and *What was the implication of this for group function?* The data reported here

focus on students' explanations of the occurrence and impact of dominance, leadership, and silence as PBL group roles and their impact on group function.

METHODOLOGY

Throughout the design and implementation process of this study, we used accepted qualitative methodology regarding rigor and reflexivity. While rigor is variously defined in the literature, a commonsense interpretation is the "trustworthiness" of the research (Liamputtong, 2013). As such, rigor ought to be embedded within research design and implementation by, for example, ensuring a coherent fit between epistemology, theoretical stance and methodology, and the selection of data-gathering methods (Carter & Little, 2007; Liamputtong, 2013). Rigor is also supported through specific strategies (Carter & Little, 2007; Liamputtong, 2013), which we adopted: reflexivity (i.e., the researcher's examination of her own role and relationships in the study), triangulation to enrich data and allow for contrasting views (i.e., observation, interview, focus group), and member checking (i.e., participants enriching and clarifying findings via transcript review and focus group participation).

Therefore, we designed a naturalistic study from a social constructionist theoretical perspective (Crotty, 1998). Using this perspective, we proposed that PBL groups and their meanings for students were constructed through students' beliefs and everyday practices and activities during PBL. Similarly, we understood that research is also a process of coconstruction of meanings between the researcher and the participants. Given our theoretical perspective and our research aim—to understand the meaning of PBL groups for the students involved via their everyday practice—we chose ethnography as the most appropriate methodology (Carter & Little, 2007; Crotty, 1998). The research methods included participant observation and unstructured interviews, followed by focus groups (FGs) with the interviewees to further enrich the data and to check and clarify our observations and interview findings and conclusions. After obtaining ethics approval from the relevant committees of each institution, we conducted a cross-site investigation at two dental schools, one in Australia and one in Ireland. Our reasons for designing a cross-site study were twofold: to enhance researcher reflexivity via the experience of an unfamiliar PBL

context and to enrich the data and strengthen our conclusions by comparing and contrasting the cross-site findings (Denzin & Lincoln, 2005; Liamputtong, 2013).

The primary author (VS) was responsible for all data collection and preliminary data analysis such as coding, and all other authors were involved in data analysis discussions. The primary author/on-site researcher had experience in facilitating PBL and a professional interest as an educator in understanding it but was not involved in teaching or assessing students at either school during the study. The study arose out of the primary and third authors' informal observations of student PBL groups and a desire to understand them better in order to improve our group learning environment. During the study, VS kept a reflective journal in which she recorded her thoughts and feelings about her involvement with the participants and the development of the research. This was done to enable critical examination of the researcher's role in constructing the findings.

Participants were first-year students at the commencement of their program and their engagement with PBL in a dental curriculum. Most participants had entered dental school directly after completing their secondary schooling ("school leavers," Table 2.1); the non–school leavers had either transferred from another tertiary program or were classed as mature-aged entrants (see Table 2.1). Students were classified as domestic (i.e., Australian or Republic of Ireland/UK residents) or international (i.e., temporary residents from overseas). Most participants had no previous PBL experience. Novice PBL students were of interest because of the prior informal observation in our school that group practices established in early years tended to be maintained in subsequent years. We used maximum variation purposive sampling (Coyne, 1997; Liamputtong, 2013) and so invited the entire Year 1 cohort at each school to participate in the observation phase of the study. As researcher, VS was solely responsible for running the information and recruiting session at each site, in which project documents were provided to all students in the cohort, and for all of the group allocation processes. Consenting and nonconsenting students in the cohort were identified, and a stratified list of consenting students was created: female domestic, male domestic, female international, and male international. This stratified list of consenting students was used to randomly assign students to PBL groups with equal distributions of male/female and domestic/international students. These groups, composed only of consenting students, participated in the observation phase of the study

TABLE 2.1 *Australian and Irish Student Participants*

Site	Participants	Domestic female	Domestic male	Int'l Female	Int'l Male	Total students
Australia	Year 1 cohort (all invited)	Total = 27	Total = 17	Total = 16	Total = 8	Total = 68
Australia	Four PBL groups observed[a]	11	9	5	3	28
Australia	Interviewees,[b] 5 from each of the 3 observed groups	7 Amy[c] Angela Cathy[c] Diane[c] Julie[c] Paula Roseanne[c]	4 Bruce[c] Morgan Peter[c] Sam[c]	3 Alice[c] Carol[c] Ruth[c]	1 Martin[c]	15
Ireland	Year 1 cohort (all invited)	Total = 20	Total = 10	Total = 6	Total = 4	Total = 40
Ireland	Two PBL groups observed	12	6	2	0	20
Ireland	Interviewees,[b] 5 from each observed group	5 Aileen[c] Brigid[c] Deidre[c] Kerry[c] Maeve[c]	4 Brendan[c] Kevin[c] Hugh Liam[c]	1 Fiona	0	10

Note. "Domestic" for Australia means permanent resident; for Ireland it means Republic of Ireland or UK permanent resident. "Int'l" means international student, an overseas temporary student resident.

[a] Four PBL groups were observed, and three groups were selected for interview recruiting and data reporting.

[b] All names are pseudonyms.

[c] School leaver on entry to dental school; others are mature-age entry or have transferred from another tertiary programme.

(see Table 2.1, rows 1–2 and 4–5). Nonconsenting students were assigned to nonobserved PBL groups. In Australia, four groups of the total ten were observed, and in Ireland, two of the total four were observed. For the interview phase of the study, we invited all members of three of the four observed Australian groups and both of the observed Irish groups (see Table 2.1). Consistent with our ethical approval to protect participant anonymity, we have not reported the exact composition of the PBL groups with

regard to their domestic/international or school leaver status, because this could potentially identify the groups and hence the individual participants.

Both schools had hybrid five-year undergraduate/PBL curricula based on the Maastricht seven-jump approach to PBL. The curriculum context and the Maastricht implementation of PBL at each school have been described in detail elsewhere (Skinner, Braunack-Mayer, & Winning, 2015). In Australia, each PBL group was composed of seven students, and it was expected that each week one student would be the scribe for the session and record key information on the whiteboard, with everyone taking turns at this role. There were no other directions concerning group roles. Irish groups each had 10 students and were required to have a chair and a secretary for each session. The chair's role was to monitor the PBL steps and member participation during the group discussion (there was no equivalent to the chair role in Australia). The Irish secretary role was equivalent to the Australian scribe role. Each student was expected to take a turn at chairing and being secretary, and each group had its own approach to achieving this. One group's tutor prepared a roster of volunteer pairs several weeks in advance, while the other group's tutor asked for two volunteers prior to each upcoming problem.

The investigation took place over two full academic semesters (Australia) or one full academic term (Ireland). Phase one was observation with the participant PBL groups over multiple PBL cases/problems early in Semester 1 (Australia) or the Michaelmas (i.e., first) term (Ireland). Semester 1 in Australia took place over 12 weeks from March to June; Michaelmas term in Ireland was 10 weeks between October and December. Phase one was designed so that observations of each group were spread over multiple cases both early and late in the observation period; this meant that the whole 12 weeks of Semester 1 in Australia and weeks 1–9 of the Michaelmas term in Ireland were included to allow VS to observe any change over time. Participant observation meant that VS attended both the analysis and reporting-back phases of several problems with each group; in Australia VS also attended group meetings convened by students to discuss their between-class research. Phase two consisted of individual interviews with students from observed groups early in Semester 2 (July/August, Australia) or later in the Michaelmas term (November, Ireland). Each interview in Australia lasted approximately one hour, and in Ireland each interview lasted approximately 45 minutes. The interviews with Australian students were relatively unstructured to be as broad as possible

(in the context of the whole study) and contained just three topic areas/questions:

1. Would you describe your PBL group?
2. What were the good things about being and working in a group?
3. What were the not so good things about being and working in a group?

Since the Irish study was a smaller, triangulating investigation, the interviews were semistructured, with slightly more focussed questions, which in relation to PBL and group work included these questions:

1. How would you describe the way your group works?
2. What makes a good/bad brainstorming/reporting session?
3. How do you decide when you're happy with what you've done for a PBL problem?
4. What are the good things about PBL so far?
5. What about not so good things?

Data for analysis included VS's observation field notes and professionally typed interview transcripts. The field notes included descriptive accounts of group activities and individual member behaviours and dialogue as well as VS's reflective notes about her involvement and preliminary analytical ideas. Initial analysis proceeded as interviews were conducted at each site, making interviewing and analysis an iterative process (Carter & Little, 2007; Liamputtong, 2013). Interviewees each reviewed and, if desired, amended their own transcripts before analysis. For analysis and results reporting, VS assigned each interviewee a pseudonym. The analytical approach drew on grounded theory by commencing with codes "grounded" in the data and used a thematic approach by seeking patterns among the codes to construct analytical themes (Charmaz, 2000; Liamputtong, 2013). For example, many students spoke of people as "active" or "passive" and as "leaders" or "followers," so these words became initial codes that were then grouped into themes, such as "types of people in the group." Then the analytical themes were arranged into a set of broader interpretive themes, representing the researcher's story of the students' actions and stories, such as "group and people skills development"

and related subthemes such as "appreciating individual differences." After this stage of data analysis at each site, the interviewees were invited to comment and elaborate on the interpretive themes (i.e., member checking). All interviewees were e-mailed a list of the key interpretive themes from the data analysis for that site and a dot point summary description or elaboration of each theme. Australian interviewees participated in FGs to discuss the interpretive themes. The FGs were divided into separate domestic student and international student sessions to enable the international students to have a voice. Irish interviewees responded individually to an e-mailed summary of interpretive themes. Themes were refined following this student consultation. A core goal of our analysis was to address the internal, or emic, meaning of groups from the students' perspective and the researchers' etic or explanatory perspective (Patton, 2002). Therefore, the roles reported represent both "emic" (i.e., students' meaning, as explained in interviews and focus groups) and "etic" (i.e., researchers' understanding, from observations of groups in action). The subsequent discussion presents our explanation of dominance and silence in PBL groups.

RESULTS

In response to the opening interview question—"How would you describe your group?"—students at both sites described their colleagues and how they comprised the group in terms of their usual or typical behaviour and related roles. The following account presents evidence of this using excerpts from the primary researcher's field notes during the observation phase of the project and student interviews/FGs from phase 2. Students are identified as Australian or Irish with a superscript "A" or "I" after their pseudonyms. The Australian groups are named Blue, Red, and Yellow, and the Irish groups are Green and Purple. The account is written in the first person as an account of the primary researcher's engagement with the participants.

Group Development

Through engaging in PBL, groups in Australia and Ireland spontaneously developed a tacit structure in the early weeks of the semester/term. Students spoke of this as a "natural" process of each person finding a role that suited him or her within the group:

Sam[A]: We didn't set specific roles to people. We didn't really talk about anything with each other. It just happened, whoever ended up. . . . [P]eople have it in them to do this and we found that out eventually.

Students described and explained group structure and function in terms of the types of people in the group. Each group developed its own member profile, which in turn shaped how the group functioned. When students described their groups, they either provided generic profiles of groups or listed group members by name, relating their functions to their personalities:

Julie[A]: Going back to the high school thing, you know what everybody is like, so you don't really get the whole group effect, it's more of a friend thing you know, working with friends, but here it was more of the—you know how you read about the group and you have the dominant person, the introverted person and the shy person and you know and you've got the mediator. I could actually really see all of those people in the group, so that was interesting for me, the whole analysing thing [laughs].

Deidre[I] [in week 4]: I tend to notice that everyone has their own wee roles now. We've got Briony, and she's the one that makes sure everything's done, she's really thorough and will go through things again to make sure we understand, and she's kind of like the Mum, and then Hugh, he's like the Dad, he's a bit older and wiser and he kind of takes control. And then we've got Brendan, fountain of knowledge, knows everything. And then we've got Kevin, and he knows how to keep things going and make sure you're going the right way. Maeve doesn't say much but she would know a lot. And . . . then there's Pat, he has a lot of irrelevant things to say, he'll have a whole page off Google, and he'll decide to read it out. Ahhmm, there's kind of quieter girls, Gayle, Catriona, they don't say as much. I think they're just not usually that inclined to talk that much.

And so within a few weeks each group took shape and developed a group role profile and a usual way of functioning during group discussions.

Although this was a tacit process, the similarities between different members' accounts of their own group were striking: people generally agreed on who did what and why in their group:

> **AMY[A]:** There tends to be not someone who says "*You have to do this and you have to do this*" but the way it pans out is that I end up writing on the board and Peter and Cathy tend to give most of the feedback to the cues that we're doing.
>
> **BRENDAN[I]:** The chairperson starts off, I would probably, anything the chairperson's missed I give direction to and there is probably three members who, any facts and definitions they go on about and then there is probably three people who are normally silent and on the odd occasion they say something and then there is two more people who back up any other people who give information.

Importantly, for most groups this structure and resultant pattern of function remained mostly stable over the semester/term.

Dominance and Leadership

A consistent feature of students' accounts of their groups at both schools was their classifying group members dichotomously on the basis of how vocal or quiet they were in the group, and this was often seen as a personality feature, such as being dominant or passive, and was also accepted as an inevitable or natural feature of groups:

> **PETER[A]:** I think everyone knew who was louder and who was more passive. Obviously some people are quieter and some people are louder, so that's normal.
>
> **MAEVE[I]:** I like our group because it's a mixture. . . . [T]here are some people, I think, not dominating but more outgoing than others, but you're going to get that in every group.

The group leaders in Australia were the dominant members, while the other members became followers. The leaders directed and organized the group, which included deciding the direction of the PBL problem analysis, selecting the PBL goals, and deciding on group processes. In two of the Australian groups, Blue and Red, the leaders were clearly identified

to me by students, both in interviews and during my observation. These leaders self-identified and were named by other group members as leaders. For example, in Blue group, Paula and Angela were the discussion leaders:

> **Paula[A]:** We had a few dominant people, a few not so dominant people and then we had the people who just did whatever, just followed. Discussions were more dominated by say, Angela or I. . . . [W]e directed most of the discussion.
> **Angela[A]:** There were two of us who would talk a lot more, share their own experiences a lot more and guide the discussions a lot.
> **Martin[A]:** [Angela] was someone who became a leader.
> **Researcher:** What did she do that made her a leader?
> **Martin[A]:** She talked about this and this and suggested this and this and we tend to follow her and discuss basically what Angela said.
> **Alice[A]:** Paula is the one to say "*We should divide the topic into this*" and why we should do this topic.

In Blue and Red groups there was some tension due to a contest for leadership. Julie and Morgan both explained that they tried to lead the group to improve its performance and productivity; they said that their leadership duties included directing discussion, making decisions, and organizing group activities. However, Julie said that she and Morgan were in "head to head" conflict over the leadership role, and other interviewees from Red group verified this:

> **Diane[A]:** There were a couple of people who were quite dominating and you know, you can't have two of these people in the same group and expect everything to go smoothly. . . . If they have a *conflict*, then there's trouble because they're both dominating.

All interviewees from Yellow described the group as having no distinct leader and being democratic and free of conflict. However, from the first day of observing the group I recorded in my field notes that the group of seven students appeared to be divided into two subgroups and that participation across the two was uneven. Four domestic students, who all spoke English as a first language and came from the same city, had befriended

each other at the start of the semester, and the remaining group members included two international students and one domestic Australian student from interstate. This pattern continued throughout the semester.

> **Field notes—Week 1 Observation Session 1—Yellow:** It appeared that Peter, Sylvia, Amy and Claudia all knew each other, so they ended up chatting. . . . During the whole session no one spoke to Carol, Bruce or Neil, they were excluded from the others' conversation.

I interviewed three of the four members of a Yellow subgroup, and none identified a specific leader who directed the group or dominated conversation. For example:

> **CATHY[A]:** It wasn't one of those groups where people had to stamp their authority. It wasn't one of those groups where you have the really, really loud person who would need to be in charge or anything like that. Everybody was just happy to let everybody's personality be exactly that. There was no need to adjust yourself or make yourself a little bit quieter because people were happy just to let the group flow.

Only Carol, an international student in the three-member subgroup, commented differently on the group:

> **CAROL[A]:** These people were more the organisers of the group and they put in more ideas.

Leadership and personality were associated. The Australian students explained why certain people and not others were leaders by referring to their attributes as individuals. Students appeared to believe that people with particular personalities and abilities were most suited to leading groups, taking charge, making decisions, and delegating, even though this could lead to conflict:

> **ALICE[A]:** They're two kinds [of people], active and passive, so the passive one will do, wouldn't mind doing the work and the active one will be the one that allocates the work.

ROSEANNE[A]: Julie was an organiser, Morgan was an organiser. . . . You could see it, their personality shone through.

The majority of the self-identified leaders also attributed their own leadership to personality. Paula, in the Blue group, told me that she and Angela were "both fairly opinionated people," and Angela explained that she herself was "pretty arrogant" and that she thought Paula was "one of the more aggressive people" in the group. Similarly, in the Red group, Julie felt equipped to be leader on the basis of her personality:

JULIE[A]: In high school people always associated me with being a leader, you know those little quiz thingo's that they give, you know, "what kind of person are you?" I always get the one that says "you are a natural born leader." I like to take control, in school I was always the one who organised the group.

Morgan was an exception to this pattern of leader attribution; he spoke of the leader role as a skill-based job, which any team member could learn to undertake. Morgan said that as leader "you just tend to be another team member who has this responsibility." However, the other members of the Red group took a different, negative view of Morgan's leadership because they found it overbearing. Consistent with their general understanding of why people adopted roles, they interpreted his leadership style in terms of personal characteristics that influenced behaviour. They described him as "dominating," "really pushy," and a "bit of a dictator."

In Ireland, students expressed ideas similar to those of Australian students about leaders and leadership. However, in Ireland, leadership was more complex because there was the official role of chair, with certain designated leadership duties, and there were also dominant students, who took on other leadership duties of their own accord. The following account illustrates students' understanding of how two PBL groups operated at the school in Ireland.

The Irish chair's designated responsibilities included managing group and PBL processes. Managing group process involved monitoring members' participation and enabling all members to have equal input. Managing PBL process meant ensuring that the group addressed each of the seven PBL steps in order without skipping any steps. The chair and the secretary were not supposed to partake in the content of the PBL discussion; they

were to stand aside in order to fulfil their designated roles. The chair's designated duties to manage group and PBL processes were acknowledged and valued by students:

> **Kevin[I]:** The chairperson really needs to control it and when people start rambling on, tell them to just relax and let other people talk.
> **Aileen[I]:** The role of the chairperson, you need it to keep some sort of structure in it and make sure you get everything going in the time.

However, the Irish students constructed a further element of the chair role: they expected the chair to be a leader and direct group discussions (like Australian students' expectations of their leader). Students expected the chair to keep the discussion on the right track. Directing the conversation involved asking the right questions to adequately cover the topic, which placed a demand on the chair to know the topic in order to control discussion:

> **Brigid[I]:** [The chair] should provide information where necessary and involve everyone but mainly direct the conversation.
> **Hugh[I]:** The chairperson should take control of the group and not let irrelevance creep in.

Although students had definite ideas about the responsibilities of the chair role, the chair did not necessarily control and steer the group. Group control was related to the presence of "dominant" people:

> **Maeve[I]:** The chairperson might as well not be present, because no matter who the chairperson is, it's the same three, four people dominating.

I observed that in each group particular students regularly monopolized the conversation and influenced the direction of the discussion. The Green group had a set pattern of talkers and nontalkers. My field notes record that the same students constantly clamoured for airspace and talked over or interrupted each other, and the same students were regularly not part of the discussion. The dynamic in the Purple group was less boisterous

but had a similar pattern; the same students dominated each session, and the same students were regularly quiet. Students from both groups commented on this phenomenon. Green group students acknowledged that the vocal students directed discussions and that it wasn't always a good thing:

> **KERRY[I]:** It hinders the progress of the group because an awful lot of the time we spend all of us trying to say our bit, but no-one listening to each other.

Purple group interviewees also noted that the vocal or dominant students led the group, although no one described it as domination in an oppressive sense. This may be due to the general feelings of goodwill among group members (Skinner, Braunack-Mayer, & Winning, 2012). Kevin explained, "There's a couple of people who take it by the reins." Maeve used the word "dominate" but qualified her usage as not being negative:

> **MAEVE[I]:** Three to four just dominate the group and what they say goes. . . . [*N*]*o way* that they are bullying or anything like that.

Consequently, in spite of students' additional expectations of the chair's role, the chair did not necessarily lead the discussion; the dominant students always seized control, which frustrated other students. As a result, not all chairs were considered equally effective. A good chair required the right personality and ability to manage people plus appropriate content knowledge to direct the discussion:

> **KERRY[I]:** When we have a strong chairperson everyone—everything goes according to plan but otherwise I think our group can go a bit pear-shaped.
>
> **DEIDRE[I]:** You have to kind of be able to [slight pause] not be harsh to people but kind of cut them off, almost. And things like that; make sure you are always sticking to the problem, the discussion hasn't gone too far away and kind of make sure your problem statements are all covered, so your learning goals can then be established.

The Irish students attributed the effectiveness of the chair and the PBL session to the personal qualities and abilities of the student in the

role. Brendan believed that how well the group worked "depends on how good the [chair] person is as a leader." Leadership skills and authority were associated with being a good chair and were assumed to come naturally with age:

> **Fiona[I]:** [A good chair is] someone who knows which questions to ask, which can include everyone in the discussion and someone who is assertive. You need maturity to be a good chair.
>
> **Aileen[I]:** I think some people have more authority than other people and people listen to them and follow their instructions, whereas they maybe ignore other people more.

Likewise, poor chairing was also due to personal attributes. Hugh's explanation for sessions being less successful was due to the chair "not being able to speak out and not trying to take control of the issues at hand." Liam's understanding of how he thought he was supposed to chair was contrary to how he saw himself as a person:

> **Liam[I]:** I'm not an aggressive person. I don't want to shout down people and say will you shut up please; it's not what I want to do.

The Quiet People

In both Australia and Ireland, students clearly identified group members at the other end of the vocal continuum from the dominant people, referred to as the "quiet people." When describing their group, students referred to quiet people either as a subgroup of members or by name. This group consisted of both local and international students, and some students identified themselves as quiet during group discussions:

> **Roseanne[A]:** Thomas wouldn't talk that much; that's his nature overall. Julie talked a lot. Morgan talked a lot. Freddie was just moderate; if he wasn't quiet, he wasn't too talkative. Diane and Ruth: Ruth was quieter than Diane but, you know, everyone talks, but Ruth was quieter. Diane was probably between Freddie and Thomas. So, yeah, you had the variations.

Using the same approach to understanding leadership as a personal trait, many students attributed quietness to qualities that members had

brought into the group, such as shyness, lack of confidence, or a preference for quietness. Therefore, being able to speak up in group discussions was considered to be largely the result of individual characteristics and choices:

Bruce[A]: The ones who stayed quiet, I don't think they felt they were forced to stay quiet, it was just their personality. . . . [S]ome people are just naturally quiet, so they don't say anything.

Aileen[I]: Some people, a lot of people, do have a problem like speaking in public or whatever, so it's difficult for a lot of people. I don't really mind it. I did debating and it's good for me; I love a bit of discussion.

Brendan[I]: There would be some members who are not confident in expressing their views . . . and then there's me [said with a "smile" in his voice] who says everything.

Since quietness was regarded as natural, the quiet people were not criticized for their quietness if they were seen to be doing work. Other students often characterized such members as "quiet but valuable" participants in the group's undertakings:

Angela[A]: The reserved people usually wouldn't say anything. They could probably go a whole PBL without saying anything, but that doesn't mean, who am I to say, they're not focused or working hard.

Roseanne[A]: The people who talked less, when they did talk, they put in really valuable things because they're waiting for other people to say it, but they didn't, so they just say it and it was worth it.

Kevin[I]: Obviously some people are more vocal, some people are less vocal, but, um in terms of learning, you know that the less vocal people even if they don't speak they still have all the work done; you know they've done it, it's just they don't necessarily speak.

However, students in the quiet role gave a range of explanations for their quietness. In addition to being shy or naturally quiet, both domestic and international students gave alternative reasons for their quietness. A domestic Australian student, Bruce, who described himself as "quieter, not

the quietest," explained that he remained quiet by choice, and he didn't feel as though it was a role put upon him by others:

> **Bruce[A]:** It was easier to be quiet because other people think the same thing and will say it.

Other domestic Australian students were dissatisfied with their quiet position because they felt that it had been imposed or chosen unwillingly. For example, in the Red group, students I interviewed expressed dissatisfaction with being quiet. Diane, whom I observed to be an outgoing, talkative local student in interview and social settings, told me that choosing to be quiet in the group was her response to having her input "shunned" by Morgan in his leadership role. Roseanne had similar feelings:

> **Diane[A]:** If you're constantly voicing an opinion and, you know, it's not being accepted then, you know, you're going to think "oh well what's the point?" "What's the point," you know, "I'm probably wrong." so I just kept quiet about it.
> **Roseanne[A]:** When we did contribute, it didn't feel as if we were contributing anything that was relevant and useful.

These accounts are similar to events recorded in my field notes. For example:

> **Field notes: Week 1, Red group:** The facilitator asks if someone can draw the lower jaw and teeth on the whiteboard. Roseanne volunteers and makes an attempt on the board but Morgan says that it isn't good. He comes to the board and draws his version. He then does a "chalk and talk" lecture to the rest of the group about the drawing.

Similarly, in Ireland dissatisfied local Irish students who felt that their quietness was due to group factors explained how the dominant students made it difficult, if not impossible, for others to contribute due to the speed and loudness of their interactions. Students expressed frustration about this:

> **Maeve[I]:** I talked to one girl outside the group and she is really nice and she is really chatty but when she is in the group she

doesn't speak, and I am kind of the same, with me I hardly ever talk in my group because there are some people who have the same information as me, they just get in before me and I find it's a race for airspace.

Liam[I]: Three or four people are continuously dictating and never shutting up and everything is on their wavelength and it's their confusions, their points, their notes, their questions, it's their everything that the PBL session revolves around.

The international students in Australia whom I interviewed, and with whom I ran a separate FG, attributed their quietness to having an Asian cultural background (ranging from India to Southeast Asia) and traditional schooling. They told me that they had not learned to speak freely and offer opinions in class, and so they were unprepared for the demands of PBL:

Alice[A]: The Asian schooling system is different, the term they use is spoon-feed, they don't make you think.

Ruth[A]: Our education system has not taught us to speak out, speak up in class, it has not trained us to think on the spot, it's more spoon-feeding for us during class sessions, it's very passive, everybody listens to what the teacher has to say.

All three told me that they silently watched and listened to the other students in order to understand what PBL required of them. For these students, doing PBL was a process of cultural adjustment and learning to speak out in class. However, this was made more difficult due to the discussion practices of the local students, such as the speed of their speech, their use of Australian colloquialisms or slang, and their use of humour.

Carol[A]: The local students, they know a lot and can think really fast. . . . [T]hey gave responses to each other very quickly. I didn't have a chance to join in. It was difficult especially when local students talk and relate the discussion to things they know, that I might not understand. . . . 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.

This complex state of affairs was not mentioned by any of the local Australian students. Only two local interviewees referred to the possibility that the international students were quiet not only due to their passive personalities but also because of their "language barrier." Therefore, approaches to including these students were directed toward individuals:

CATHY[A]: It was up to the rest of the group to help her with that and to try and deal with that.

PETER[A]: A couple of times the louder people tried to stop and actually ask the more passive people for their input.

Some students experienced a shift in their roles. The social environment eventually enabled one international student in Australia to participate in discussions. She described how her initial discomfort with participating was eased by the friendships she eventually developed with some group colleagues:

ALICE[A]: Once you get to know each other better, even though you don't know anything about the topic, because you're comfortable with each other and you can—you just talk about something else, you can ask questions and you get to share your opinion because you are comfortable, with them, so it's easier.

In contrast, other international students in Australia continued to feel excluded. One student reported looking forward to joining a new, hopefully inclusive, group in Semester 2. Another student described using her own invisible strategies to participate:

CAROL[A]: I was participating in my head, I listened and followed the discussion and joined in when I could. Sometimes they were talking about other things, not the PBL. While they were talking, I was thinking about the topic and working out what I wanted to say about the PBL. . . . I waited for the dead air [i.e., when no one else was talking for a moment].

In contrast, Fiona, an international student in Ireland, had no difficulties with being part of the conversation and was one of the dominant voices. She had done her secondary schooling in a British-run school in

her home country, was used to speaking and thinking in English, and had experience in group work and group discussion. She told me that she found her group colleagues "nice and friendly."

DISCUSSION

As noted in the introduction, PBL is based on collaborative learning principles, including all group members' active participation in group discussions (Dolmans et al., 2005; Hmelo-Silver, 2004). Furthermore, PBL is designed to foster the development of leadership skills, principally through rotating leadership duties among group members (Kwan, 2009). In contrast to this ideal situation, our study and others report discrepancies with PBL in practice.

As part of our larger investigation into students' constructions of PBL groups, this chapter addresses students' understandings of dominance and silence within PBL groups. Australian and Irish first-year dental students explained group development as a natural process of each person finding a suitable niche. This occurred early in the semester/term and was the result of people's usual or typical behaviour in PBL activities. The most noticeable aspect of students' accounts was the presence of the dominant people and the quiet people. Dominance and quietness were described as oppositional qualities and were regarded as a normal part of any group's composition. However, this assumption led to the acceptance of group members being leaders or followers according to their tendency to be loud or quiet, respectively. The assumption also underpinned/enabled social practices that privileged some group members and marginalised others.

Little has been reported in the literature about students' roles in PBL groups. One of the first papers on group dynamics in PBL included a "balance of task and group-building roles" as part of a list of ideal group dynamics but did not expand further on this topic (Tipping, Freeman, & Rachlis, 1995, p. 1051). In a study of criteria for assessing group function, role sharing was listed as a desirable criterion: an "outstanding" group "frequently and appropriately" rotated roles, but a "poor group" underwent no role changes (Willis et al., 2002, p. 496). However, there was no other mention of roles in the Willis et al. paper. A detailed investigation of equity in student groups reported that group members "self-selected" into particular roles and that no roles were "explicitly assigned" (Duek, 2000,

p. 92), just as in our study. Duek (2000, pp. 91–95) observed that roles included group leaders, who led discussions and whom she described as "discussion dominator/discussion coordinator" and exhibiting behaviours such as "aggressing" and "hypercontributing" or "withdrawing/following" and "hypocontributing," which compare to the dominant-quiet roles and active-passive behaviours described by students in this study. Our participants believed that a natural part of any group structure was this basic dichotomy of "dominant" or "vocal/active" and "quiet" or "passive/follower" members and that this shaped group function.

In our study, the dominant people became group leaders who directed the group discussions and decision making. The leaders themselves regarded their leadership and guidance as benefiting the group. The majority of students believed that leaders were born or matured, and so the leader would be someone "naturally" suited to the role who had the necessary skills and attributes. In Ireland, this belief informed students' expectations and their subsequent evaluations of the chair, a role that was regularly rotated within the group. They believed that the chair ought to lead the group, and if the chairperson was not a natural leader, then he or she was a "weak chair" who could not match their expectations for the role. Therefore, there was an inevitability to students' beliefs that rotating the chair was ineffective at maintaining order within the group. The exception to this belief in natural leadership was a mature-age Australian student who had previous team leader experience in a professional setting; he viewed leadership as a set of learned skills.

There is little in the literature about leadership in PBL groups. Although the ideal criteria listed by Tipping et al. (1995) included leadership and its style and effect, they did not address leadership in their discussion even though it was one of the three items that students had identified as important for group success. A detailed study of leadership in PBL groups described what the authors labelled as "collaborative" and "heroic" leadership, the former being situational and shared and the latter being a personality-driven model (Palmer & Major, 2004). As with the students in our study, Palmer and Major (2004) observed that the heroic model was used by some of their students. The notion of fitness for leadership and a sense of obligation to lead, as expressed by our participants, has been reported in other studies, in which students have explained that they took control of their PBL group in the belief that they were best suited to this task or were natural leaders (Benbow & McMahon, 2001; Duek, 2000).

In addition to the presence of dominant people, our participants believed that a natural part of any group structure was having "quiet" or "passive" members. However, students did not criticize the quiet people; they said that although the quiet people were not actively involved in directing or decision making, they were engaged in learning, as evidenced by their occasional contributions. Some of the quiet people in our study explained that silence was used for learning during PBL and about PBL. Other in-depth studies on PBL have revealed that silence can be a learning space and strategy and have indicated the importance of valuing silence in PBL. For example, students may choose silence to learn from others, to analyse others' contributions and compare/contrast them with their own understanding, and as a strategy to manage knowledge conflicts (Jin, 2012; Remedios et al., 2008b). Silence can also be a means of students acculturating themselves to PBL through observation and reflection (Remedios et al., 2008a; Imafuku, 2012). Authors have also suggested that silence in PBL has a discursive and social use: it can enable turn-taking by creating space for others to speak, provide openings for feedback and commentary, and enhance respect and accord among group members (Jin, 2012; Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014).

Yet students in our study were sometimes dissatisfied with being quiet and explained that quietness had been imposed on them, resulting in frustration and resentment. This occurred with both local/domestic and international students. Some students were silenced because they felt that their contributions were rejected, so they gave up trying. Other students, local/domestic and international, were excluded from discussions by various group practices. These included members speaking loudly and quickly so that there was no entry point for others, using slang and colloquial English, using humour that was not understood by all group members, and combining PBL-oriented talk with social talk that excluded others. The sometimes mistaken assumption that people were quiet due to their own preference underpinned/enabled these social practices that privileged some group members and marginalized others. Furthermore, the same assumption meant that any attempts to manage or reduce silence were aimed at individuals and increasing their participation, such as periodically asking the quiet people if they wanted to say anything or if they agreed with decisions. Therefore, as result of mistaken assumptions about silence and dominance, power and participation in PBL groups was restricted. PBL groups became sites of unintentional exclusion.

When the results of this study are taken together with other explorations of silence (Imafuku, 2012; Imafuku et al., 2014; Jin, 2012; Remedios et al., 2008a, 2008b), it is clear that learning to value silence is just one element of the need to rethink how PBL is implemented. The complementary element is to be aware that silence can be imposed on students unwillingly by erroneous assumptions and exclusive social practices. However, it is our view that change may be a slow, cumulative journey and not brought about with a single remedy. The apparent naturalness of people's ideas and assumptions about leadership and quietness means these ideas may not be easily challenged and disrupted in order to change behaviour. The problem may lie as much with tutors' beliefs and assumptions as with those of students. We suggest that a useful approach to changing ideas is to develop training for tutors and students in cultural and social knowledge and skills to facilitate greater inclusivity in PBL. For example, at our school we have recently introduced sessions on culture, health, and health care, which not only examine how culture impacts health from the patient point of view but also explore dentistry and dental school as cultures. These sessions include analysis and discussion of students' previous educational experiences and potential differences in students and staff roles in supporting their student learning. We introduce the notions of visible and invisible culture via the concept of the "culture iceberg" (originally proposed by Edward T. Hall in 1976 and now widely used) and stereotypes and assumptions. In the context of this study, a student's quietness is visible behaviour (i.e., the top of the iceberg), from which we may wrongly assume that the student is naturally quiet or may stereotype the student (e.g., quiet Asians). We discuss the need to look for deeper cultural and social reasons for classroom behaviours (i.e., the lower part of the iceberg): Is this student's behaviour due to a particular view of politeness, such as not interrupting, combined with the social setting, which means that the student has less opportunity to speak among people for whom jumping into the conversation is acceptable? We intend to show students how the social interaction of these two cultural ways will mean that some students are excluded and some dominate. This strategy has yet to be evaluated for its impact on groups.

Another part of the remedy, we suggest, is that changing PBL group practices around silence might be further supported by directly addressing tutor and student behaviours; for this to happen, specific guidelines about group interactions could be provided during tutor and student induction

and training sessions. However, the issue of whether and how to rotate roles is problematic, as shown by our results relating to the chair role in Ireland. It is possible that training tutors to explicitly model appropriate behaviours and teaching tutors how to intervene in group dynamics to support the chair might be effective. We don't believe that having tutors identify "reticent students" explicitly would help, as this risks situating the problem with the individual and devaluing silence. Further, it would be possible to transfer to the PBL setting some simple whole-class teaching strategies designed to facilitate participation but that employ silence positively. One example is the well-known "think, pair, share" technique, whereby students do not verbalize their ideas until they have thought individually and then shared their ideas with another student. This technique introduces the notion of silence as thinking and idea-formation time and also gives students a "rehearsal" space for presenting their ideas to the larger group. Such strategies may ensure that all students have the opportunity to have a voice and that silence can fulfil its generative role in learning.

While this study offers the insights of ethnographic research, it is limited due to the situated nature of the research and the scale of the study. Therefore, any generalization to other sites must be done with caution. The focus of our study was students' practices and explanations; tutors' roles and explanations were not addressed and would add another dimension to the story.

CONCLUSION

Through an ethnographic investigation of PBL groups in practice, we have shown how group roles and function developed in ways that were not always compatible with whole-group collaborative learning. Students assumed that groups were naturally composed of a balance of dominant and quiet people who would become group leaders and followers. At times, the quiet people's silence was not seen as dysfunctional; it was considered by both dominant and quiet members as contributing to learning. However, this assumption of quietness as natural enabled the social practices that privileged some group members and marginalized others; silence became the consequence of exclusion. Therefore, power and participation in decision making in PBL groups was restricted to dominant group members.

This chapter adds to our knowledge about PBL groups from the inside by illustrating the dual nature of silence during PBL. It can be both a generative element of a PBL group, as a student learning strategy, or it can be a negative element of a PBL group, as a result of exclusion of students through everyday social practices. The implication for practice is to raise tutors' and students' awareness of how normal interactions may be noninclusive and may preclude some group members from collaborative engagement, as well as to encourage tutors and students to make use of strategies that recognize the value of both silence and activity.

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CHAPTER 3

A Framework for Problem-Based Learning

Teaching Mathematics With a Relational Problem-Based Pedagogy

Carmel Schettino
Avenues: The World School, Research and Development

INTRODUCTION

Over the past few decades researchers have called for change in the way mathematics is taught in American schools to provide equity and accessibility for all (Leder, 2003), including changes specifically focused on students in our society who are underrepresented and underperforming due to gender, race/ethnicity, class, or socioeconomic status (SES) (McGraw, Lubienski, & Strutchens, 2006). Some studies found safety and equity in mathematics classes especially to be issues for underrepresented groups such as females and students of color or those with lower ability levels (Boaler, 2008; Kellermeier, 1996). For girls especially, it seems that the mathematics classroom environment has a great influence on their attitudes toward learning and is greatly affected by the relationships and beliefs that are forged in those classrooms.

Some gender theorists and educational researchers claim that the "level of interaction and exchanges" in social and interpersonal learning relations is "perhaps the least studied and most potentially informative area of research on gender equality" (Riegle-Crumb, King, Grodsky, & Muller, 2012). It is time that we looked at how young women view learning mathematics and the subject of mathematics in their secondary education and whether or not the method of learning plays a part in that experience. In my view, the instructional methods that are employed in mathematics classrooms should allow all students, regardless of gender, race/ethnicity, or SES, the safe, secure space to build those relationships and beliefs that

would make their learning experience optimal. Therefore, it should be a goal of mathematics educators to find instructional approaches that satisfy the relational needs of a diverse group of learners and improve the experiences of those learners in mathematics classrooms. However, given the inequities that persist in the fields of science, technology, engineering, and mathematics (STEM) and the problems that exist in retaining women in STEM careers, it remains of crucial importance to examine girls' learning and paths to STEM fields of work and study.

To that end, the purpose of this qualitative study was to explore the nature of adolescent females' experiences learning in a classroom utilizing a relational problem-based pedagogy. I sought to explore the question of how adolescent girls experience a mathematics classroom situated in a pedagogy of feminist relation and using an instructional approach that I called relational problem-based learning (RPBL). RPBL intends to foster a different type of learning environment, potentially positively impacting the feelings of adolescent females (and other underrepresented groups of students) about their potential success in the field of mathematics. I defined RPBL as an approach to curriculum and pedagogy whereby student learning and content material are (co)constructed by students and teachers through mostly contextually based problems in a discussion-based classroom in which student voice, experience, and prior knowledge are valued in a nonhierarchical environment utilizing a relational pedagogy (Schettino, 2013). To investigate how the use of RPBL related to young women's experiences of mathematics, I endeavored to address the following questions:

> What is the nature of the relationship between girls' attitudes toward mathematics and their learning of mathematics during and after experiencing it in an RPBL environment?
> How do they describe their experiences?

THEORETICAL FRAMEWORK

To situate this study, and hence my own framework for mathematics education, I put forth the following two premises, as stated by Burton (2002):

- Learning in the mathematics classroom is social, not individual.

- Coming to know mathematics depends on active participation in the enterprises so valued in that community of mathematics practice that they are accepted within that community.

In this view, mathematics knowledge is understood to be constructed within the classroom community in which it exists, and a learner "knows" mathematics based on the values that are prescribed within that community. For many, this is a very different view of mathematics learning and knowledge. For example, a traditional lecture-based mathematics classroom that many adults today presume to be the typical mathematics classroom involves teacher lecture or demonstration of methods followed by individual practice that take up 84% of classroom time (Boaler, 2008). This method of instruction implies a philosophy that values one version of the truth of knowledge (which stems from the instructor): the learning of mathematics is mostly individual (since students learn from the instructor and then practice themselves), and listening to the teacher allows students to learn the information they need to know. If a learner "knows" mathematics based on the values prescribed within such a learning environment, I argue that in a traditional mathematics classroom, a learner comes to "know" mathematics in a very individual, superficial, rote way.

Further, and in contrast to the context described above, I situate mathematical learning, and learning in general, within the context of the greater relational approach to knowing, whereby "knowers are social beings-in-relation-to-others," and these relationships must be built on respect and care, not oppression and power (Thayer-Bacon, 2004). According to this view, education has a relational character, and it is precisely that relationship between the teacher and the student, and even possibly the student and his or her classmates, that affords the community the opportunity for the interaction in education (Biesta, 2004). The communication in these interactions between individuals is not about the transport of meaning but rather about the participation in and coconstruction of meaning between individuals and those members of the community in relationship to each other that, in turn, allows "education [to] exist only in and through the communicative interaction between the teacher and the learner" (Biesta, 2004, p. 21). In this relational world of knowing, learners improve their knowledge and further develop understanding by making greater connections—with material, concepts, and others (Thayer-Bacon, 2004). This is consistent with the definition of mathematical learning for understanding

that has been widely encouraged and supported in the mathematics teaching community:

> A mathematical idea or procedure or fact is *understood* if it is part of an internal network. . . . The degree of understanding is determined by the number and the strength of the connections. A mathematical idea, procedure or fact is understood thoroughly if it is linked to existing networks with stronger or more numerous connections. . . . Understanding involves recognizing *relationships* between pieces of information. (Hiebert & Carpenter, 1992, p. 67)

The task, then, is to craft a pedagogical framework for mathematics instruction that facilitates construction of knowledge, creating strong connections between "existing networks," both knowledge based and relation based. It should also incorporate the ideologies that enable as many students as possible the agency to create those connections and relationships. My theoretical framework, which includes relational trust, relational authority, relational equity, and voice and agency, has at its roots what was historically known as feminist mathematics pedagogy, stemming from the gender difference movement of the 1990s (Becker, 1995; Boaler, 1997; Burton, 1995; Solar, 1995; Willis, 1996).

Relational Trust, Inclusion, and Active Participation

In the greater workings of a school, relationships are extremely important for success in communication, motivation, morale, and many other interpersonal values in the community. Viewing trust through a relational lens can help support that success (Bryk & Schneider, 2003). However, in the microcosm of the classroom, this relational view of meaning making could also be seen in the collaborative learning experience between the members of a learning community, which inherently implies a level of trust between those members. Creating that connection in the classroom is not always easy and does not always come naturally for all individuals, teachers and learners. However, it can be nurtured if an environment of trust is established based on relational ideals that are generally led by teacher beliefs and behaviors. I focus my definition of relational trust on the aspects that pertain most directly to classroom interactions between members of the learning community.

The first two facets of relational trust that stem from the teacher are somewhat intertwined. They link the teacher's ability to connect to the learners (and hence the learning community as a whole) and her ability to actualize the "genuine interest" she has in the students' own ideas (Raider-Roth, 2005). This "connectedness" can be interpreted as a willingness to question further, a sincere interest in the well-being of the student, or a mindfulness of the holistic nature of the individual. At one point in educational theory this concept of "connectedness" was formalized to support women's and girls' ways of knowing and learning, specifically in mathematics education (Becker, 1995; Belenky, Clinchy, Goldberger, & Tarule, 1986). However, more recently opponents of gender difference theory in mathematics education have promoted an "unfixing" of the differences "to see mathematics as an opportunity to develop relations with others and re-make themselves" (Mendick, 2005b, p. 142). Mendick went on to say that "by aligning separate-ness with masculinity and connected-ness with femininity, these approaches feed the oppositional binary patterning of our thinking and in the final analysis reiterate it" (p. 163). Supporters of this more humanizing approach to the multiplicities of student relationships with mathematics agree that rethinking gender differences in a larger framework would benefit both boys and girls. It may be possible to do this if mathematical learning is viewed in less of an oppositional way (male vs. female, objective vs. subjective, etc.) and in more of an interhuman relational way—appreciating all of the various needs of connection, including being "authentic" and "feeling seen" by the other (Raider-Roth, 2005).

To allow for this more inclusive view of feminist mathematics pedagogy, we must consider the gendered nature of the classroom while also valuing each student as a doer of mathematics—valuing students' intuition, risk taking, and exploration—and finding ways of validating the knowledge with which they come to the problem-solving table (Anderson, 2005). This necessitates active participation in those pursuits within the context of the learning community. There is an accepted challenging of the norm that mathematics is cultured and objective and values certain ways of knowing above others. "Demystifying the construction of knowledge" by making the internal process of problem solving external and "valuing intuition and emotions as opposed to rationality and objectivity" are distinct ways to actively include multiple perspectives on a regular basis in the classroom (Solar, 1995).

To foster this type of active learning environment within this connected relation of trust, the teacher would also need to sincerely express interest in listening to and following up on students' original ideas. In order for this expression to come through in the classroom, the teacher needs to attend to being "present," as defined in terms of relational connections to self, students, pedagogy, and subject matter:

> A key aspect of being present to students' experience means assuming a connected stance. In this stance students must have a sense that their teachers can see them and their learning, their strengths and their weaknesses. Not only do they see but they also accept what they see without judging it as good or bad. It is mutuality that strengthens the vision. . . . They [the students] know that they can extend themselves to the very edges of their learning, to the borders of their known world, because they know that someone will be there to meet them. . . . In short, a teacher who is "present" is a real learning partner. (Rodgers & Raider-Roth, 2006, pp. 278–279)

Allowing the teacher to be seen as a partner in collaboration builds trust in the classroom, helps to redefine the vision of classroom authority, and dissolves the traditional structure of hierarchy in relational and feminist ways. This helps to build an environment of safety and risk taking that empowers student agency and encourages student voice—both of which further the relationships that will enable learning to take place.

Relational Authority and Relational Equity

Considering that learning is a relational enterprise, one must also consider that traditional classrooms in the United States, especially mathematics classrooms, are fraught with problems of equity. Authority is often described as something that one single person holds and possesses. Although many authors describe the concept of "sharing" authority, it is difficult to get away from the concept of authority being held by one person who is the sole leader and wielder of the "influence over another" (Bingham, 2004, p. 26). Gadamer's philosophy of authority was elaborated on by Bingham:

> For authority to succeed in its aim of educating the student, the student must acknowledge that there is an important insight to be

> gained from the teacher. The student has an active role of authorizing the teacher by following the teacher's pedagogical lead. To learn thus entails the authorization of the teacher by the student. (2004, p. 31)

This concept of relational authority is at the heart of a pedagogy of relation. If education happens relationally in the interactions between individuals in the community of learning, then there must be an acceptance that all members of the community have authorized the learning to take place. That respectful and reflexive interaction allows opportunities to arise for learning to happen. Connected to this construct of authority is a similar view of equity. The term "relational equity" (Boaler, 2008) has been used to describe classroom relations between students, and I extend that to relations between teachers and students; respect for others' ideas is held as a priority, as is treating different viewpoints fairly. There is also a commitment to learning from others' ideas, and this mutual respect and common commitment lead to positive intellectual relations (Boaler, 2008).

Voice and Agency

In theory, relational authority and equity in the classroom is a very idealistic notion, with the goal of fostering an environment that allows students to freely express ideas, grapple with learning tasks openly, and question not only authority but also knowledge in general. Those of us who strive for these ideals in our practice know the realities of the obstacles that encumber the development of student voice and agency in the learning process. We are all too aware of the hidden curriculum, the unspoken social prescriptions that govern the classroom, and the habits of learning that have been subconsciously taught for years through the traditional educational process. Especially for those students who consider themselves in underrepresented groups because of gender, race, ethnicity, sexual orientation, or other categorization, including opportunities for dialogue in the classroom by itself might not be enough:

> Student voice . . . may not currently have the practical or theoretical tools . . . to explain, or to contend with, the multifarious ways in which power relations work within school . . . processes. As a consequence, it may find itself implicated in reproducing,

> rather than unsettling or transforming, the hegemonic-normative practices it sought to contest. In addition, it may remain bound by the presumption that . . . such dialogue is itself a manifestation of a classed, gendered and "raced" form of cultural capital. (Taylor & Robinson, 2009, p. 169)

In other words, if not done in a deliberate and careful way, dialogue, even when attempting to be emancipatory, can simply perpetuate the hierarchy that already exists in the community of practice. Voices that were silenced can remain silenced, and those that have been heard will continue to be heard. One view of student voice work is geared toward action, participation, and change (Taylor & Robinson, 2009). These are worthy goals that need to be focused on allowing the individual student to use that action, participation, and change to move toward his or her own agency in the learning process. Taylor and Robinson (2009) discussed the focus of postmodernist theory on reflexivity: transparent and open sharing of thoughts–and the production of knowledge in the context of student voice. It is important that the dialogue move individuals toward growth in their agency in the educational process. In addition, one must keep in mind the multiplicities of identities that students construct as they move through the process of belonging to a community of practice (Maher & Thompson Tetreault, 2001), which can make the formation of student voice even more complex. Therefore, any empowerment that is promoted in dialogue should also consider the awareness of the subtleties of the race/class differences in students' identities. In the context of creating a relational learning environment, empowering student voice and agency is facilitated by creating a safe environment, further demonstrating the interdependence of the parts of the relational framework.

Included in this framework are characteristics described in models based on tenets of postmodern feminist epistemology that resist dichotomous thinking and focus on subjective thought and multiple perspectives (Hesse-Biber & Leavy, 2007) and are quite different from those of traditional pedagogies in mathematics. Such pedagogies include process-driven and objective perspectives of mathematics that create environments that are "highly ritualized" and surrender student agency while students "watch the teacher demonstrate procedures and then practice the procedures—alone" (Boaler & Greeno, 2000, p. 177). Therefore, a feminist mathematics classroom should be situated in a theoretical framework that is consistent

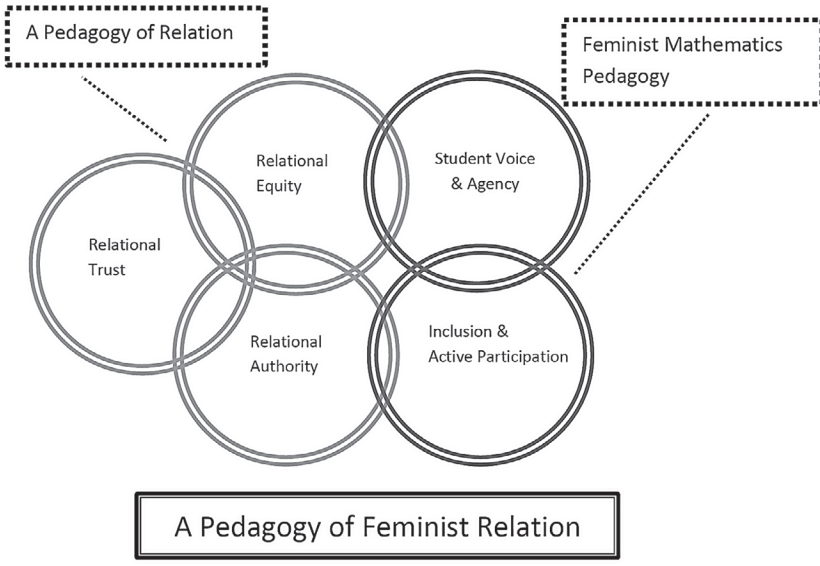

Figure 3.1 Theoretical framework structure.

with goals that allow for a sincere environment in which the interhuman connectedness of relational learning takes place. Figure 3.1 shows the intersections of these theories.

LITERATURE REVIEW

The growing racial, cultural, and overall diversity of our student body in the United States has caused a surge of concern about the inequity in mathematics education for underrepresented groups such as African Americans, Hispanics, Latinos, and those of lower SES. Many researchers have asserted that similar to females, these students are not served by the traditional ways that mathematics has been taught in many school systems (Ladson-Billings, 1995; Lubienski, 2007; Vithal, 2002). Researchers have studied the needs of students when controlling for race, ethnicity, and SES in mathematics classrooms and have found that valuing their cultural perspective and their need for political empowerment, encouraging reciprocity and responsibility, and promoting equity in experience are common values that help improve success for marginalized groups of students (Boaler, 2008; Frankenstein, 1983; Gutstein, 2007). Lower SES and racially diverse

mathematics classes were also found to have great success in settings that exhibited "relational equity" (Boaler, 2008).

Since females can be considered a specific subcategory of all of these marginalized groups, it seems prudent to consider the intersections and comparisons of the literature in mathematics education. When looking at the research on gender equity in mathematics education, there is evidence that the "gender gap" in mathematical ability is closing, but there is still concern about performance, an interest gap at the secondary level, and a lack of females choosing to enter math- and science-related fields (Hanna, 2003; Hill, Corbett, & St. Rose, 2010; Lloyd, Walsh, & Sheni, 2005; Modi, Schoenberg, & Salmond, 2012; Mullis, Martin, & Foy, 2005). Much of the minimizing of the gender gap in the past two decades has been attributed to "female-friendly" teaching techniques that have been motivated by the realms of mathematics and gender research (Belenky et al. 1986; Boaler, 1997, 2002; Jacobs & Becker, 1997). Many educational philosophers and researchers have integrated these ideas and connected them to feminist perspectives and epistemologies and have argued against the "deficit model," positing that perhaps the problem was not with girls' ability to learn mathematics but with the way the teaching of mathematics was being delivered to girls, not matching their learning styles in mathematics (Boaler, 2002). In discussions of feminist mathematics pedagogies, several authors have explored a means by which gender equity might occur in mathematics classes with different instructional approaches (Anderson, 2005; Burton, 1995), which were often consistent with Belenky et al.'s (1986) research on women's ways of connected knowing and learning. These characteristics included equity and power sharing, valuing prior knowledge and experience, cooperating and collaborating, valuing intuition and emotion, allowing room for authorship and ownership of the material, and making space for discussion-based learning that values all voices (Kellermeier, 1996; Mau & Leitze, 2001; Weiler, 2001).

Once the "deficit model" was dismissed, it became acceptable to view mathematics and its learners in a broader way. Research began to focus less on females as a broad category of mathematics learners and more on the differences between groups of females—African American, Hispanic, or white girls' attitudes toward learning mathematics, the mathematics classroom, or the subject of mathematics (Hoang, 2008; Lim, 2008a, 2008b). Feminist standpoint theory, which is rooted in the concept that all perspectives, and thus knowledge, are situated in the individual's personal

life experience standpoint, informs research methods so that investigators place their participants at the center of the research process and consider the unique perspectives from which they come. Taking a lesson from standpoint theory, researchers became concerned that for too long they had been generalizing about the issues surrounding gender equity in mathematics, making assumptions about all types of girls by looking through too unfocused a lens. Looking through the filter of culturally relevant and relational pedagogies, what seems clear is that most mathematics classes in the United States even today are still "fundamentally grounded in separate, procedural, individual and competitive work" that often opposes young women's cultural and social inclinations (Lim, 2008b). Communication characteristics such as free verbal expression and talking aloud are often considered disruptive behavior in a typical mathematics classroom. The preferred learning and pedagogical characteristics of holistic and relational interdependence (Ladson-Billings, 1995) are generally replaced by distant, objective interactions. This poses problems for holding the interest of and maintaining positive attitudes among many young women, specifically young women of color. Lim (2008b) found that in general adolescent girls of color struggle with accepted norms in traditional mathematics classrooms, to which their cultural and learning communication behavior norms do not conform. These struggles may even go as far as purposefully repressing natural behaviors such as excited discussion and emotional relationships in order to fit the norms in these classrooms.

Because of this, many researchers, including Meece and Jones (1996) and Zohar (2006), have noted the overlap between the constructivist teaching movement and feminist pedagogies. Both the National Council of Teachers of Mathematics and the U.S. National Research Council have prepared documents citing new standards and principles of mathematics learning that coincide with the values of feminist mathematics pedagogy (Donovan & Bransford, 2005; NCTM, 2000). In order to find ways for teachers to better prepare students for these new outcomes, problem solving as an instructional outcome became the focus of a number of studies (Kurz & Batarelo, 2005; Lampert, 2001; Renkl, Atkinson, & Maier, 2002).

Relational Pedagogy and Problem-Based Learning

When comparing the literature on the desired outcomes for these pedagogical frameworks and problem-based learning (PBL), it is interesting

to note the intersections of the two. For example, group work, which is a foundational part of PBL, when done collaboratively and with respectful discussion would support feminist mathematics pedagogy—valuing all voices and thereby creating a nonhierarchical group setting. In critical pedagogy, the concept of respect goes one step further and reaches toward reciprocity and responsibility for others' learning. In PBL, discourse in community is foundational for construction of learning—between teacher and students and between students and students—because in order for construction to be truly owned by the whole community, all voices must take part. This discourse also is foundational in both pedagogical practices because the methods used to exhibit the values of the theories need to ensure that all voices are heard, fairly and without bias. These intersections also resemble the theoretical framework of the feminist pedagogy of relation in which I am framing my study. Unfortunately, there is little to no literature on connecting the mathematics classroom and relational pedagogy. Database searches that include such keywords as "pedagogy," "relational," "relation," "mathematics," and "instruction" only seem to turn up past studies that have interpreted culturally relevant pedagogy or critical pedagogy in a relational way (Cobb & Hodge, 2002).

It also seems that to optimize the PBL learning environment, the teacher must make the classroom environment as open and safe as possible when it comes to the potentially risky practices of conjecture and stating one's perspectives and opinions. From a feminist perspective, *belonging* and *becoming*, in terms of "learning in community," are key agents in an individual's practice in that community (Griffiths, 2005). In other words, how one enters that community of practice not only helps define who he or she is individually but also defines the practice of that community. Using a pedagogy of relation and focusing on respectful learning sets the tone for individuals to be who they are and to support one another as a community of learners.

In Savery's (2006) overview of PBL, 10 bullet points summarized the main tenets of the instructional approach, but not included was the relational connection that I describe in my definition of RPBL, wherein safety, trust, and student agency are of extreme importance in the learning process. The main difference between RPBL and other definitions of PBL (in mathematics classrooms or other disciplines) is the overarching awareness integrated into the pedagogy of the need for relational pedagogy in the framework of the classroom culture. Otherwise, the PBL classroom may

simply perpetuate the same hierarchical authoritarian structures that have existed in traditional learning environments for decades.

Unlike a traditional classroom, which might include practice problems that follow a lecture, PBL classrooms are places where communication skills, prior knowledge, metacognitive skills, lifelong learning skills, and content knowledge are practiced by focusing on problems prior to or, more often in lieu of, explicit instruction. RPBL classroom practice is based on student presentation of solution ideas that are partially complete or not necessarily known to be fully correct at times. The curriculum is an open-source problem set that is adapted and edited annually based on an integrated algebra and geometry college-preparatory syllabus (e.g., Schettino, 2015). However, the problems have different purposes, such as introducing new material, triggering prior knowledge, offering a different perspective on a new concept, setting up abstraction of a new or old concept, and of course, practice (Schettino, 2011/2012).

Individual time to grapple with problems is an important part of the problem-solving process, so every day the teacher assigns approximately six to eight problems to read, reflect on, and possibly follow through with a complete solution. It is not presumed that students will come to class with full and correct solutions. In class the next day, students share their thoughts from the night before in at-board presentations or in small group discussion, then larger group discussion follows in order to draw conclusions, compare and critique others' ideas, and find connections between prior knowledge and potential new material through discussion. Class typically begins with students randomly assigned, volunteering, or pairing up to share their partially complete solutions or ideas on each problem. A whiteboard or digitally enhanced presentation is generally the beginning of the discussion of a problem, as the student becomes the leader of the discourse. Classmates can question the presenter directly about the methods, ideas, errors observed, connections to other topics, or overarching themes. Often the leader of the discussion must hand off questions to other students, and the teacher then steps in to facilitate open dialogue and fair reciprocal discourse. After the students have agreed upon the goal of the problem being met, or solution methods have been shared to their satisfaction, another student then becomes the leader of the discussion for the next problem. Summaries of theorems proven, conjectures made, and solution methods that might be connected to other problems are useful parts of the dialogue as well and are often done in the voice of the student or the teacher.

Other aspects of problem discussion and learning in the RPBL classroom include working on student communication through feedback on students' presentations and questioning skills, as well as metacognitive journaling to reflect on errors, thought processes, and others' perspectives (Schettino, 2014). Listening to each other and learning to take risks are skills that are encouraged throughout the class time together. Students utilize technology and other resources in the process of problem solving in order to become more independent and aware of the multitude of mathematical resources at their disposal.

METHODS

This study took place in an all-girl's independent boarding and day school; approximately 60% of its students are boarding, and 26% are international. The sample of participants from the school is of course limited in that students at this selective private school are not fully representative of the general population because this is a tuition- and admission-based school, and students are generally more academically motivated and may not reflect the diversity that would exist more widely in a public setting. However, with almost 18% students of color in the student body and 53% of the student body receiving some form of financial aid, the diversity of the school (race, ethnicity, SES) allowed for a diverse selection of the students in the study.

Teacher Participants

The mathematics department at the school had decided to change its geometry curriculum to a problem-based one three years before this study, the rationale being that incorporating more discussion and deliberate problem solving would allow students to foster the twenty-first-century skills needed to develop independent and higher-order thinking (McCain, 2005). The three teachers of the course during the year in which the study was conducted were me, Ms. Brown, and Ms. Johnson; all three of us were the original collaborators on the department's curricular RPBL project (see Table 3.1). Ms. Brown and Ms. Johnson had both been there for six years and had been teaching with RPBL for three years. Ms. Brown was a mathematics educator at midcareer and was the chair of the department at the time of the study, while Ms. Johnson was a younger teacher with a

TABLE 3.1 *Participant Teachers' Information*

Teacher	Number of sections taught	Education	Years at current school	Years of teaching experience	Years of teaching RPBL
Ms. Brown	1	BA, math; MAT, education	6	13	3
Ms. Johnson	2	BS, physics; MS, physics and engineering	6	8	3
Ms. Schettino	3	BA, math; MA, math	10	19	15

background in physics and was newer to the classroom. The classes that year varied in length from 50 to 75 minutes (two of each class period length per week). The classes utilized inquiry activities that ranged from computer lab activities with dynamic geometry software to having students in groups at the board working on problems that motivated new ideas. After each activity, however, large group discussion always came back to summarizing conjectures and having the teacher facilitate a discussion in which students agreed upon what had been learned.

Student Participant Selection

In any given year there were usually five or six sections of the course, which over a period of four years had come to be taught with RPBL. It was titled "Integrated Algebra and Geometry: M210" and generally enrolled students from grades 9–11; each class had an average size of 13 students. It was important to have a range of students in the study who captured the diversity of the current students enrolled in the course. My hope was to recruit a maximum of approximately 8 students from the total number of girls (n = 46) who were enrolled in M210 in that academic year. The recruitment of participants began with my making short visits to each of the five M210 classes, during which I read from a "student recruitment script" to introduce them to the concept of the study.

Initially, 14 students expressed interest in becoming participants and returned an assent form, and at that time I e-mailed the parent consent form to their parents. Once assent and consent had been obtained, I acquired the metacognitive writing journals from the RPBL class of those 14 students who had shown interest in becoming participants. My main

goal was to be sure there was diversity among the final participants in the study over a variety of categories. Figure 3.2 outlines the diversity of variables I hoped to achieve among the population of students taking M210. I read through these students' journals to ascertain whether their written communication would be helpful in telling the story of their experience by providing snapshots of their problem solving or explaining their processes in detail. Some students had started the year in a less articulate way and grew, which gave me insight into their experiences, and others had been skilled in this method of communication from the start of the year. Other students' journals did not give helpful insight into their experiences in the classroom because they had not learned about writing mathematically or been able to use the journal as a tool to describe their problem solving usefully at that point in the year. At times I found it difficult to ascertain from the many varieties of writing styles at that point in the year which students might be the most suitable candidates for participation. However, I used the range of grades on the journal entries, student ability to articulate mathematical ideas and processes, and expressiveness in their writing as guidelines to help decide who would be interviewed. I believe that in the end it was most important for me to include a variety of demographic information to be sure that all teachers were represented and to allow for a range of interest and ability.

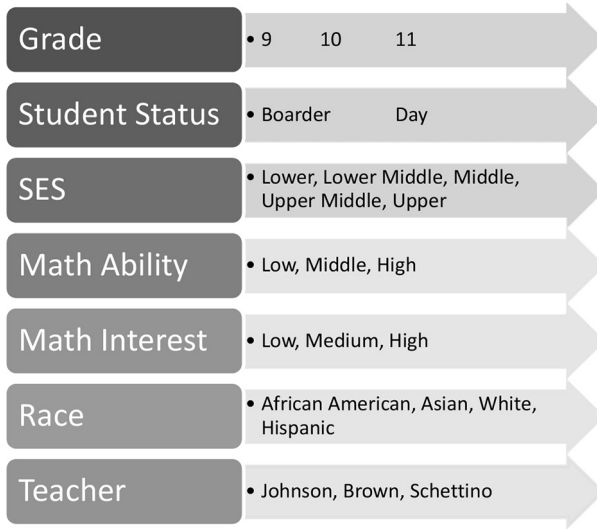

Figure 3.2 Desired demographic for student participants.

TABLE 3.2 *Student Participants' Information*

Name	Leona	Isabelle	Kacey	Sarah	Alanna
Grade	10	9	10	9	9
Teacher	Schettino	Johnson	Schettino	Brown	Schettino
Race	White	Mixed	White	White	African American
SES	Upper	Middle	Middle	Upper Middle	Lower
Ability	Low	Middle	Low	Middle	High
Interest	Low	Medium	High	Low	Low
Boarder/Day	Boarder	Boarder	Boarder	Day	Day

I identified a set of eight students to participate in the interviews and obtained student assent and parental permission. I had the wonderful experience of conducting initial and final individual interviews with all eight young women who examined their experiences with this pedagogical approach. After completing all data collection, however, I had to narrow down the eight participants to five due to time constraints and data management issues. Although the result was not always optimal, I found ways to balance the diversity in all seven categories as best I could. The diversity of characteristics of the five final participants can be seen in Table 3.2.

The data collected over six months included student metacognitive journals, classroom observations, teacher interviews, and initial and final student interviews. (See Figure 3.3 for a summary of all data collected and Appendix A for the interview protocol.)

This collection of data allowed for triangulation through observation of the students' work in the classroom, student metacognitive journals, teacher interviews, and student pre- and postinterviews, which provided each student's perspective on the experience. The interviews allowed students to reflect on their change and growth, while the journals provided more consistent and longitudinal data.

DATA ANALYSIS

In keeping with the theoretical framework of education as a relational phenomenon, I used the "Listening Guide" (Brown & Gilligan, 1991, 1992;

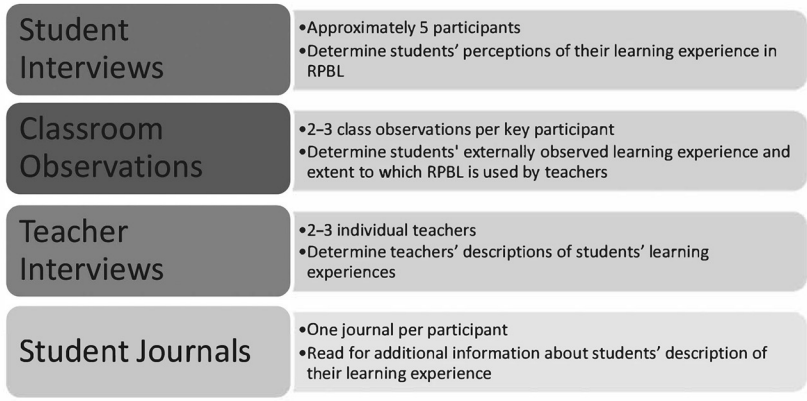

Figure 3.3 Summary of data collected.

Gilligan, Spencer, Weinberg, & Bertsch, 2003), a voice-centered, relational approach to narrative data analysis. In this method, a researcher employs multiple readings, or "listenings," of interview transcripts. In each reading a different participant perspective is identified and "listened for" (Doucet & Mauthner, 2008), because one's discourse has multiple layers. The first reading is done while listening for plot—that is, the basic story of what the interviewee is telling. It includes how the reader has responded to that story. During the second reading, the voice of the self should be listened for, and in this stage phrases that are described in the first person (with the pronouns "I" and "we") are contrasted with phrases described in the second person (with the pronoun "you"). These I-poems, as they are called, provide an alternative way of viewing the interview text in poetic form. In each consecutive reading thereafter, "contrapuntal voices" are read for. This reading brings out voices that seem to be in potential contradiction with each other. With this method, it is important for the researcher to respect the participants' experiences without judgment as she navigates the often coded, indirect language of girls and women (Beauboeuf, 2007). Table 3.3 lists the different readings and the questions I looked at while analyzing the participants' narratives for coding.

During each reading of all interviews and journals, I utilized the coding software MaxQDA to consistently use codes for student pre- and postinterviews, teacher interviews, and journal entry texts. The coding helped me sort the themes that emerged from the I-poems as the

TABLE 3.3 *Listening Guide Process*

Reading (listening)	Theme	Questions
First	Plot/reader response	What is happening? What has occurred? What actions are described? What stories are told? What are my interpretations of the story?
Second	Voice of the self (are there subvoices?)	Who is the actor? Can I engage with the speaker? Can I identify "I statements"? Are there multiple voices speaking?
Third/Fourth	Contrapuntal listenings for attitudes in research question	Which voices seem to speak out about the experience in mathematics class? What are the juxtapositions of the experience? Where do they happen, and how do they relate to each other?

listenings happened in each iteration. In answering the questions (in the third column of Table 3.3) during each reading, I highlighted segments of text as well as the personal pronouns that were used by the interviewee (I-you-we), which helped in structuring the poems as well as recognizing emerging themes.

Data analysis of the classroom observations on each participant included open coding prior to the application of the Listening Guide to the narrative data. This allowed for an overall general view of the stories of the girls' work in their classes: the similarities and differences in their behavior and interactions in the classroom setting and any consistencies that I might see in their mathematical learning.

DISCUSSION AND FINDINGS

The five participants were a diverse group of young women who had much in common in terms of their overall characteristics: adolescent girls in the 9th or 10th grades, all participating in the same RPBL learning experience. However, they all had unique stories to tell.

Sarah

Sarah was an artistic freshman from a public school background where most of her mathematics classroom experience was described as traditional.

> [T]he teacher would just stand at the board and she'd just like read off notes and how to do the problem, so you never actually got to figure them out with each other.

Although she had been grouped with honors students, she never had considered herself a "math person." She commented that "even in, in elementary school I never liked math, it was always like my least favorite subject." Sarah entered high school with a lack of confidence in mathematics, a feeling of frustration and disappointment in her ability, and a fear of being left behind and confused in math class. However, observing Sarah in the RPBL classroom, there was a different person learning. One example of this was when Ms. Brown had students work on a problem in which they were finding the area of the cheese on a piece of pizza. Students did not have a formula for the area of a sector of a circle at this point in the course.

> What is the area of the cheese on one piece of a 16-inch cheese pizza if it is cut into 12 slices?

The goal of this question is to lead students to the relationship between central angles and sector area as well as arc length in circles. Sarah and her classmates were at the board working on this problem, and after discussing what it meant to have a 16-inch pizza, they easily realized that if they found the area of the pizza, they could take a 12th of it to find the area of one slice. Quickly, Sarah thought of another question and asked, "What if it only asked for the area of the crust?" and drew a diagram (Figure 3.4).

Suddenly the class was very interested, and Sarah went on to say that she wanted to subtract the isosceles triangle's area from the sector area. It was a great example of a moment when she was able to follow her curiosity and extend a problem into something that was more complex than the question asked.

Sarah described how much she valued her ability to go deeper into her own questions and the questions of the group in this classroom. ("I think it, it like helps you remember how to do the problem more and you understand it rather than just knowing the steps.") The other aspect of the class that seemed to foster Sarah's sense of inquiry came through in her voice every time she spoke about being "at the board." ("I think going

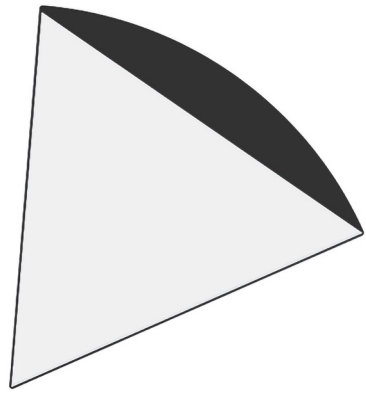

Figure 3.4 Sarah's pizza slice.

I	**You**	**We**
		we sit around the table
I think going up to the board		
I find interesting		
	you kind of have to learn	
	on your own	
	help you along the way	
	you like	
	do your homework	
I go up to the board		
I always find mistakes		
I did the night before		
I go up and do it		
	you're up there explaining	
	you get a better understanding	
I think		
I think		
I think about it		

Figure 3.5 Sarah's I-poem.

to the board helps me more, like it'll, it'll help me like remember how to do the problems.") In this classroom, students' presentations of their ideas are a valued and focused part of the class discussion. In the I-poem in Figure 3.5, I could hear Sarah's voice of appreciation for what she had learned from being "at the board."

Although this poem starts with an inclusive "we" voice, in it Sarah alternates between the "I" and "you" voices later, denoting more of a sharing

between the first and second person. She wants to describe the experience from her perspective but also share the views of a general student in the class. In the first person, she is sharing her own experience of going up to the board and the mistakes that she has made. In the "you" voice, she is speaking as a student in the class about how, as a student, "you" actually learn from those mistakes, and the experience enables not only "you" but the others in the class to learn as well. It is quite telling that she starts with "we sit around the table" and ends with "I think about it," which shows the connectedness in the learning between the whole group, the individual, and the material (we-I-it). This feeling of connectedness and a unified community is part of the learning environment that is definitely something that Sarah felt was missing in her prior mathematical experiences.

In class, Sarah worked with others, laughed, and communicated about mathematics while remaining positive about problem solving. Ms. Brown was optimistic about her attitude toward mathematics and was certain that she had positive feelings toward both mathematics and the class ("she has one of the best attitudes about math—she loves it"; "she came in here and suddenly just like looks forward to class every day"; "she talks about how much she loves math"). However, when Sarah was asked about her attitude toward math class, she responded with the tension between enjoyment and aversion from the past:

> Well I, I don't know. I think I'm a better math student now and I think this class has made me, like, have a better understanding of math and that I can actually do problems and . . . I think, *I think it's helped me learn a lot better and I have a, like, better respect for math class* [*both laugh*] because before, even in, in elementary school *I never liked math, it was always like my least favorite subject*.

Even when Sarah was talking to me about how proud her parents are about this change in her attitude, she became a bit modest and changed the subject to what she saw as good about enjoying mathematics:

> **Sarah:** Well I mean, I—I tell my parents that I like math class, and they think it's really great that I have a good teacher . . . and everything, like even when I bring home my journal entries, there's like pages and pages of how to do centroids and

orthocenters and I was trying to explain it to my dad one day. [*pause*]

Ms. S.: Yeah. But they, they're impressed?

Sarah: Yes.

Ms. S.: That you had this change?

Sarah: They're definitely impressed [*both laugh*].

Ms. S.: OK. [*pause*] That's great.

Sarah: Because **I** have like pages of how to, like in my . . . my um, journal *I* have like color-coded. . . . It's great to have, um, like not maybe a love for math, but if **you** understand it and **you** like math, I think it's better and **you** can use it in like everything else.

Sarah's switch to using "you" instead of "I" in the last statement indicates a disconnection from the idea of enjoying the mathematics, as if she were talking not about herself anymore but about a student in general. Sarah felt a certain amount of pride in her excellent work in her journal and also in her enjoyment of mathematics, but something was stopping her from taking total ownership of this part of her identity. It is clear from research that the formation of an individual's identity in mathematics learning is a complex and subtle process (Lim, 2008a). Recent research points out that identity formation in mathematics for both boys and girls often stems from a culture that relies on gendered stereotypes and conceptions of a binary oppositional system of relationship with mathematics (Mendick, 2005a)—you either get it or you don't, you're either fast or you're slow, you like math or you don't—and often these dichotomous views are linked to specific genders, although sometimes they are not, depending on the experiences that individuals have had. From the tension in Sarah's voice, it sounds as though she was still struggling with her mathematical identity. Perhaps this course helped break down those clear distinctions of dichotomous mathematical identity and muddied the waters for her in order to allow her to gain a different perspective to enjoy mathematical activity a bit more.

I was encouraged by how Sarah found a place for herself and made a connection with this classroom and Ms. Brown. Sarah discovered that mathematics could be seen through a different lens ("I try to solve problems in different ways"), and although she still struggles with the strength of her ability and being solid in her confidence, she is moving forward with this idea, which is certainly progress from where she was.

Leona

As a returning sophomore, Leona was a very confident, outgoing young woman who characterized herself as having somewhat midlevel ability in mathematics and relatively low interest in the subject. She loved theater and debate and so found herself attracted to humanities-based courses because they allowed her to utilize her strengths. However, in her final interview she summarized her thoughts about learning mathematics in the RPBL classroom as follows:

> It's not the teacher sitting in front of the classroom being like, "Oh, do you remember when we did this? Well, this is like that." . . . On my homework for example, using Pythagorean theorem to find the length of the hypotenuse and then having to find a distance on a coordinate plane, and relating the concept back and applying it to that. . . . It kind of gives me a satisfaction of being like, "Oh I'm smart enough to connect that point and understand that."

Leona's comments here describe her overarching feeling of this course giving her a larger sense of ownership of and control over her own learning. They also confirm the feeling and belief that she was "smart enough" to make the connections on her own or that she would not need the teacher to tell her which way to do a problem.

In Leona's interviews I heard a tension between her value for and the strength of her independence and her interest in and desire for interdependence with others; it made me wonder about her feelings about relational learning. This is consistent with what is known about girls (Brown & Gilligan, 1992) but is not necessarily utilized or focused on in mathematics classes in the United States. Leona was very articulate about what it was about the relational aspect of this classroom that helped her learning. She said that she liked how it "kind of put you through another person's mind, in a way." She even extended herself to say that "for me, when I have a better relationship with a person, I want to listen to them more." She tried to explain that wanting to listen to them more and wanting to learn from them are inextricably tied together, since "seeing the way another person thinks, [allows me to] develop a respect for them." She followed that thought by saying, "I just think it opens up a lot of discussion . . . which promotes learning inevitably . . . and creating new ideas and things like that." At one point in our initial interview, I asked Leona what she

thought about how the open discussion allowed students to share their own ideas, and she responded:

> It's nice because we all do things differently, like as different people, everyone has a different personality and everyone thinks differently and it's really nice to see how I think or look at something versus how someone else like in my class looks at something and being like "wow, that could work, I could use that," or "I could use my way, whichever feels most comfortable." But it's nice to have that option presented by not only the teacher, but the student too because, I think, in a way, it develops like a relationship with your class that you don't really have because you're talking to them and you're learning how they think.

This might be something that Leona was used to in an English or history class but found very novel in a mathematics class, where she was used to there being "no other way to look at it" than the way the teacher showed students. This idea of bringing multiple perspectives on a problem to the discussion really worked for Leona, mostly because of the relational aspect of learning. She had such a deep respect and appreciation for other people's ideas that it was natural for her to learn this way. When asked for an anecdote from class, Leona gave an example from a class period that I remembered vividly. Here was the problem:

> An airplane is flying at 36,000 feet directly above Lincoln, Nebraska. A little later the plane is flying at 28,000 feet directly above Des Moines, Iowa, which is 160 miles from Lincoln. Assuming a constant rate of descent, predict how far from Des Moines the airplane will be when it lands.

In class, another student had presented this problem by using slope as the rate of change (i.e., 8,000 feet/160 miles); she had used 28,000 as a y-intercept and wrote the equation of the line. She had then graphed the line and found the x-intercept to find how far from Des Moines the plane would be when it landed. This made no sense to about half the class, who were thinking geometrically, including Leona. So another student said that she just did it by "counting"—she started at 36,000 and went down by 8,000 and tried to see how many times she needed to do that to get to

the ground (i.e., 36,000/8,000 = 4.5). So she figured that she needed to go over to the right 4.5 times 160 miles, and that's where the plane would land. That seemed to make more sense to a few more students, but then Leona got up and said, "Oh, so it's like drawing a bunch of triangles with sides of 8,000 and 160 from 36,000 to the ground?" (Figure 3.6).

It took a few minutes of discussion for her to show how what the other student said had inspired her geometric approach to this solution, but then a great connection was made between the other student's algebraic approach and this one. The students realized that finding the x-intercept of the line was actually the same as finding the landing point the way Leona and the other student had done. Experiences and discussions such as these allowed Leona to grow in her appreciation of the multiple ways in which students viewed different problems. She learned a great deal from seeing these different perspectives, and this only added to her learning experience. In our initial interview she made the statement "I really like that you get that 'why' in a few different ways—from your teacher, from your friends, well, I consider them my friends." And because of the relational aspect of the learning, she really did consider the majority of the class her friends even if they were not close friends outside of class.

One part of the relational learning that pleased Leona the most was the fact that there was interaction and connection between the students in

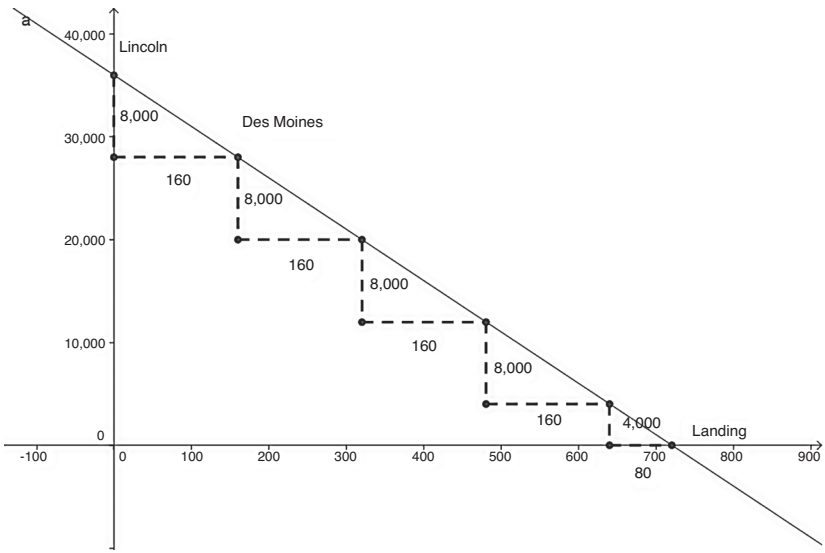

Figure 3.6 Student's geometric problem-solving method.

the class. This interconnectedness and responsibility for each other seemed to give her some satisfaction not only in her own learning but also in the learning process in the classroom as a whole:

> I feel accomplished that I get to . . . not influence, but in a way influence others and at the same time receive influence from others, because . . . then I feel accomplished like I've done something [that] not only affects myself as a learner, but others as well. And . . . it's just a good feeling that I could hope to make others understand, if I'm correct with what I'm saying. And even if I'm not, I mean, everyone learns from mistakes so to present myself and kind of put myself out there, too, in front of people, it's nice to have them accept what I'm saying, or choose not to. And so, I feel accomplished.

When I asked her to talk about how this course had possibly changed her as a mathematics learner or her identity as a mathematics learner, her narrative created the I-poem in Figure 3.7.

In this passage, it is striking that Leona begins with the "you" voice, or the second person, distancing herself from the idea of growing up, getting older, maturing, and having power. She may see this as something that will happen in the future, perhaps when she is out of school—that is when you get to express yourself. She then takes the "I" voice, or the first-person narrative stance, when she says that she "likes to solve it this way," where you can distinctly hear her voice expressing her own opinion, something she had said she didn't think would happen, or should happen, until you are older. She then moves into the third person, into the "We" voice, speaking as the class as a whole or two classmates who disagree on their ideas in class coming to the conclusion that even if they had both used different methods that disagree, "both of us is right." This idea that there might be more than one "right" solution is actually the very essence of the freedom that Leona is looking forward to in the future. The idea that she can independently come to conclusions based on her own ideas is freeing, has changed her identity and given her a voice (one she didn't have before in mathematics class). It is clear in the last stanza of the I-poem that Leona is still conflicted between what she can and cannot do (by the alternating "could" and "could not" lines), but in the end she is clear that she has been deeply affected by the methods utilized in this class.

I	You	We
	As you grow	
	When you turn 18	
	You have the power	
	You get to express yourself	
	No matter what side you're on	
I feel like		
I could be on		
I like to solve it this way		
		We both get to express
		One of us is wrong
		If one of us is right
		Or even if both of us is right
Changed my identity		
Given me a voice		
I didn't really have one before		
I think		
I could always		
I guess		
I could go		
I needed		
		We had each day
I could ask		
I didn't really feel		
I could go		
I couldn't go		
I could ask how		
I could ask what		
I couldn't ask why before		
I think		
I mean		
I hope so		
I mean		
I mean		
I feel like		
I'm affected		

Figure 3.7 Leona's I-poem.

Leona summarized her appreciation for the empowerment of her agency in her own learning of mathematics by commenting on how her experience in this course had changed her ability to speak in class:

> It's changed my identity and given me kind of like a voice in math—whereas I didn't really have one before. It was a silent voice.

Leona's experience of having a "silent voice" in the mathematics classroom can be extended to many marginalized students in the United States today, where the "'silencing' constitutes the process by which contradictory evidence, ideologies and experiences find themselves buried, camouflaged and discredited" (Fine, 1987/2012). Whether she was actually silent by not talking at all or was silenced in this way when her ideas were buried or discredited by a learning environment that was not conducive or welcoming

to them is really irrelevant; what is important is that this is how Leona felt. She spoke of not wanting to "go to listen to her [the teacher] talk to us," which can be interpreted as students not wanting to be "talked at" instead of having interaction with others. This type of oppression on the part of the teacher reduces the students' agency in learning in that it does not allow them to express their ideas or investigate their questions. Leona also described a form of self-silencing that came from knowing that the type of questions that were acceptable were those that kept things moving along and were not creative or interesting. ("Questions were always a possibility. Teachers never denied us of that, like, *privilege*; I guess you could call it.") I was impressed with the depth of understanding of the subtleties of the classroom that she was able to share with me and how articulately she verbalized her thoughts.

Isabelle

Isabelle was another student who came from public middle school and was "moved up" from a "regular" track to an accelerated one. She had left that system with the feeling of being a bit "behind" the other students, who had been together in the sixth grade. Isabelle was a rather mature, articulate freshman of mixed race who described herself as having mid-level mathematical ability and interest in the subject. Her teacher, Ms. Johnson, noted that Isabelle lacked passion and interest in the classroom, but nevertheless regularly counted on Isabelle as a strong contributor to class discussion. Although I observed her to be a valued member of the classroom community, in our discussions Isabelle would regularly admit to not seeing the value in doing the mathematics. Also, although she freely admitted that math historically had not been her favorite class, she did "like math" because she thought it was "really interesting when you can connect different ideas together."

All of this begs the question, what would make a student who does not see the value in a subject or think she is particularly able enjoy studying it? What seems to have worked well for Isabelle in this situation was that she had an inherent sense of confidence in herself and what she was asked to do in this particular classroom setting. While reading for the contrapuntal voices of value and worthlessness in some of Isabelle's narrative, I could hear a voice of doubt in her ability in mathematics. Although she was a confident young woman, she had had experiences that led her to doubt her abilities in mathematics. Seeing herself as "average" in the accelerated class and having

her teacher choose to place her in those classes later than the other students in her grade had led her to believe that she might not really belong and perhaps might not be as able as the others. This shadow of doubt came up when she talked about times she was confused and how this classroom had helped her. ("If I didn't know something and I didn't think it was right, I wouldn't put it up on the board.") However, the voice of confidence can also be heard when she realized how much she could accomplish on her own. For example, on individual assessments, it seems that although there may have been times when she doubted her abilities, it is also true that there were times when she saw problem solving as fun ("it's more like a puzzle than a test"). She ended up feeling accomplished when she tried something on her own or with her classmates. The I-poem in Figure 3.8 shares her confidence in the mutuality of the relationship she had with her class.

In this segment, Isabelle speaks only in the "I" and "we" voices, indicating that she is totally inclusive in what she is saying. She moves back and forth, narrating her feelings about what she did, knew, and needed for herself and what the class as a whole (including herself) did, knew, and needed. However, the processes for problem solving somewhat parallel each other, and she has played a role in both. I believe that her own confidence has played a part in her ability to see that she can be a more active participant in mathematics in this classroom and part of a community of problem solvers.

More than once in our conversations, Isabelle identified herself as a mathematics student who "really likes algebra" because of its procedural nature; traditional classrooms had really worked for her in the past. ("I like steps.") However, she also stated that "if more math classes were taught like

I	**We**
I'm helping somebody	
I know	
I'm in a lot of situations	
I'm the one needing	
	We're all pretty much friends
	We had to do this problem
	We didn't know
I got it right	
	We needed to know
I think	
I don't remember	
I think	

Figure 3.8 Isabelle's I-poem.

this I might like them a lot more." However, she theorized that a "math person," which Isabelle described as "button-up shirt, pants, tie, glasses, ruler, you know, really straight-forward and stuff," might not like an RPBL class because of the ambiguity in the lack of directness and the open-ended discussion that occurs.

As Isabelle started describing more attributes that seemed to be adding up to her enjoying the class more, I tried to paint a picture of what it was that produced her enjoyment. The interesting thing is that it was not the mathematics she was enjoying but rather the class—the interaction between the people in the class—and should the class be solving some interesting problems that pertain to mathematics, that was OK too. What Isabelle described enjoying about the class was the way in which she saw mathematics as no longer black and white, with only the teacher's information as what counted. I asked her to describe for me what it was like in class with Ms. Johnson:

> **Isabelle:** Like it's, if you have a question you can just ask it and then that can lead into like some conversation or she can ask a question and then kind of leaves it out there for us, the kids to answer it, so . . .
> **Ms. S:** OK, and why do, why do you like that better?
> **Isabelle:** Um, because it's not so uptight and [*laughs*], like it's not like focused, "memorize all of this stuff."
> **Ms. S:** Hmm.
> **Isabelle:** It's more relaxed, and that helps me learn better I think.

Isabelle's more traditional view of the mathematics classroom with its "uptight" and rigid nature reminded her of memorizing facts and formulas, and she stated that she responded better to a classroom that, in her eyes, was more "relaxed" and interactive, allowing her views and responses to matter. This is consistent with Maher's (Maher & Thompson-Tetreault, 2001) view of the feminist classroom's responsibility to "deliberately position students as academic authorities" in order to allow them to feel that their responses matter but also not to "dismiss their own emerging sense of themselves" (p. 92). Also, Isabelle's feelings are consistent with what Keller (1985) once called "dynamic objectivity," which she defined in terms of how we might be inclined to think about the idea of integrating student input with factual mathematical knowledge:

> *Dynamic objectivity* is a form of knowledge that grants to the world around us its independent integrity but does so in a way that remains cognizant of, indeed relied on, our connectivity with that world. In this, dynamic objectivity is not unlike empathy, a form of knowledge of other persons that draw explicitly on the commonality of feelings and experience in order to enrich ones' understanding of another in his or her own right. (1985, p. 117)

We can consider this more flexible way of viewing knowledge as necessary for including students such as Isabelle, who find the more rigid mathematics classroom not conducive to learning. She would rather remain connected to the material and the persons in the classroom with her in order to facilitate learning for herself. Isabelle truly enjoyed the fact that students were the contributors to the knowledge and shared in the presence of authority in the classroom. Because of the openness to the dynamic objectivity of the knowledge, the students (and she) were able to accept that their input was valuable. When I asked her why she thought the students felt so compelled to participate in the classroom, she had this to say:

> **Ms. S:** Yeah, there's almost a guarantee that people will. . . . I wonder why? I wonder what guarantees that everyone will have something to say.
>
> **Isabelle:** Well [*both laugh*] it's probably just because geometry has like twen . . . like a lot of different ways to do certain problems so there's a lot of variations in the way that people do them, so. . . . That might be it, or it might just be that people feel comfortable in the situation they're in to participate and it's not like, "OK nobody ask questions so we can leave now."
>
> **Ms. S:** [*laughs*] Yeah. Ok. So there's a certain amount of like motivation to want to talk about it?
>
> **Isabelle:** Yeah.
>
> **Ms. S:** Because it's like interesting to hear what other people did? [*pause*] Um, yeah, I can't figure that out.
>
> **Isabelle:** I think everybody like shares the same curiosity level and like when somebody . . . like I know in our physics class he never tells us the answer to questions and it drives everybody crazy . . .
>
> **Ms. S:** Huh . . .

Isabelle: And then we all start talking about it to try and figure out if like we can find out the answer ourselves so and the same thing happens in my math class so . . .

Ms. S: Yeah?

Isabelle: I think it's just the motivation to find the right answer and like, because I know everybody in my class wants to understand.

Isabelle's newfound appreciation for both the dynamically subjective nature of mathematical learning and the connected community of learners of the RPBL classroom influenced her learning experience greatly.

Alanna

Alanna was an African American high-ability ninth grader growing up in low-income circumstances with a single mother and moving from school to school. She often found herself unchallenged in many of the public schools she attended. When asked, she described herself as "lazy" and "distracting to others" in math class, mostly because she didn't see any value in it. In reality, her ability was much higher than the care that her teachers could provide for her, and although she did well grade-wise, she never really enjoyed mathematics. Her past experiences in math class had been isolated, passive, and lonely, since she would finish work early and her teachers would give her work to do on her own. She had was no appreciation for the material, and it was an easy A. "It was just like *talking,*" but there was no interaction or actual communication of concepts or ideas going on in the classroom.

Alanna told me she didn't understand the reasoning behind mathematics class. When I listened to the voice of the self, there was a clear sense of frustration, even sadness, when she spoke about this lack of understanding. The I-poem in Figure 3.9 came from a passage in my initial interview with Alanna when she and I were discussing her memories of her past mathematics classes in comparison to her experience so far in the RPBL classroom. She tried to summarize what those experiences meant to her.

What strikes me most as meaningful about this I-poem is the initial use of the "you" voice to describe her experience of the lecture-practice method, which is very standard and assumes a set of objective factors. It would be natural for Alanna to disassociate herself from that process if she does not feel that it is the way she should be learning or that it does

I	You	We
	they would teach you something	
	you'd go home and practice	
	you have to be able	
I think I've learned		
		we'll learn something
		we'll investigate something
		teaching us something
		we go home and practice it
		we didn't have midterms
I was pretty much screwed		
		we'd take a test
I'd forget it		
I remember stuff		
I take a test		
I feel		
I have, I have to retain		
I don't know yet		
I would have to know		
I want to do		
I'm not really sure		
I remember them		
		we'd just learn words
		we never went back

Figure 3.9 Alanna's I-poem.

not work for her. She then speaks in the "we" voice as the students in the class are talking about "learning," "investigating," and "practicing" the things that are taught in class, but somehow it all sounds very passive and disassociated from herself in the first-person plural voice. She claims in frustration that she was "screwed" on the test since she never really fully constructed any knowledge or had any opportunity to do so. Once she gets to her "I" voice in this poem, she is extremely active in her frustration with the expectations of knowledge that she has never gained from the processes of the class. She's not even sure she can remember something that she was supposed to have learned at all. Most touching is the fact that "we just learned *words*," not concepts that they could go back to and have them actually make meaning in the context of something else once again. Alanna's voice in this I-poem is clearly expressing her frustration with the lack of relationship she had with the material in her past class—it is what was missing for her and perhaps what would have answered the question of what the "point" was in being in the mathematics classroom.

Alanna had a difficult time putting into words that the relationships between the people were integral to her engagement, but she was able to list the people and the interactions between them that made the relationships important. Expressing herself in relation to the others in the classroom community allowed her to be more comfortable and find purpose in

learning. Like many African American young women from urban culture, Alanna considered herself very loud and outspoken, and she might have seen her cultural and social personality as in conflict with what was acceptable in the traditional mathematics classroom. Lim (2008b) said of the internal conflict that young African American students grapple with in a traditional mathematics classroom: "Black students' communication style (e.g., free verbal expression and talking aloud) and learning preference (e.g., holistic, relational, and field-dependent) were rarely respected in the classroom space; rather they were considered disruptive behaviors or, at best, an attitude non-conducive to mathematics learning" (p. 92).

Alanna found that her personality and outspoken attitude were valued in the RPBL classroom because sharing her thoughts and creating relationships were encouraged. This actually worked in her favor. There has been evidence especially for students of color and low SES that a more cooperative learning environment and attempting to create processes that relate to their everyday lives (such as authentic problem-solving scenarios) foster deeper appreciation and higher achievement (Boaler, 2008; Lim, 2008a). Alanna summed up her appreciation for this pedagogical style thus:

> 'Cause that's like basically the essence of the class—just working together . . . incorporating what they say into what I say and just making something out of it.

It is just this relational aspect of the RPBL that Alanna seemed most grateful for. In class, I observed Alanna truly enjoying putting problems on the board and sharing her solutions with the class, but as the year went on, I watched as she learned to sit back and allow her classmates to present their solutions because she knew that they learned just as much from making their own mistakes at the board and not necessarily always watching her present. This was part of Alanna's realization in her growth, which there was much of throughout the year.

Kacey

Kacey was a new student who was repeating her sophomore year, so she was 17 years old. She came from a rural town in a mid-Atlantic U.S. state and was very athletic—a star on the school's track team. She was widely respected in the school community for her ability to speak her mind on politics and school matters and for openly questioning her sexual and

gender identity. Kacey's past experiences with learning mathematics were back and forth between homeschooling and a large regional public school from 6th through 10th grades. The inconsistencies in her knowledge were huge, as was her inability to make connections, which led to poor grades and a low feeling of self-efficacy. However, she had a tremendous curiosity for learning and a positive attitude.

Kacey consistently contended that she was not a "math" person, as her identity centered on sports and humanities, but she admitted that she developed in this course and came to value mathematics in a way that many self-identified weaker students in mathematics usually do not. Kacey saw how RPBL helped her to understand mathematics better in ways that a direct instruction classroom teacher just "telling you how to do something" did not. I asked her to elaborate on why she thought that someone else telling her something would leave her understanding less than figuring it out on her own.

> I like to think about like *compared to me throwing the shot put without the technique*. Because like you could just do it with just brute strength . . . and you could do it faster. But you would have to backtrack and go through the steps through the technique and learn it like down from . . . like start from the bottom, and build yourself back up and it goes slower, but *in the end you'll like throw it so much farther.* Just like when you do geometry, ... *I feel like once you understand the connection, you actually become smarter and you can make connections in other things as well*. And it just helps everything.

Kacey was describing a phenomenon that many educators have realized through experience and many researchers have confirmed through experimentation: that retention of knowledge and development of learning comes with experience and deliberate thought processes. The educational researcher and teacher Caleb Gattegno once said of learning, "We are retaining systems and do not need to stress memorization as much as most teachers do. We hold better in our minds what we meet with awareness" (1976, p. vii). Because RPBL stresses the process of problem solving and the collaborative relationships between those involved in the process, the learning is enhanced by making students aware of processes through their own realizations and discoveries. That awareness is often more meaningful

and creates more mathematical sense making in terms mathematics in the long run. As stated by the National Research Council report on student learning in mathematics, "Metacognition and adaptive reasoning both describe the phenomenon of ongoing sense making, reflection, and explanation to oneself and others" (Donovan & Bransford, 2005, p. 218). Deeper understanding and more active participation definitely increased Kacey's enjoyment of studying mathematics.

Kacey was clearly aware of her strengths and weaknesses based on her background. She was also aware of what she appreciated about the classroom and how she learned best. She could remember times when she was being homeschooled that she craved interaction with other people. ("All I want to do is talk to somebody or do a math problem. I would try to go upstairs and talk to my parents." "I think everybody has a need to talk about it.") When she was in a more traditional public school classroom, she was frustrated with the way students would silence themselves. When asked how Kacey viewed the traditional classroom now that she had experienced the RPBL classroom, she focused on her need for independence and agency in her own learning as well as a relationship of mutual respect with the teacher.

Like many weak mathematics students, Kacey saw her mathematical limitations as innate inadequacies in her ability as opposed to problems with her foundational preparation. ("I think there comes a time when you realize there's like a block that some students put up against math and science and say, "Oh, I'm an English person and I still don't like to say I'm an English person.") I could hear Kacey's voice surrendering to her perceived lack of ability and how the external measures of the college process and grades judged her. However, I can still hear the voice of her appreciation for the satisfaction of finding a solution on her own and the value of problem solving and logical thinking. The ownership of the material and knowledge was hers and her learning community's. In the I-poem in Figure 3.10, Kacey describes how her ability in the humanities is reciprocated with grades, but not in math. There she accepts the wonderful feeling that she gets from mathematics, which is encouraged by the ownership she has found in the learning.

The Framework

After coding and comparing all of the collected data, I found that themes had emerged. It was important to question how the girls would explain

I	You
I think	
I've taken	
I can learn history	
I can get an A	
I have to study	
I still don't get As	
I love	
	The feeling you get
	You know
	You make a connection
	You know
	You were the one

Figure 3.10 Kacey's I-poem.

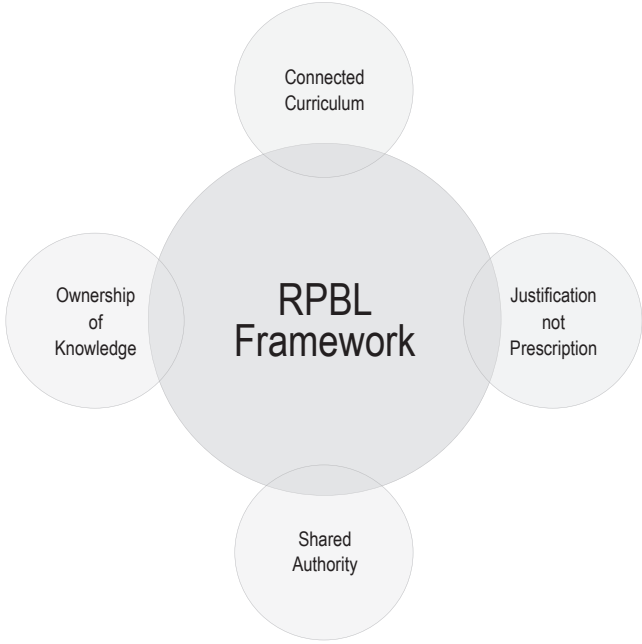

Figure 3.11 A framework for a relational PBL classroom.

their growth through the utilization of RPBL. I posit that it is the combination of the pedagogy of relation and the PBL curriculum that fosters the outcomes they described in their stories. Figure 3.11 illustrates the relationship between the recurring themes in these five girls' stories and how the RPBL classroom attributes support those themes. Each part of the results from data analysis described previously can be related to one

of the four aspects of the RPBL classroom framework, but specific examples follow.

Because qualitative research allows for deep and rich views of the personal experiences of specific participants, I cannot generalize to all students. However, when themes emerge from the analysis and perspectives of all participants, this does help guide a framework for aspects of the classroom or teacher choices that have fostered the outcomes for the students. The themes of (1) ownership of knowledge, (2) justification—not prescription, (3) the connected curriculum, and (4) shared authority emerged from code maps of these five girls' descriptions of their experiences of the RPBL classroom. Referring to dynamic objectivity once again, many of the participants referenced this more flexible way of viewing knowledge as helpful for including students who find the more rigid mathematics classroom less conducive to learning. This concept seemed to summarize all four aspects in many ways. The students would rather remain connected to the material and the persons in the classroom to facilitate learning. Because of their openness to the dynamic objectivity of the knowledge, the students were able to accept that their input was valuable. Isabelle mentioned the multiple solution methods and the different perspectives that each student brought to the discussion of each problem. When presented with a problem whose solution is unknown, this relational approach affords students more of the need to critically listen and combine others' ideas with their own. The teacher presumes a certain level of authority in the students, and the students take on a level of responsibility and curiosity in finding solutions and methods for those solutions.

All participants commented on how student ownership of the material allowed them to have more agency and that RPBL allowed this through metacognitive journaling, student presentation of partial solutions, and the deliberate discourse moves that the teacher-as-facilitator used to create the discourse-driven classroom. Sarah admitted that working with her peers and figuring something out meant "more than just a teacher telling you how to do the problem."

A classroom "lesson" focus and summarization that did not focus on prescribing methods was also a main theme. Leona commented on how seeing multiple perspectives on problems had opened her eyes to mathematics:

> I could use my way, whichever feels most comfortable. But it's nice to have that option presented by not only the teacher, but

> the student too because, I think, in a way, it develops like a relationship with your class that you don't really have because you're talking to them and you're learning how they think.

For many of the students, having a mathematics classroom that focused on curiosity and inquiry instead of processes changed the way they viewed mathematics as process driven, allowing them to take advantage of their creativity for the first time.

Using a scaffolded curriculum and connected problems, as opposed to traditional units that were compartmentalized and disconnected, made a huge difference for many students. Alanna described her appreciation for the connected curriculum:

> The ability to connect other things . . . 'cause before they would teach you something and you'd go home and practice it. But in this class you have to like be able to bring back other information and then do the problem, so . . . I think I've learned that skill.

The awareness that mathematics is made up of related rather than discrete topics showed many of the students that they were capable of making those connections themselves.

The shared authority was evident when many of the girls made reference to times when although no solution was clear, they started discussing their ideas, and the integration of the new ideas with their own helped move their thinking forward:

> **Kacey:** You think you say, "Oh, I'm stumped, I don't know what to do," but then someone says something and someone else says something and maybe the group doesn't get it as a whole but somehow what they said makes a connection in your head and you know how to do the problem.

Mathematics teachers must become more comfortable with sharing mathematical authority in the classroom with students. Dissolving the authoritarian hierarchy that generally exists in traditional mathematics classrooms can be a difficult task but is a very important part of the RPBL framework. It allows students the freedom of agency to find their voice and change their mind-set about learning mathematics.

CONCLUSIONS

The positive nature of the experiences of these five girls in their mathematics learning encourages us to follow up with further study on whether this framework is transferable to other classrooms and populations. Clearly no generalizability was implied from this qualitative study, which was intended only to obtain a rich description of student experiences relating to interest, engagement, enjoyment, empowerment, and agency. Further study may include populations of other underrepresented students and in coed environments. However, should further research find that RPBL is an effective means by which underrepresented students' learning in mathematics can be improved, professional development will be needed for teachers in addition to curriculum work and support, all of which will need to be assessed for effectiveness and delivery.

In a study of two schools with different pedagogical methods, Boaler wrote, "The Amber Hill girls [at the traditional school] found that they were unable to improve their situation, not because they were disillusioned by their own inadequacies, but because they were powerless to change the pedagogical traditions of their institution" (1997, p. 302). In short, her advice was to "change the system, not the girls." Still, 22 years later, schools in the United States have not learned how best to teach our underrepresented students so that they feel empowered to learn in the ways that meet their needs. I have spent my career attempting to reach out not only to students but also to teachers who are interested in this type of change in the hope of making a difference in mathematics education. I have been encouraged by how many individual teachers are looking for a change in their pedagogical approach to mathematics in order to have some semblance of equity, communication, and sense making actively occurring in the classroom.

At its most basic level, what this study has done for me is confirmed my beliefs about how RPBL is valued in the experiences of young women studying mathematics. Their journeys, as told in their stories, touched me deeply and moved me as an educator. At the highest level, my hope for this research is to inspire further study with PBL and a movement in the education community to look for alternative and powerful ways in which all students can have experiences in the mathematical classroom that are valuable and meaningful to enrich their lives and affect their futures with enough depth to see some of the beauty in this field.

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APPENDIX A: SCHETTINO STUDENT INTERVIEW PROTOCOL

Inside the Class (Adapted)—Student Interview Protocol (Semistructured)
I appreciate your letting me interview you today. I have some questions I'd like to ask you related to your experiences in your math class. Would you mind if I recorded our interview? It will help me stay focused on our conversation, and it will ensure I have an accurate record of what we discussed.

Preliminary
If applicable, ask:

What is the name/title of this course?
What class period was this? Who is your teacher?

Experience in Learning
I'd like to know a bit more about your learning in this class.

1. How do you think this class is going for you?
2. *Tell me what goes on in the classroom that affects the quality of learning for you.* Can you give an example of a specific time when a classroom interaction affected your learning?
3. Can you tell me about a story about how this type of teaching method works with your learning?
4. Do you have any stories from your previous math class experiences and how they worked for your learning in mathematics?

Feelings Toward Mathematics and Mathematics Class: Specific to Attitudes in the Study

1. What feelings come to mind when you think of your time in this mathematics class? *Can you think of a time when you felt this way?*
2. What feelings come to mind when you think of mathematics as a subject? What experiences or relationships in your life create those feelings for you?
3. If you had a magic wand that could change any one thing about the class without it adversely affecting you, what would you change? Why?

Follow-up Questions:

1. Are there any specific anecdotes that you can think of that specifically speak to your feelings toward the problem-based pedagogy in this course?
2. How do you see yourself as a learner of mathematics? What parts of your identity play a part in what you think of yourself in the problem-based learning classroom?

Is there any other experience that happened in math class that you would like to share with me? Thank you for your time. If I have need for additional clarification, how and when is the best time for me to contact you?

CHAPTER 4

Facilitating Problem Framing in Project-Based Learning

Vanessa Svihla
University of New Mexico
Richard Reeve
Queen's University

INTRODUCTION

This study is not about solving specific problems. In fact, we don't report on problem-solving outcomes. Rather, the key concern here is on the tremendous utility that ongoing problem framing holds for learning—provided students take genuine ownership of the ill-structured problems on which they are working. We present a case to show how teachers launched a project focused on designing temporary shelters for homeless clients; the teachers envisioned that each group would produce a specific design for a specific client. However, the teachers also wanted the students to frame the problem and shifted the locus of control to the students, who reframed the problem from one of charity to one about social justice. In effect, they sought to solve the larger and more general problem of homelessness, not just the problem of specific local homelessness.

In school settings, the problems that students typically are confronted with are well-structured (Jonassen, 2000), with the focus being on finding the correct solution using the canonical solution pathway. However, in these well-framed and well-structured problems, the process by which the problem develops is seldom within the control of the students (Scardamalia, 2002). Recent changes to curricular standards in the United States call upon teachers to engage their students in less well-structured, more generative problem solving (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), but this has proven to be challenging for teachers (Dole, Bloom, & Kowalske,

2016) and students alike. Thus, even when students are presented with authentic dilemmas that require decisions about possible solutions, there are few cases in which they actually get to take the necessary time to frame the problem they are solving.

This can even create tension in project-based learning (PBL) classrooms, where students are sometimes given the semblance of control but only over a limited part of the task. For instance, they may be permitted to make decisions about the format (poster, pamphlet, or presentation) of a final product but not about the scope of content, much less the nature of the problem to which they are committing their attention. Although the driving question ought to present "real-world problems that students find meaningful, thereby motivating them to take ownership of the questions and to thoughtfully pursue answers to them" (Marx, Blumenfeld, Krajcik, & Soloway, 1997, p. 345), in practice even PBL can be highly constrained in terms of the leeway students are given to determine the problem they are to work on. This can convert potentially rich, ill-structured problems into well-structured problems. While a great deal is known about how students learn as they solve well-structured problems (Mergendoller, Maxwell, & Bellisimo, 2006; Savery, 2006; Strobel & Van Barneveld, 2009; Walker & Leary, 2009), relatively little is known about how students learn as they themselves frame ill-structured problems. The purpose of this study is to investigate how teachers might support students in framing ill-structured problems within PBL settings and the resulting engagement by students.

Problem framing has been considered one of the most important components of problem solving, at least in terms of professional designers producing a high-quality solution (Basadur, Graen, & Green, 1982). In professional design settings, problem framing is where much of the learning occurs, as the designer must learn about the problem; problem framing prompts purposeful gathering of information and sets up the need for critical reflection. We therefore see problem framing as holding great potential for learning even outside of professional design settings, particularly when students take ownership of ill-structured problems on which they are to work.

LITERATURE REVIEW

Problem framing is present and valued in a range of fields, from art to business to engineering design and science (Runco & Chand, 1994). As

a result, it has numerous aliases: problem posing, problem representation, problem defining, problem finding, and problem construction. Regardless of how it is labeled, the most promising place to look for learning through problem framing is in the context of ill-structured problems. Such problems are typically design problems, even when they are not named design problems by a given field. For instance, scientists don't often reference themselves as designers, yet they *design* investigations, procedures, and data representations. Further, the problems faced by society are increasingly complex and ill-structured, and people are turning to design as a way to solve them (Dorst, 2015; Homer-Dixon, 2000). Henceforth, we refer to the solvers of ill-structured problems, regardless of discipline, as designers rather than as problem solvers.

We review literature here to build an operational definition of problem framing that includes its characteristics and activities. We consider ways that these activities enter or align with typical instruction in school settings. We then consider the barriers that might prevent problem framing from occurring in the classroom and how teachers might mitigate these barriers.

Framing Ill-Structured Problems

There is variability in how much and what activities a designer undertakes to frame a problem (Cross, 2001; Restrepo & Christiaans, 2003). This has made operationalizing problem framing difficult. Most descriptions of problem framing activities include information gathering, ideation, and evaluation of ideas generated.

More experienced designers gather more information for understanding the problem (Bursic & Atman, 1997), using various means to do so. For instance, designers might assess customer needs, investigate and analyze design requirements and constraints, research previous solutions, and identify resources (Dominick, 2001). Designers gather information to clarify aspects of the problem, eliminate untenable tentative solutions, explore possible ideas, and address a lack of knowledge (Tracy, 2005). In doing so, they focus on existing and alternative solutions (Morozov, Kilgore, & Atman, 2007) and consider a broad problem space (Atman et al., 2008). A key insight is that when designers gather information, they continue to learn about the problem. Even relatively inexperienced designers learn a considerable amount of disciplinary content as they are engaged in framing problems (Svihla, 2009).

To make progress in framing a problem, designers generate tentative conjectures about possible solutions. There are many approaches to generating such ideas (Dadich, 2014; Dorta, Perez, & Lesage, 2008; Neeley, Lim, Zhu, & Yang, 2013; Verhaegen, Peeters, Vandevenne, Dewulf, & Duflou, 2011). Commonly, problem framing also involves evaluating the ideas generated (Basadur et al., 1982) and considering ideas in light of costs and benefits to arrive at priorities (Morozov et al., 2007).

However, models of problem solving and designing often include problem framing (or a similar construct) as a separate step from information gathering, ideation, and evaluation (Jonassen, 1997; Wynn & Clarkson, 2005). Therefore, detailing the specific activities that support problem framing does not adequately detail problem framing. We argue that in order for activities such as information gathering, ideation, and evaluation to constitute problem framing, the designer must take ownership of the problem. Not doing so renders these activities inert. We therefore next consider why agency and ownership matter in problem framing and what *agentive* problem framing entails.

Agency and Ownership in Problem Framing

In professional settings, designers have ownership of problems; they choose which aspects of the problem space to attend to as they bound it (Schön, 1983). They make decisions about how to proceed. They decide "what to do (and when) on the basis of a personally perceived and constructed design task, which includes the design problem, the design situation and the resources (time) available, as well as the designer's own design goals" (Dorst & Cross, 2001, p. 432). Thus, problem framing carries with it a sense of agency (Hanauer, Frederick, Fotinakes, & Strobel, 2012).

When designers gather information, they do so purposefully, driven by "the need to structure the design problem" (Restrepo & Christiaans, 2003, p. 11). This gets at the essence of why problem framing is necessary in dealing with design problems. Design problems do not arrive as tidy, rational, deterministic problems, the way many problems that students solve in schools do. Even when issued as a design brief—a description of the client's needs and context—a design problem must be framed (Coyne, 2005). This means that even the gathering of information is nondeterministic, as "the information needed to understand the problem depends upon one's idea for solving it" (Rittel & Webber, 1973, p. 161). When working in a team this can prove to be even more challenging, as each designer brings his or

her own experiences and interests into individual understanding of the problem (Hey, Yu, & Agogino, 2008; Reiter-Palmon, 2009). As a team designs, its members iteratively formulate and reformulate the problem (Cross, 2001). Sometimes this occurs as a means for designers to render an intractable problem into solvable subproblems (Reitman, 1964), but the degree to which they do so depends on their tolerance for ambiguity, their experience, and the resources available, all of which make the process highly contingent (Schrader, Riggs, & Smith, 1993).

Part of taking ownership of a problem involves iterative problem structuring (Newell & Simon, 1972; Restrepo & Christiaans, 2003) or problem setting (Schön, 1987)—setting boundaries or delimiting aspects of the problem space. This activity often occurs in response to identified needs (Hey et al., 2008). We call out the information-gathering process of identifying needs as specifically belonging to problem framing; identifying needs involves perspectival shifts and developing empathy for those who use the designed object. Potential design decisions and tentative solutions are evaluated by considering how the design might address those needs (Griffin & Hauser, 1993). This creates an opportunity for learning, because such evaluation involves reflecting on and critically evaluating design decisions against one's understanding of the problem space, reframing it as needed. This highlights the fact that problems can be reframed even late in the process of design if designers realize that their solution is not meeting identified needs or is violating constraints.

Thus, although problem framing has been viewed as front-end activities that precede problem solving (Basadur et al., 1982; Kvan & Gao, 2006; Woodhall, 2011), solving ill-structured problems is an iterative process in which problem framing oscillates with problem solving (Dorst & Cross, 2001; Rittel & Webber, 1973; Tracy, 2005). This oscillation is visible in experienced designers, who are adept at switching between framing and solving activities (Atman, Chimka, Bursic, & Nachtmann, 1999). The problem to be solved coevolves with the solution (Dorst & Cross, 2001), meaning that the designer must frame and reframe the problem. As the designer learns more about the problem, "every question [that is] asking for additional information depends upon the understanding of the problem—and its resolution—at that time. Problem understanding and problem resolution are concomitant to each other" (Rittel & Webber, 1973, p. 161). Thus, we see problem framing as threaded throughout the design process.

We therefore argue that problem framing is an agentive process of finding information purposefully and through perspective shifts, evaluating tentative design decisions against their potential to address identified needs, and managing problem ambiguity by iteratively restructuring problems. Thus, simply transferring problem framing activities such as information gathering, ideation, and evaluation into school settings does not ensure that students will take ownership of the problems they are framing. Information gathering might be reduced to reading a textbook or searching online, often for a purpose supplied by the teacher. This reduces the need for problem framing and thereby the opportunities for learning through problem framing. Likewise, idea generation can be a hoop to jump through, with students first arriving at the idea they wish to pursue, then spending time generating flawed versions of this idea (Boling & Smith, 2014). Even when students are asked to take some ownership of the problem, they seldom have opportunities to iterate on its framing. We next consider some of the barriers that prevent students from having opportunities to participate in problem framing.

Navigating Barriers to Problem Framing in Classrooms

Supporting students to frame problems requires a "willingness to relinquish tight control over students and . . . the transfer of a large amount of responsibility for learning to students" (Roth & Bowen, 1993, p. 198). This can feel risky to teachers (Marx et al., 1997; Scott, 1994), yet navigating this ambiguity is central to maintaining student-centered pedagogical approaches (Grant & Hill, 2006) and to preparing designers who are capable of framing problems. Learning to solve only well-structured problems does not transfer naturally to solving ill-structured problems (Jonassen, Strobel, & Lee, 2006), though the converse may be true (Kapur, 2015). Less experienced designers often don't recognize the need to frame the problem, in part because of the emphasis on well-structured problem solving, which dominates the majority of their classroom experiences (Crismond & Adams, 2012). When asked to frame their own problems, young students initially frame their problems as well-structured problems (Lowrie, 2002). Inexperienced designers tend to jump quickly to solutions, treating design problems as well-structured (Christiaans & Dorst, 1992; Rowland, 1992). Thus, problem framing can be challenging for students who are not used to this type of activity (Franske, 2009). Four primary approaches to supporting problem framing have been investigated: providing students

with examples of open-ended problems and then asking them to pose their own, prompting students to restate the problem and consider multiple perspectives, scaffolding students to pose questions about the problem, and helping students connect personally with the problem.

Helping students understand that some problems have multiple possible answers can support them in framing more open-ended problems (Lowrie, 2002); for instance, after being exposed to open-ended mathematics problems and being asked to consider multiple ways to solve problems, half of the young students could pose questions such as "How long would it take for me to tie your shoes up?" and "What would a seesaw look like if you sat on one end and I sat on the other end?" (p. 358). Other students were described as less open to taking risks and only reproduced well-structured problems they had previously been exposed to (Lowrie, 2002). Therefore, additional supports may be needed.

One approach to scaffolding students to consider the problem more carefully is to prompt them to restate the problem prior to solving it. In a laboratory study that used this approach, students who were also given discrepant information explored the problem from more points of view (Reiter-Palmon, Mumford, O'Connor Boes, & Runco, 1997). Although conducted as a brief laboratory task, this is not so different from the need to consider potential trade-offs and differing perspectives in an authentic design task. Thus, ensuring that students have access to multiple points of view about a problem may help them to frame it.

Another approach to supporting students in framing the problem was investigated in a quasi-experimental study conducted in intact classrooms. Students were positioned as members of an environmental firm helping a client solve legal issues related to pollution (Zydney, 2008). All students, including those in a control condition, were tasked with planning how to solve the problem, including describing the problem and identifying questions and resources needed. Students in one condition were given an organizational tool that prompted them with eight questions to help organize their planning, such as "What are your client's objectives and goals?" (p. 366). Students in another condition were given a higher-order thinking tool that asked for a "status report" by posing three questions about their initial impression of the problem, how their ideas changed after learning more, and what they still needed to learn. A third condition gave students access to both the organizational tool and the higher-order thinking tool. Students who used the organization tool asked more questions about the

problem and had better understanding of the problem; in contrast, students who did not have this tool asked more questions about the solution, suggesting a solution-focused approach (Zydney, 2008). Thus, scaffolds that help students ask questions about the problem may be useful in supporting them to frame it.

Qualitative studies have suggested that helping students connect the problem to their personal interests is valuable but may not help them identify a problem narrowly or specifically enough to investigate it further (Ritchie, 2009). One approach to dealing with this is to provide additional framing or problem context, and this has been shown to help students feel they have ownership of the problem (Roth & Bowen, 1993). However, this does not necessarily provide students with the skills to frame their own problems. Researchers have speculated that providing problem contexts that have value beyond the classroom walls, with authentic clients, could help (LaBanca & Ritchie, 2011; Ritchie, 2009), but this is not well backed by research, at least in relation to supporting problem framing, which is the purpose of the current study.

RESEARCH PURPOSE AND QUESTIONS

Our research aimed to investigate how teachers positioned students as designers responsible for framing an authentic problem and how their students took this up. We investigated this in a setting that allowed us to consider extended problem framing that occurred over multiple weeks during which students were asked to identify and address client needs. To guide our investigation, we posed orienting research questions:

- How did teachers shift the locus of control to the students?
- To what extent did students identify needs, gather information with purpose, generate ideas, and evaluate those ideas based on identified needs?
- In what ways did students reframe the problem?
- Were previously investigated supports—providing students with examples of open-ended problems and then asking them to pose their own, prompting students to restate the problem and consider multiple perspectives, scaffolding students to pose questions about the problem, and helping students connect

personally with the problem—employed, and were these scaffolds helpful?

METHODS

Project-Based Learning Model

The PBL model employed by the study site is informed by the Buck Institute for Education and industry partners, meaning that projects are aligned to architecture, construction, and engineering practices. Because of this industry lens, most of the projects involve designing something, often for a client. This is not so different from many published accounts of project-based science, in which designing is used to motivate the need for scientific inquiry; for instance, students submitted model rocket designs to NASA to help create a need to know (Barron et al., 1998; Petrosino, 1998). At this school, teachers design projects, often with support from industry partners. We present a detailed account of this design process elsewhere (Svihla et al., 2016). As they design projects, teachers pay particular attention to creating access points for students and making sure the project is relevant to students' lives while being authentically connected to industry practices. Their driving questions are therefore typically crafted to pique students' interest. In the project presented here, the driving question "Where are you gonna sleep tonight?" additionally helped students shift their perspective, placing themselves in the role of a person who is homeless. The project content focused on English-language arts (grades 9–12), economics, and U.S. history.

Students attend a morning and an afternoon project block, with blocks lasting 135 minutes. Typical instruction involves brief whole-group instruction followed by work time, peppered with catch-and-release, ending in a debrief session. Projects culminate in a public exhibition of students' work attended by community and industry members.

In the project we investigated, the problem as initially framed was ill-structured in that students were to design a temporary shelter that met the needs of their specific clients, using waste and found materials. Because of the range of clients (some living alone, others as families), their varied needs (e.g., some had disabilities, and clients presented a range of needs in terms of being warm, secure, well camouflaged, etc.), and the found materials, there were many potential design solutions, meaning that the

problem did not have an a priori, correct, knowable solution. In fact, given the broad range of possible found materials, the project, as originally proposed, had a great deal of creative potential.

Theoretical Stance

This research was conducted in a setting grounded in constructionism (Papert & Harel, 1991); thus, learning was viewed as supported through engaged, meaningful activity in which students frame problems and construct designs that are shareable with those beyond the class. As Papert observed, such learning occurs "in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe" (p. 1). Thus, such learning is not synonymous with making but instead suggests that students pursue problems they find meaningful and present their learning in some publicly shareable format.

As researchers, we also view learning through a constructionist lens and selected this particular site to conduct research because it exemplified constructionist learning. As constructionists, we also see learning as a fundamentally social, interactional process (Bransford, Brown, & Cocking, 2000; Kuhl, 2004; Vygotsky, 1978) that occurs over time, through participation of various types (Lave & Wenger, 1991), and situated in contexts. This stance informed our research design, suggesting the need to examine learning as interactional, occurring over time, through participatory approaches that would allow the development of emic understandings.

Research Design and Data Collection

Data were collected as part of a larger long-term participant observation research project that documented multiple projects taught at the school, along with other school-specific practices. The current study focuses on one project, Waste Land II, a nine-week, interdisciplinary, and multigrade project.

Data collection included field notes, photographs, audio and video recordings, interviews, and the collection of artifacts of work. Every project meeting was documented, along with many conversations about project planning and assessing student work. The data were collected with an ethnographic stance, using participant observation (Atkinson & Hammersley, 1994; DeWalt & DeWalt, 2010; Jorgensen, 1989). The first author (Dr. S) had developed a relationship with the school over three years and was

embedded in the school daily for the duration of the project planning and implementation. In order to gain a more insider perspective, the first author cotaught the project and collected field notes, with a few days spent primarily teaching. On such days, field notes were taken by project assistants who had completed a qualitative research methods course and had been trained by the first author. The field notes were collected using a template with places to note date, time, researcher's name, overview of the data collected, list of related files, and a reflection, in addition to space for field notes. Because of the volume of data collected, field notes focused more on creating a record of turns of talk than is typical for field notes, resulting in a rough transcript of the project, particularly during class discussions and whole-group presentations. Actions, observations, and interpretive statements within the field notes were noted systematically using double parentheses, with interpretive statements called out with "I wonder," "I think," or similar sentence starters. All data were entered into a database created for the project using FileMaker Pro. As they were entered into the database, they were tagged with specific analytic foci, which included problem framing, ideation, problem solving, assessment, and other factors, to facilitate data selection and reuse.

Data collection began following institutional review board approval. The participants were teachers (Mr. W, Mr. J) and their students (n = 27) at a New Mexican charter school whose mission is to serve those who have not been well served by traditional schooling. Mr. W, who is certified to teach social studies and Spanish, has been teaching for 14 years, with 2 years of experience in project-based settings. He brings his 15 years of practicing law into his teaching. Mr. J, who is a certified special education teacher, joined the school after completing his student teaching at the school; he has 3 years of teaching experience and 14 years of experience in construction, which he brings into his teaching. The school provides five weeks of professional development on PBL each year as well as two hours of professional development each week.

The students were predominantly Latino, male, off track to graduation, and qualified for free lunch. We focus here on three students, Benjamin, Andre, and Ivan, who were selected as follows. We first opted for students who provided full consent (including video, not just audio). We then eliminated students who enrolled in the project late or who had consistently poor attendance. We included Benjamin because he was so visibly and vocally engaged in the project at the beginning, meaning that we

had a lot of data about his participation. We next aimed to select students from different social cliques and who represented a range of participation styles but were seen as disengaged at some point during the project, as these students are seen as the *least likely* to take ownership of framing the problem. All three students received special education services; the school serves a larger percentage of such students than traditional schools because of its mission. To avoid inadvertently revealing a student's identity, we do not make note of accommodations or services that affected how students engaged in specific tasks.

Benjamin was initially very engaged in class discussions, responding out loud to almost every question and posing many of his own questions. Despite this, he completed little written project work. He struggled with the project content, apparently because it was close to his own experiences; his family had experienced food and housing insecurity when he was young but had found security in a family-owned cleaning business. Benjamin stopped coming to Waste Land II two weeks before the end of the project and did not attend the exhibition.

Andre was initially commonly late to class, sometimes missing as much as the first hour, and sat with a group of students who were often engaged in social activities rather than the project. Despite this, he did his work and became very engaged in Waste Land II after the first few weeks. He began more consistently arriving on time, explaining that he found the problem to be important and meaningful. His exhibition was thoughtful and complete.

Ivan was part of a clique of young men who systematically appeared disengaged. They would commonly slip out of projects and congregate together. There were three members of this clique in Waste Land II. Typically, they spent much of the class period gazing at their smartphones and sometimes engaging in conversation with a teacher. Ivan seldom missed class and was consistently on time. At the final exhibition, despite his apparent disengagement he was able to provide answers to challenging questions from industry and community members, even though he had little work to display.

Data Selection and Analysis

The initial data corpus covered all data associated with the project and included approximately 180 pages of field notes, 80 hours of audio/video records, and 500 photos. We selected data from this corpus, guided first

by our analysis of intended and enacted project activities. All project activities were classified as primarily intending to accomplish one of five stages of designing (see Table 4.1 and Figure 4.1). The particular design stages were derived from a design process model shared with the students, with the particular stage names aligned to the terms used in this study (e.g., "Define the problem" was renamed "problem framing"). Figure 4.1 depicts an agile start to design in the first six days of the project; the activities were brief, with many lasting less than one project period. This allowed students to iterate through a design cycle quickly and set up a need-to-know. Setting up a need-to-know is a common approach in PBL. It helps students become invested in learning and directs their search for information, in this case about homelessness. This fed into several weeks of longer periods of information gathering, ideation, and solution generation. The project culminated in two weeks of solution-focused work, interleaved with opportunities to evaluate solutions in light of identified needs.

TABLE 4.1 *Categorization of Activities by Intended Design Stage*

Design stage	Description: activities intended to	Example activities
Frame problems	Provide an initial framing, orient students to the problem framing, or support students to frame the problem	The project launch positioned the project as being about designing temporary shelters for homeless people; students assessed the needs of homeless people in their city.
Gather information	Build student knowledge and understanding of the problem	Students completed crossword puzzles connected to newspaper articles about laws affecting homeless people; they researched solutions to homelessness.
Ideation	Help students consider different points of view and ways to meet identified needs	Students created worst-solution sketches as part of wrong theory activity.
Develop solutions	Support students to develop tentative and improved solutions to identified needs	Students created models of temporary shelters; they wrote letters to representatives about solutions to homelessness.
Evaluation	Provide students with feedback on how well their solutions responded to identified needs	Students gave each other feedback on their models; they presented their solutions to community members at exhibitions.

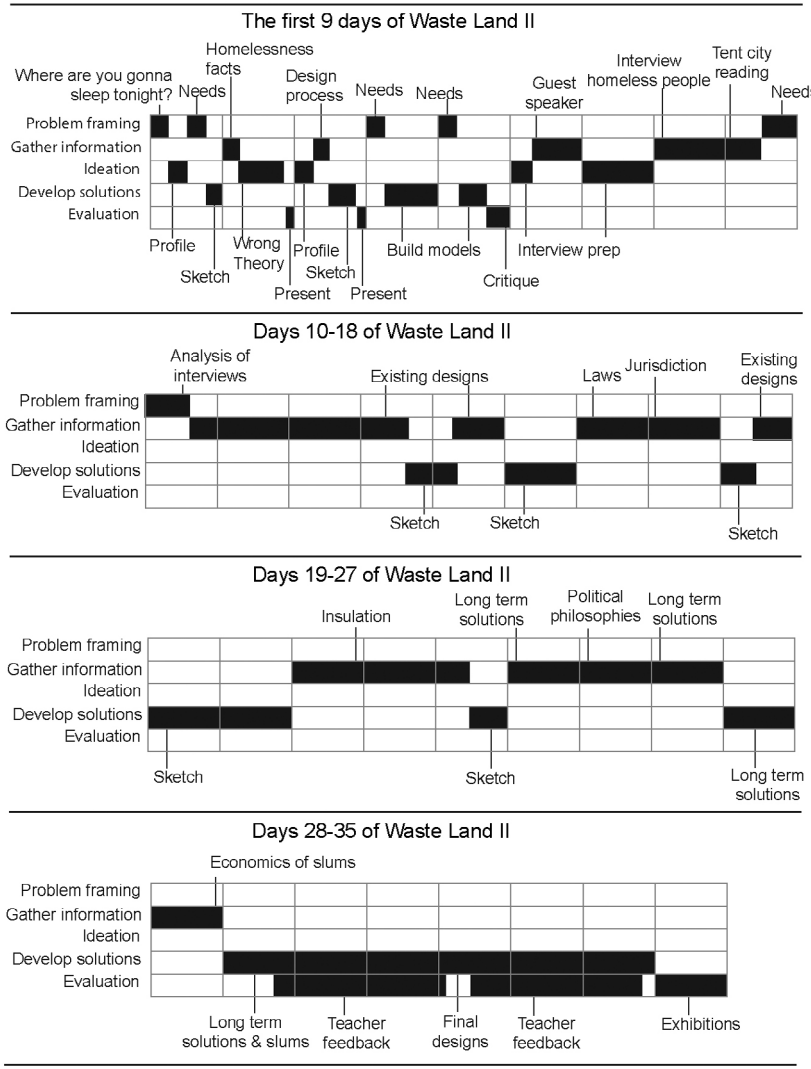

Figure 4.1 Timeline of the Waste Land II project, with activities classified by design stage. Each column represents one project period, with subcolumns representing individual weeks.

Although we classified the activities of Waste Land II in terms of their primary purpose, we noted that many activities actually provided opportunities for students to frame and reframe the problem. Thus, our data selection involved reviewing all field notes in the corpus for episodes of problem framing. We included episodes intended to support problem

framing as well as episodes in which it occurred as students worked to understand the problem. When reviewing field notes, we attended to episodes in which we recorded students

- describing their design ideas in written, sketch, or model form;
- brainstorming or ideating;
- gathering information from clients, the Internet, or guest speakers;
- making decisions or choices about their design ideas;
- posing questions about the design problem; and
- making statements about the design problem.

Because field notes were indexed to audio and/or video records, we could transcribe the episodes selected, and we supplemented the transcripts with artifacts of participation to more richly capture the interaction. This included photos of student work, whiteboards, and screen captures from videos.

We analyzed transcripts using interaction analysis (Jordan & Henderson, 1995). Unlike many forms of qualitative analysis, interaction analysis does not involve application of a coding scheme; instead, analytic foci are used to iteratively view and interpret data. Traditionally, this includes the structure of events, participation structures, the spatial organization of activity, and artifacts. We considered these in light of the design activities we described in our literature review, specifically focusing on how these played out as students framed the problem as they gathered information, generated ideas, or evaluated their ideas. We also attended to previously identified problem framing supports, including providing students with examples of open-ended problems and then asking them to pose their own, prompting students to restate the problem and/or consider multiple perspectives, scaffolding students to pose questions about the problem, helping students connect personally with the problem, and providing authentic context.

Analysis of the structure of events means that interaction occurs over time, with beginnings and endings and with segments, all of which can be recognized by participants (Jordan & Henderson, 1995). For instance, the project as a whole and individual project periods have a clear beginning and ending, though the beginning and ending of an individual student's participation may vary. Project work time is easily segmented by typical

instructional sequences common to the school but also by completion of specific tasks (e.g., drawing a possible design), which again can vary by participant. Our first-pass analysis provided an overview of activity segmentation (see Figure 4.1) and made visible a macro-level shift from agile design in the first few days to longer periods of focused work on particular design activities, culminating in longer periods of evaluation. On the meso-level time scale, we analyzed how students engaged with the tasks from minutes to days, and on the micro-level time scale we considered how they engaged conversationally and interactionally, moment by moment and/or turn by turn.

In interaction analysis, participation structures help reveal whether "individuals share a common task orientation and attentional focus" (Jordan & Henderson, 1995, p. 67). Here we considered whether a common focus was shared across students as well as across teachers and students. Likewise, the spatial organization of activity and analysis of artifacts and documents can help reveal ownership by considering who made specific artifacts, who can modify them, who can display them, where they are located spatially, and who has access to them. In traditional classrooms, whiteboards, chalkboards, and the like are the territory of teachers; students create work for teachers, who may modify the work, marking it to denote changes needed or judgments passed.

We reviewed data during research lab meetings, following events over time and across participants and considering evidence of ownership from the spatial organization of activity and the analysis of artifacts. We present vignettes here that are either representative of the data corpus or are critical moments; such critical moments, though idiosyncratic, can be influential and deserve consideration for their role in learning. Within the vignettes, we present transcripts in which we have used a few conventions to better convey the tone and cadence of conversations:

- A WORD in all capital letters indicates that it was spoken in a loud voice. Capital letters used WITHin a word indicate that a syllable was spoken in a loud voice but the rest of the word was not.
- A wo:::rd with colons in it indicates that the sound was drawn out.
- // indicates overlapping talk.
- (.) indicates a noticeable pause.
- Ellipses indicate an omission or edit for clarity.

- Underlining indicates that a word was emphasized somewhat, through moderation of tone or cadence, but not noticeably louder, softer, or more drawn out.
- Punctuation is used to indicate tone; thus, a question mark is only used when the tone conveyed a question, regardless of grammar.

RESULTS

We present vignettes from the first six days of the project to highlight both the regularities and critical moments we identified related to teachers shifting the locus of control to the students. In the first vignette, the teachers positioned students as designers. This supported the students to start taking ownership of the problem. We present this positioning and then highlight how the teachers struggled to follow through on it; for instance, as students took ownership, they reframed the problem to be larger than the teachers had envisioned. We follow the teachers in their interactions with Benjamin, Ivan, and Andre across vignettes in which their positioning as designers is visible and the students take ownership of the problem. Our purpose is not to follow the project to designed solutions but rather to show tensions in transferring ownership of the problem to the students and how doing so opened opportunities for students to learn.

Positioning Students as Designers and Scaffolding an Iterative, Client-Driven Design Process

Mr. W introduced the name of the project and asked students what they thought the project would be about. Students guessed that the project would be about building with waste materials. Mr. W then explained that they would be "designing stuff for people who maybe can't afford to buy anything, right? Who have no resources or very limited resources. How can they build something with stuff that they can just find?" The teachers then positioned the students as designers:

> **Mr. W:** What do you gotta think of as a designer?

This initial positioning was somewhat implicit, but the teachers then followed this question with scaffolding on how to begin framing the problem by thinking about their client:

Mr. W: Who are you designing for? A homeless person, right? So really, what we are looking at here//

Mr. J: // So, that's your client guys. So, who is the client, right? You can't sit down and—You can start designing something, but until you know WHO you are building that for, and what their SPEcific needs are, you're gonna probably be pretty far off the mark as far as what your end product looks like, right? If you know these questions, maybe come up with questions to begin with, right, and use that to inform the design you create, what do you guys think? Is that gonna end up being a better design, or is your design gonna be worse?

Mr. W: So that means that step number one in this process is gonna be what we call a needs assessment.

The teachers emphasized the importance of understanding client needs as a means to guiding design work. They then prepared the students for conducting a needs assessment with clients by having them craft a profile of a hypothetical homeless person. This helped them begin to frame the problem but led to a broader framing than the teachers had envisioned. Ivan arrived late but near the end of class recorded his hypothetical client's needs as "Food Shelter-warmth Clothing Basic Helth [*sic*] Shopping cart Knife Fire." Likewise, Andre referenced a place to stay, health concerns, and other services (see Figure 4.2). Benjamin did not complete the assignment and shared with Dr. S that he didn't care about homeless people.

Because the teachers envisioned a narrower problem focused on temporary shelter design, they introduced the idea of iteration and staying in *sketch mode*.

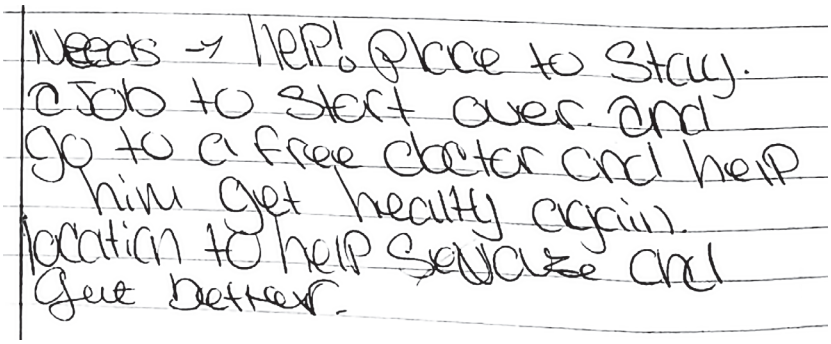

Figure 4.2 Andre's description of his hypothetical client's needs.

Mr. J: So, you guys, rough sketches, right. Don't make this perfect, because it's gonna go through a lot of transition, and updating, and, and using each others' input, as well as what we get from whoever it is we interview to make it different, make it better, right? So don't spend all your time focusing on one aspect, or just one shelter, alright?

Mr. W: Make it rough. . . . When people put too much time into their first idea, then they're upset when people say "I don't like it. Change it." . . . What's the likelihood that your first idea is the best idea, right?

Although the teachers brought the idea of client into their instruction, they did so in a somewhat vague manner, "whoever it is we interview"; this, paired with making hypothetical client profiles, signaled to students implicitly that there was not a specific client at this point. This allowed the teachers to emphasize the importance of iteration in designing, an important point, as many of the projects at the school included designing but few included iteration.

Most students' initial sketches for temporary shelters were cardboard boxes; as they were pushed to sketch multiple ideas, other ideas emerged (see Figure 4.3). None of the focal students completed the initial sketches. Benjamin, however, talked about just finding a box, and Mr. W shared Andre's design idea at the end of class as they discussed how to meet needs: "Andre was talking about, uh, foam boards. It's a great idea, you know, like insulating foam board, right. Good insulation, but are homeless people gonna be able to find those laying around reliably?" Ivan, who had arrived late and missed the initial project launch, remained disengaged; he sat at the back of class, chatting with friends, though Mr. J introduced the project to him. The low level of participation from

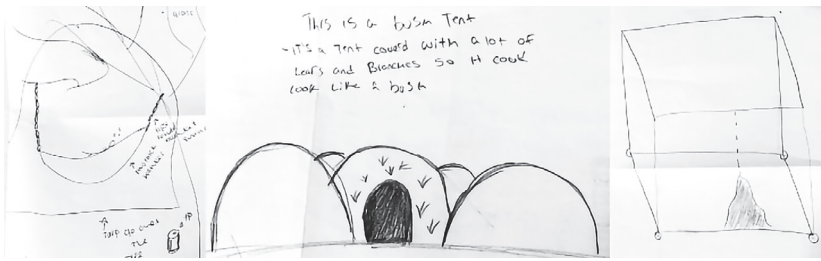

Figure 4.3 Students' initial sketches (hammock, bush tent, wheeled box).

the focal students suggested that they were not terribly excited by the project as posed to them.

On the second day of the project, Mr. W began by reminding the students of the driving question and their goals:

> **Mr. W:** We started off yesterday by, um, talking about how this project is gonna go, and one of the first things we're gonna do—and we started yesterday—is we started to design a shelter, right. A shelter that a homeless person could possibly sleep in, that would cost him or her zero dollars and zero cents, that can be manufactured out of waste products, right. Meaning, meaning stuff that we can find that nobody would have a problem, if we took it, right. That's our design challenge, and we, we started really by talking about how, before you design you have to stop and think, who are you designing this for, right?

Students then worked on a crossword puzzle to help them develop familiarity with relevant vocabulary and to introduce facts about homelessness in New Mexico. Because many students had seemed stuck in terms of coming up with design ideas in the previous class, Dr. S introduced an ideation technique based on wrong theory (Dadich, 2014) once students had completed the crossword puzzle:

> **Dr. S:** How many of you sometimes try to come up with an idea and you get stuck? You can't come up with any good ideas.
>
> **Benjamin:** I think we all have
>
> **Dr. S:** Yeah, everyone. This happens in design. So what designers have found is—so sometimes when you come up with the worst possible idea, you really try to get a bad idea out there, that it just gets the, gets the ideas flowing and you start coming up with better ideas. Yeah, so your goal, for the next little bit, in your groups, is to come up with the worst possible solution you can imagine. And then you're gonna present these. And you're not gonna have a lot of time, so you gotta really hit the ground running on this. . . . I want you to convince us why your idea is the worst.
>
> **Mr. J:** . . . We're gonna vote, and see whose idea was the absolute worst. Sound fair?

Benjamin: Yeah.

Mr. J: So, no hurt feelings. No people getting upset because the goal here is to have the worst ide—design.

Mr. W: Yeah 'cause think about it, like, an insult would be, I don't know, "Actually, that is a pretty good idea," right. . . . We talked about needs assessment, so one way to approach this is like, "What do they NOT need?" Right. That might be one way to approach it. Right. Or how can I make sure that I don't meet their needs.

Students engaged in the assignment reluctantly in the first minute or two and then enthusiastically. Benjamin's group came up with many ideas and volunteered to present first. Benjamin explained that "my ideas are THE worst ideas . . . because I really thought about what's gonna hurt them in the long run." He shared their idea of a "tequila water dispenser" and "a building with walls but no roof. . . . The walls are gonna be made of glass. Glass-walled house, which would provide no privacy." Ivan, who had initially sat at the back of the room, came to the front during the activity. He was visibly pleased to have his group's idea celebrated as one of the worst: "Either you live in a flaming car or you can die," to which Benjamin responded, "That's horrible. That's the ultimate." Andre's idea was "four branches and a hefty bag," which, when he realized it was a comparatively *good* idea, he amended with "it's located on side of mountain. It's really windy." Students were then turned loose to return to coming up with ideas that would meet their clients' needs. Their new designs were no longer based on boxes but instead represented diverse approaches to temporary shelters that generally met at least one need, such as keeping someone out of the sun or rain.

At the beginning of the third day, as a way to help the students understand the role of assessing needs in problem framing, the teachers asked students to compare the hypothetical profiles they had created to the facts about homelessness they had learned the previous day. They hoped to prompt understanding of general versus specific needs. Ivan began the assignment, writing, "In general, the homeless population. The homeless is 40 to 60 years of age. My specific client is 45 years of age," but did not complete the assignment. Benjamin engaged with the assignment, talking to the teachers about his ideas, but did not write them down. Andre shared his comparison aloud:

> **Andre:** My fictional homeless friend is [a] 32-year-old veteran that was brought back home traumatized from war. He was prescribed with some strong meds to keep him calm. After a while taking his medication, and witnessing its effects, he began to have an addiction. I say Bill has a same story as many other homeless veterans in general.

The teachers then provided students with a design process model (see Figure 4.4); although the model depicts design process as a sequence, Mr. J explained that the designer does not "have to move in that specific order," thereby problematizing the model for the students.

After introducing the design process model, Mr. J explained he wanted the students to frame the problem:

> **Mr. J:** So, what we're gonna do right now as a group, is define our problem, alright. We kinda know the whole purpose of what we're trying to do here, but I want everybody to be on the same page, and I could tell you what the problem is, but that doesn't include you guys and more importantly it doesn't give you guys the opportunity to contribute and say, "No, I think this is the problem, or I think we should word it that way." So what we need to do, as a group, here, is collaboratively come up with a specific problem that we are trying to address by building these homeless shelters. So someone start shouting something out. What's the problem that we are trying to fix right now? What are we trying to solve?
>
> **Benjamin:** I'm just guessing here, but homelessness.
>
> **Mr. J:** Homelessness. Alright. So are we trying to solve homelessness, in general?
>
> **Benjamin:** No, we're trying to help them.
>
> **Mr. J:** We're trying to help the homeless.
>
> **Benjamin:** Living accommodations.
>
> **Mr. J:** Right, living accommodations.

The majority of students who recorded this in their notebooks listed the problem as homelessness. Students' framing of the problem continued to be broader than the teachers had envisioned. Although Mr. J explained that designers frame problems and that the students were designers, when

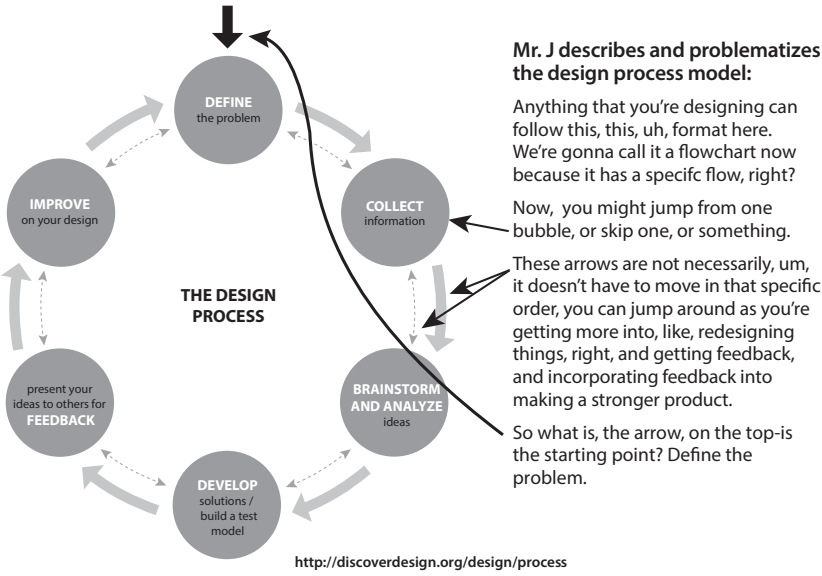

Figure 4.4 The design process model presented to the students and Mr. J's initial explanation of it.

Benjamin framed the problem as "homelessness," Mr. J pushed back on this, trying to bring him back to the narrower problem of designing temporary shelters. To further reinforce the idea that they would design temporary shelters for homeless clients, the next two days were spent creating models. All focal students created models (see Figure 4.5), but several models, including Benjamin's, addressed a broad range of needs beyond temporary shelter, and Ivan's listed "food water shelter" next to his model. When they began gathering information on the sixth project day, the division between the teachers' and students' framings of the problem became very clear.

In contrast to the kind of information gathering commonly observed in schools, in which students are typically apathetic to the process of locating "enough" sources as prescribed, gathering information for design does not have a stopping rule. This type of information gathering aligns with what was observed once the students took ownership of the problem. Little of the information they sought related to the initial framing from the teachers as a problem focused on temporary shelter. Instead, the students pursued their curiosity, familiarity, and empathy with the broader problem of homelessness. Because this bigger issue was one they connected to in various ways, they learned as they gathered information.

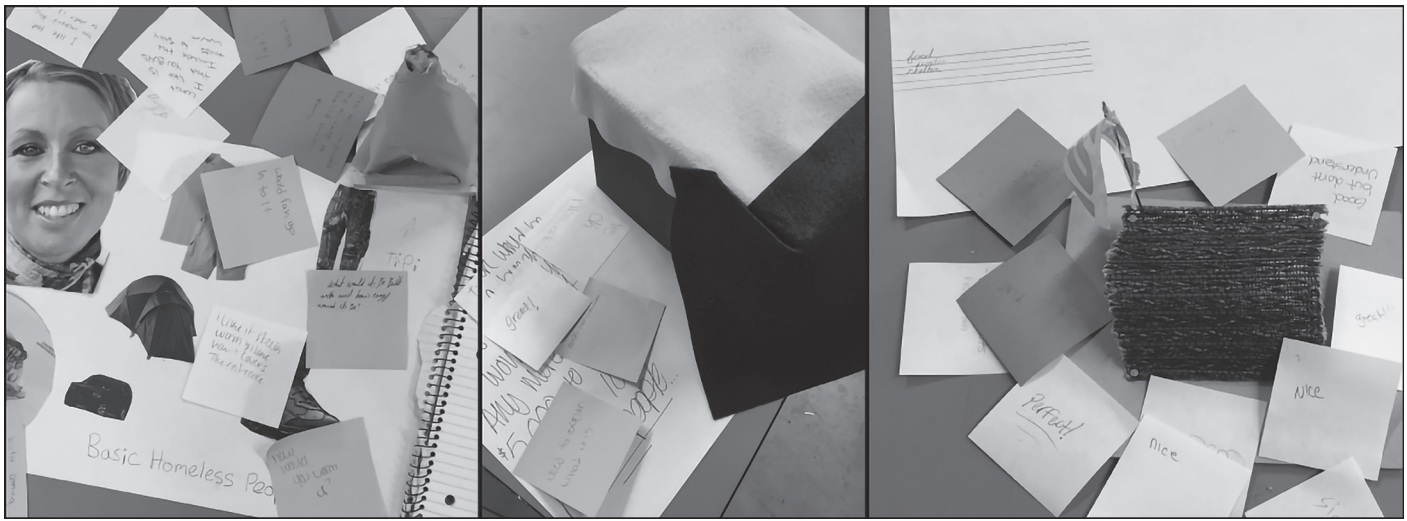

Figure 4.5 Students' initial models of temporary shelters, with Benjamin's on the left, Andre's in the middle, and Ivan's on the right

For instance, on the sixth day of the project, a guest speaker from a local day shelter presented to the students. Benjamin asked the guest speaker 121 questions, and she answered his questions patiently and seriously. For instance, he asked:

- "You said most of—the majority of the homeless people have mental illness. Do you guys, uh, rehabilitate them or? Is that your job? Or, how do you know they have a mental illness?"
- "Is there like a doctor who works with you guys to diagnose these individuals or is it something, like, based on how? Or do you GUESS? I don't—I don't know. I'm just curious how do you know that."
- "Do you give them food?"
- "Do you work with them every day?"
- "Is there, like, a needle exchange?"
- "If they have, like, you said something about a criminal record—you guys don't turn anybody down, right? Violent? Or you accept anyone?"
- "Do you guys find 'em homes? Do you have, like, uh, do? You get them homes, right? You said that. How do they pay for those homes? How do they pay utilities?"
- "Do you guys also give 'em, like clothing?"
- "Do you give them bus passes?"

Although Benjamin asked the majority of questions (Andre asked if they provided laundry detergent for them to wash their clothes, and another student asked if their clients could bring pets or if they served families), most students attended to the guest's answers and took notes. The students were surprised, for instance, to find out that people could be arrested for sleeping on the street. Benjamin expressed this out loud: "Oh, so you can't just sleep wherever you want?" Many students looked up, startled at this information. In the midst of this, Mr. W attempted to steer the conversation back to the original framing:

> **Mr. W:** We're hoping to focus on, you know, are there solutions that could help them be warmer, drier, you know, <u>at night</u>, right? Not building a shelter. Not changing the government. Kind of immediate solutions.

In his last statement, Mr. W urged everyone to think about temporary solutions, such as the temporary shelters the teachers envisioned. Benjamin connected this to the information that it was illegal to sleep outside:

> **Benjamin:** So, um, like, you said, they can't just sleep wherever they want, right, and sometimes—on private property or parks or public? I don't know. They get kicked out? Where CAN they sleep? WHERE can they? Is there an actual place where, um? Like, do you guys give them, like, uh, advice so to speak? Like, "you guys can sleep on this side of town, don't—avoid this side of town."

As Benjamin wrestled with this, he struggled to make sense of why there would not be enough beds for them and yet it would be illegal for them to sleep on the street. His struggle is visible in his fragmented speech:

> **Benjamin:** So, why don't they do something about? They see that it's? Why don't they? They have shelters. They know that they need, that sometimes? They see the limits. Where do they put them? I don't understand that. . . . They can't just be forgotten.

The guest responded that she was likewise frustrated by this situation and explained a bit more of its complexity. After the guest left, the students spent time preparing questions to ask the clients of the day shelter. Ivan primarily focused on how to interview his client: "1. Basic introduction. 2. Ask non-personal question. 3. Lead to more personal info." Andre had a longer list of interview ideas that he jotted down as the guest spoke: "1. Is it hard for you to get a job? 2. Where do you sleep, if you don't mind me asking? 3. Do you have family here? 4. Do you have many friends?" After hearing the clients might be hesitant to answer some questions and that having a friendly conversation would be a good way to begin the interviews, Andre added the following: "I will first let him know my name and ask him how his day has been." And he added new questions: "What is your motivation that keeps you going? What gives you the strength to accomplish your goals?" He further explained that he was most "interested in learning about [the client's] struggles with life."

These vignettes, from early in the project, show how students began to take ownership of the problem and how, even though the teachers wanted

to support this, it was initially a tension and something they resisted. The students consistently framed the problem more broadly as homelessness, not just where a person could sleep at night if he or she was homeless.

The guest speaker presented a pivotal idea: she suggested that one way to help organizations such as hers was to write letters to representatives. This seeded the idea that rather than focusing the project on designing temporary shelters, the students could investigate and design solutions to homelessness in New Mexico, communicated to their state representatives through persuasive letters. Ultimately, the teachers decided that this focus could still allow students to study the focal content while pursuing the problem they had claimed ownership of and framed.

Mr. W explained that when designing, he considers "whether or not the topic seems to be something that's provocative for kids." In this case, he felt that the students were "far more interested in, kind of, the social justice issues. They were more interested in that than they were in building something." He reflected how uncommon this was, as at this particular school a common strategy when students seemed to be uninterested or disengaged was to get them to start building. The idea that they seemed more excited at the idea of writing a letter to their representatives than at the idea of building temporary shelters was unexpected for the teachers. Mr. J reflected on this unexpected shift:

> **Mr. J:** Instead of us just trying to force them on a trajectory, we kind of let their engagement and, and their levels of interest sorta guide the project and we, we, you know, we have the oars, we're at the helm, but they may be the winds that—that push the sails. . . . Maybe we're the wind and they're at the helm.

This resonates with the oscillation of ownership of the problem framing that was observed.

The varied participation styles of the focal students reflected much about the school context, with many students bringing habits learned from damaging prior experiences in traditional schools. Throughout the project Ivan maintained a disengaged stance. Benjamin's departure from the project was complex. He was clearly engaged, and his participation played a visible role in reframing the problem to focus broadly on homelessness, yet equally as clearly, he struggled with the idea that he might be helping someone get something they didn't deserve. However, he explained his

departure as tied to his need to work on completing a required project for graduation. In contrast, Andre connected to the project. Reflecting on his experiences in the project, he explained that "it connected me a lot—personally also—to this project."

DISCUSSION

By positioning students as designers within project-based instruction, they not only have opportunities to frame problems but need to actively frame and reframe the problems. We also found that students gathered information, generated ideas, and evaluated those ideas in a purposeful manner because they were given ownership of the problem. We presented vignettes showing how teachers worked to shift the locus of control to their students. They positioned the students as designers, described and problematized a design process model, and asked the students to frame the problem. Despite this clear intent, the teachers struggled to give complete control of the problem over to the students when they realized that the students were reframing the problem not as designing temporary shelters for homeless people but instead as solving homelessness. Initially the teachers resisted, inserting reminders of the project goal as they themselves had framed it. Unlike many of the familiar problem-based teaching strategies, such as revoicing and summarizing (Hmelo-Silver & Barrows, 2006), guiding students to take ownership of problems means releasing a great deal of control. Thus, even the most experienced project-based teachers in our study displayed efforts to redirect students to the problem the teachers had originally framed, despite explicitly wanting students to engage in problem framing.

This shift in problem framing, from charity to social justice, may have been partially cued by the introduction of an activity on facts about homelessness in New Mexico, but we also documented active identification of needs, generation of ideas, and information seeking in support of this framing. Even as the students drew or built models of temporary shelters, they included details about other needs and solutions, such as food, needle exchanges, and places to store belongings.

We found evidence of specific supports, but these were used in more complex ways than described in previous studies. First, students were provided with an open-ended problem (designing temporary shelters from

waste materials) and then were asked to define the problem. Many recorded an open-ended problem ("homelessness") in their notebooks. Students were also scaffolded to pose questions about the problem. They were supported in doing so in the form of questions to ask the guest speaker and interview questions for clients; we see this as extending and integrating prior work on posing questions (Lowrie, 2002; Zydney, 2008) and the role of authentic context (LaBanca & Ritchie, 2011; Ritchie, 2009). Specifically, asking students to pose questions about the problem to an authentic audience supported their framing of the problem. The actual responses provided multiple perspectives and discrepant information, as suggested by prior laboratory studies (Reiter-Palmon et al., 1997). This sometimes surprised the students, such as when they found that people "can't just sleep wherever they want." For the students, this insight may have made the idea of constructing temporary shelters seem less viable and the need to solve homelessness even more urgent. These perspectives may have strengthened their resolve, and ultimately it was the guest speaker's suggestion to write persuasive letters to their representatives that seeded the idea of the format their designs would take.

The problem was authentic and one that students could connect to personally in various ways; some had experienced homelessness or housing insecurity, but all of them saw or interacted with people who were homeless on a nearly daily basis simply because of the location of the school. It was this connection that drove Benjamin toward and then away from the project and drew Andre closer to it. Benjamin strongly influenced the problem framing and actively struggled to make sense of the problem. His departure, as noted earlier, was complex, and because of its complexity, we do not see it as a contraindication to allowing students to frame problems with which they are personally connected, though we do argue for some caution and care when problems might be proximal to students' prior traumatic experiences. Ultimately, Benjamin's engagement resulted in meaningful learning for him and his classmates. And similar to prior work, though compelling to many students, the personal connection did not help narrow the problem (Ritchie, 2009).

Problems vary by type, from well-structured to ill-structured. These different problem types provide different opportunities for learning, with design problems producing some of the highest effect sizes (Walker & Leary, 2009). The present study extends this finding to show how ownership of design problems, while challenging to manage, presents abundant

opportunities for students to engage in meaningful learning opportunities. The teachers provided what they viewed as an ill-structured problem, complete with clients and instructions about a design process; they encouraged students to begin their design work in "sketch mode," talked about the iterative nature of designing, and problematized the design process model. This set of supports engaged students in taking ownership of and thereby taking responsibility for framing the problems. In taking this ownership, there were myriad opportunities for learning. In this way, designing and learning became inseparable (Collin, 2006).

Limitations

The data presented are deeply contextual; the particular population of students, in this case, was somewhat idiosyncratic. Thus, the supports detailed may not transfer to other settings, particularly those that do not often engage design problems. The particular topic—homelessness—was close to the lives of these students. Many of them had experienced food and housing insecurity. This connects in complex ways to the potential learning opportunities experienced by the students. The particular school has a large social work staff who worked closely with the students, particularly with Benjamin and Ivan. Thus, this same topic, given different students or fewer social supports, would look quite different, including its potential for supporting learning.

Future Research

Further research should contrast the types of learning made available through ill-structured problem framing to the kind of learning that happens in the absence of this type of problem framing. Understanding how to support students to learn through problem framing opens possibilities to better prepare them to learn in less-scaffolded, real-world settings. Extending this work should also explore other settings and disciplines in which ill-structured problem framing leads to rich learning for students.

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CHAPTER 5

Collaborative Learning

Students' Perspectives on How Learning Happens

Abdulaziz Almajed
University of Adelaide/Prince Sultan Military Medical City
Vicki J. Skinner, Ray Peterson, and Tracey A. Winning
University of Adelaide

INTRODUCTION

Professional education must adequately prepare graduates to practice in a continually changing context; for example, graduates will increasingly work in cross-disciplinary teams and with people from diverse backgrounds. Therefore, an adequate professional education should "actively engage preservice [professionals] in opportunities for knowledge seeking, for problem solving, and for the collaborating necessary for effective practice" (Evensen & Hmelo-Silver, 2000, p. 1). Accordingly, to provide students with opportunities to develop future work skills, collaborative learning (CL), a core component of inquiry-based learning approaches, is often used in professional education. CL has advantages over other learning methods, such as sharing learning experiences; learning information-searching skills; having peer support; learning presentation skills; having authentic opportunities; providing opportunities for cognitive conflict within a CL team, which encourages learning; and simulating a real work environment (Barrows & Tamblyn, 1980; DeGrave, Boshuizen, & Schmidt, 1996; Johnson & Johnson, 2009).

However, CL contexts are complex and affected by various factors. For example, CL processes and outcomes are influenced by a range of social, psychological, and personal factors. Students' personal relationships with each other directly affect the quality of interpersonal interactions during group activities and the success of their collaboration (Skinner, Braunack-Mayer, & Winning, 2012). It has been shown that students' personalities

and preferences impact the learning environment, with levels of engagement varying depending on perceived reactions of colleagues (Cockrell, Caplow, & Donaldson, 2000). In addition, a range of culturally related factors can explain variations in students' involvement in a CL context (Jin, 2012; Melles, 2004; Remedios, Clarke, & Hawthorne, 2008). While it is recognized that knowledge conflicts are important for stimulating students' learning (DeGrave et al., 1996; Johnson & Johnson, 2009; Littleton & Häkkinen, 1999), it has been reported that students did not manage these conflicts as expected and spent less time discussing them (Visschers-Pleijers, Dolmans, de Leng, Wolfhagen, & van der Vleuten, 2006). As a result, these factors have a variable impact on learning outcomes (e.g., either negative or positive) depending on the CL context (Rich, Keim, & Shuler, 2005).

Therefore, to ensure that we optimize CL for students, we must understand their perceptions about CL contexts and the practical experience of CL and those views' effects on student learning (Biggs & Tang, 2011; Till, 2005). This is important, as we know that students' learning outcomes are influenced by their perceptions of their learning context (Lizzio, Wilson, & Simons, 2002; Prosser & Trigwell, 1999; Vermetten, Vermunt, & Lodewijks, 2002). However, a recent comprehensive systematic review of medical and dental students' perceptions and experiences of CL within various inquiry-based learning contexts demonstrated that there were few studies exploring students' perspectives of elements necessary for effective CL (Almajed, Skinner, Peterson, & Winning, 2014). Rather, the majority of studies investigated students' perceptions of advantages and disadvantages of CL and evaluations of courses and learning outcomes. Furthermore, the methodological and reporting qualities of many studies were limited. For example, lack of a clear methodological approach and underrepresentation of students' voices were identified. In addition, the systematic review (Almajed et al., 2014) identified gaps in our knowledge about students' perceptions of learning in groups. Specifically, there was a lack of evidence regarding students' understanding of what CL involves, students' perceptions about when learning happens, what enables their learning when learning collaboratively, their understandings and management of knowledge conflicts, and their goals for learning in CL contexts.

As a result, it was necessary to conduct a focused and rigorous study to inform our knowledge base about students' perceptions of CL. This qualitative study aimed to explore students' understandings of the core

elements necessary for learning collaboratively. Specifically, this study aimed to explore students'

- perceptions about when group learning works (based on their current experiences of when learning occurs and how),
- understanding of what learning together involves,
- goals for group learning, and
- understanding of the role of conflicting knowledge in their learning and how they manage such disagreements.

Findings from this study should inform curriculum planning, design of learning activities, induction of students to learning in CL contexts, and tutor training activities, with the aim of improving CL experiences in the education of dental and health professionals.

METHODOLOGY

To address these aims adequately we used a qualitative study, drawing on a constructionist interpretive methodological approach (Merriam, 2009). An interpretive approach was appropriate to investigate participants' constructed understandings of their current CL environment through asking participants open-ended questions that encouraged them to explain the meaning they had developed about their CL context (Creswell, 2003). In turn, patterns of meanings from participants' constructions of their experiences in CL were generated (Creswell, 2003; Merriam, 2009). The authors then further interpreted students' understandings using the theoretical underpinnings of CL to extend our knowledge and the current qualitative evidence in this area (Braun & Clarke, 2006; Merriam, 2009). The current study design also aimed to address methodological issues identified in the systematic review (Almajed et al., 2014) by following recommended approaches for qualitative educational studies (O'Brien, Harris, Beckman, Reed, & Cook, 2014; The Joanna Briggs Institute, 2011).

Acknowledgment of the researcher's theoretical and cultural position and any potential bias in relation to the research topic is considered an important element for rigorous qualitative research methods (The Joanna Briggs Institute, 2011). The primary researcher's (Author 1) interest in exploring complex CL environments developed from completing

postgraduate dental study in a CL setting. Following this experience, areas for further investigation included students' perceptions of CL in terms of their learning management, factors affecting their learning processes, and their learning goals. The need to investigate these areas was reinforced after conducting a comprehensive systematic review (Almajed et al., 2014), which showed that more focused studies are needed to explore students' perceptions through qualitative research that yields meaningful, rich data.

Ethical Considerations: Participant Recruitment and Data Management

Ethics approval (HS-2013-001) for the study was obtained from the institution's Human Research Ethics Committee. The ethical considerations in terms of student participation in this research involved protecting students from any breaches of their privacy and also protecting their personal and academic well-being. Author 1 had no established relationship with the undergraduate dental students/participants prior to the study and was not involved in any teaching or assessment processes. Therefore, he conducted the participant recruitment and consent processes and data collection and de-identified all the related documents and subsequent data for the study. In a class, Author 4 introduced students to Author 1 as an international PhD student who would not be involved in their teaching or assessment. As a result, they could talk openly to him during focus groups (FGs). Author 4 then left the class, and Author 1 informed students about the study. To disseminate the invitation to participate in the study to students who did not attend that class, an e-mail from Author 1 was sent using the dental school's e-mail distribution service. Participants were invited to respond on a voluntary basis. Information sheets and consent forms were provided to support the explanation, and students' questions were addressed. The remaining authors and other staff involved in teaching and assessment for dental students during the study were not involved in the collection or recording of consent forms or subsequent data collection and management. The organization and running of the focus groups were undertaken solely by Author 1. Focus groups were arranged at times suitable for students and in locations away from staff offices.

The study documents and data were de-identified by Author 1 by removing any references to student and staff identities. This process included giving each participant a code to de-identify transcripts, such as $F_4$1, $F_4$2, $M_4$1 (F = female, M = male; the subscript number = the year level). All data analyses and reviewing by the remaining authors (research

supervisors for Author 1) were performed after de-identification. The data were not accessible to any staff or students who were not involved in the study. All data were handled confidentially and were securely stored, without any identifying material, in a locked cabinet that was not accessible to academic staff involved in any teaching or assessment processes.

Context

This study involved students from the five-year bachelor of dental surgery (BDS) program at an Australian dental school. Students in the BDS program are a mix of school leavers (i.e., students entering directly from secondary/high school) and university graduates (i.e., students who have undertaken or completed tertiary studies) and included domestic and international (temporary resident) students. The curriculum involves small and large group learning within a single multidisciplinary integrated stream. Case-based learning, encompassing a range of small-group (five to seven students) CL contexts, organizes students' learning (Kaidonis, Skinner, Lekkas, Winning, & Townsend, 2013). First- to fourth-year students analyze professional scenarios, involving research, integration, and application of concepts from other learning activities, over two- to four-week blocks. Students begin each case working in small groups within a whole-class setting, with staff facilitating. This process concludes with students developing research questions that link with key observations about the patient case. Subsequently, students meet in their small groups to review their research questions and integrate their research in the context of the patient or situation. In the first and second years only, tutors facilitate these small-group meetings (two one-hour sessions/cases). In the first session, students discuss their initial research plans, including clarifying key areas to investigate, potential resources, and how the group members will manage their research. The second small-group session involves students discussing their research findings, including reviewing key concepts and relating these to the patient's situation. The other key outcome of this session is to collaboratively work on their groups' summary of their research, to be discussed at the subsequent whole-class review of the case. Various classes (e.g., interactive lectures, learning labs, clinic activities, and tutorials) are provided to support students' research. The case analysis cycle concludes with groups submitting a summary of their research. These summaries form the basis of the review of their learning in the final session with the whole class (two hours). Students again work in their small groups within

this whole-class setting and discuss the core outcomes from their research and/or respond to staff-provided questions that require application of their learning to the patient's situation. Staff facilitate this review and application phase.

To support students' development of CL skills, their participation in the small-group tutorials is assessed over the four semesters of the first and second years. Specific criteria and standards (i.e., knowledge, reasoning skills, and use of evidence; professionalism; and interpersonal, communication, and learning skills) are used. The initial six weeks of the first and second years are formatively assessed. At the end of this initial period, students use the criteria and standards to complete a self-assessment of their performance. The students' self-assessments are discussed in the small-group tutorial, supported by group and individual feedback from the tutor. Tutors provide feedback during the semester and a summative assessment (nongraded pass) at the end of each semester.

Participants, Data Collection, and Analysis

A purposive sampling approach was used to achieve maximum variation in the selection of the study participants (Coyne, 1997). All first- and fourth-year students were invited to participate. First-year students were selected, as this was the first experience of CL in a higher education environment for many. Therefore, it was considered important to understand this group of students' experiences of a CL context at this early stage of their learning experiences in higher education. Fourth-year students were selected because they were the first cohort who had experienced the revised BDS curriculum when it was implemented at the School of Dentistry in 2010. Their insights were considered important, as they provided the longest experience of the CL context in the revised BDS across all current cohorts. Details related to age, gender, and residence of first- and fourth-year cohorts are presented in Table 5.1.

A self-selection approach was used for student recruitment. No exclusion criteria were set, as the sampling process aimed for a wide range of student experiences. Fourteen first-year and 14 fourth-year students participated in FGs, with further data collection by e-mail. Details related to age, gender, and residence of first- and fourth-year participants are presented in Table 5.2. These ratios are similar to their cohorts, with slightly more international students participating from the first-year group. Both school leavers and students with previous tertiary experience were equally

TABLE 5.1 *Demographics of the First- and Fourth-Year Student Cohorts*

Year level	Number of students & F:M ratio	Average age in years & SD*	Domestic students: South Australia (No. & %)	Domestic students: interstate (No. & %)	International students (No. & %)
First year	78 (44 F:34 M)	19.6 (3)	15 (19.2%)	39 (50%)	24 (30.8%)
Fourth year	69 (40 F:29 M)	22.4 (2.7)	19 (27.5%)	29 (42.1%)	21 (30.4%)

* SD = standard deviation

TABLE 5.2 *Demographics of the First- and Fourth-Year Participating Students*

Year (total students)	Gender: female male	Average age in years & SD*	Domestic students: South Australia (No. & %)	Domestic students: interstate (No. & %)	International students (No. & %)	Previous education: school or tertiary (No. & %)
First year (14)	11 F 3 M	19.6 (1.6)	4 (28.6%)	4 (28.6%)	6 (42.9%)	7 school (50%) 7 tertiary (50%)
Fourth year (14)	12 F 2 M	21.5 (0.7)	2 (14.3%)	7 (50%)	5 (35.7%)	7 school (50%) 7 tertiary (50%)

* SD = standard deviation

represented among the participating first- and fourth-year students. In comparison with their student cohorts, fewer males from both year levels participated in the FGs, while similar numbers of domestic and international students were involved.

The FGs were year specific, with a total of nine FGs conducted: five first-year FGs and four FGs with fourth-year students. Each FG was approximately one hour long and consisted of two to four participants (Morgan, 1997; Vaughn, Schumm, & Sinagub, 1996). Factors such as the amount of collected data, available resources, and practical issues of finding convenient times for the participants limited the number of FGs for each cohort in this study. Three to four FGs were considered optimum for

each cohort in terms of the resultant data size and the available resources. Running small FGs assisted in managing issues of participants' availability, enabled all participants to express their opinions while minimizing problems of interruptions that occur with larger numbers of participants, addressed issues of clarity of recordings (Millward, 2012), and enabled participants to feel more comfortable sharing their ideas (Onwuegbuzie, Dickinson, Leech, & Zoran, 2009).

The authors developed the content of the FG questions from the findings of the initial systematic review (Almajed et al., 2014). Author 1 then piloted these questions with a small test group (five volunteer dental postgraduates). On the basis of this group's feedback and discussion with the other authors, the questions were refined into the initial set of FG questions. These open-ended questions included "What made learning in a group work?"; "What resulted in learning?;" "How important is group learning?"; and "How would you improve your experience of learning in groups?" During the data collection and concurrent analysis, the authors discussed and then further modified the questions as data were obtained (Morse, Barrett, Mayan, Olson, & Spiers, 2002). The main changes related to the aim of investigating students' understanding of what learning together involves. In the initial FGs, students did not discuss their learning processes; therefore, the questions were modified to try to elicit these data. For example, to direct students toward talking about learning processes, an additional question was added: "Can you describe what's going on inside your head?" By the time FGs 8 and 9 were conducted, the modified questions yielded data on students' CL processes. Therefore, to find out how the participants from FGs 1–7 would respond to the final modified questions and to maintain consistency throughout data collection, follow-up e-mails were used with the other focus group participants. An initial e-mail involved the same question about "what's going on inside your head," with follow-up e-mail questions regarding their learning processes indicated by other students. All 10 first-year students in FGs 1–7 responded, and 12 out of 14 fourth-year students responded. In their e-mails students described various learning processes, which provided data to add to what was obtained in FGs 8 and 9.

Each FG was audio recorded, and the recordings were transcribed by a professional typist. After participants had approved copies of their own transcripts, analysis began with summarizing each de-identified transcript (Krueger & Casey, 2002). Transcripts and field notes were analyzed

by Author 1 using NVivo qualitative data software version 10 (© QSR International Pty Ltd.), in consultation with the other authors. An inductive thematic analysis strategy was used (Braun & Clarke, 2006; Merriam, 2009), resulting in identification of emergent ideas with constant comparison to confirm codes and recurrent patterns and themes. The first step of the analysis was to develop subcodes, which were labels for key ideas that emerged from the transcripts. These were usually based on students' words, such as "same motivation" and "similar personalities." Subsequently, subcodes were grouped into codes, which represented similar concepts and were labeled using students' words (e.g., "The right batch of people") or by the researchers (e.g., *benefits and positive outcomes of conflict*). Finally, the codes were examined for larger patterns, which were identified as themes such as *facilitating factors*. Further, these themes were reinterpreted in relation to the theoretical underpinnings of CL to create final themes (Braun & Clarke, 2006).

RESULTS

Based on the theoretical elements of CL (Dillenbourg, 1999), the analysis of FG transcripts generated four main themes:

- context,
- group/learning interactions,
- group and learning processes, and
- outcomes.

In general, the results of this study showed that students acknowledged how their group learning experiences provided them with key academic and social supports. Apart from a few exceptions, there was a strong similarity in students' responses in both year levels across the main themes.

Theme 1: Context

This theme, representing students' perceptions about the CL context, included three codes: *difference*, *facilitating factors*, and *inhibiting factors*. With respect to *difference*, students perceived that different people with different perspectives, bringing various opinions and inputs to their

discussions, were important and a major factor in influencing positive outcomes and enriching their experiences:

> I think even our group of 80 we are all from so many different places and there are just so many new cultures and that sort of stuff that having all of these absolutely different opinions is really—like, makes a whole difference to my learning this year in comparison to any other year, because I'm just surrounded by this whole different group of people who [I] never have been. ($F_1$14)
>
> I think it's very important. Like what I mentioned before, everyone has a different understanding of the things that they can read or understand and it's good to draw from other people's experience and their understanding. ($F_4$11)

Various contextual *facilitating* and *inhibiting factors* affected students' learning. Seven key facilitating factors positively affected students' learning:

- Coherence toward learning: group members having similar attributes and approaches toward learning in groups.
- Group organization: having a small and organized group with clear directions and goals.
- Learning preparation: group members being prepared before group meetings.
- Accountability: being accountable and encouraged as a result of being part of a group that was working well.
- Relaxed environment: having a relaxed group environment.
- Relevant topics: learning about relevant and interesting topics.
- Tutor support: receiving support from a tutor/leader.

Coherence Toward Learning

Students considered having "the right batch of people" ($M_4$2) a key factor in the effectiveness of CL. Specifically, having group members with similar approaches toward group work—"common objectives" ($F_4$11) and motivations, being hardworking and enthusiastic, participating and sharing, and having the required "communication" ($F_4$1) skills—was perceived as influencing group performance and subsequent learning outcomes. Students considered that these similarities would allow the group to work as a united team during CL, which subsequently would improve group dynamics and

their learning processes. However, most of the students thought that a similarity in academic levels was not necessary:

> But I think what has to be similar is the attitude towards group learning, that they feel that group learning is important, so everyone must feel that group work is something that they have to do together, that everyone must feel that group meetings is something everyone must participate in, so that is what I feel must be the same kind of—that everyone must agree on that aspect but not in the sense that you must be on the same level when it come[s] to academics or that you must study in the same way together. Like it doesn't matter if someone is a visual learner or someone is a different kind of learner, that is fine, it is just about the attitude towards group work. ($F_1$23)

Group Organization

Participants said that having a small and organized group with clear directions and goals was an important factor for the success of their learning experience in CL:

> When the group is organised, when all the people in the group have the same ideas—not the same ideas but they kind of understand what the aim of the project is and work together really well. ($F_1$19)

Learning Preparation

Students indicated that preparation before group meetings was a key factor for their learning experiences, as this facilitated sharing of information and participation in the group's learning activities:

> For me what makes it successful is when everybody comes prepared. ($M_4$1)

Accountability

Students reported that they experienced a positive and motivating effect due to being counted as members of a group. The effect of group membership worked as a driving force that increased the students' "sense of responsibility" ($F_1$20) toward their group, and subsequently this increased their motivation toward group work and collaboration:

> If there's five other people that you made this commitment with and they're all accountable to do their share as well and you let them down that's a really big motivating factor to make sure that you do pull your weight and do the extra work. ($F_4$6)

Relaxed Environment

The fifth *facilitating factor* involved having a relaxed group environment in terms of group composition and absence of stress of assessment, thereby enabling learning:

> If it was relaxed they would be fine saying their ideas that they had—it could be something totally out there—but they would still say it whereas if it's an assessed thing I feel like a lot of people, except those who are really confident, will probably just sit back and see what the other people say first. ($F_1$14)

Relevant Topics

The sixth factor expressed by some participants was the belief that having relevant and interesting topics, such as clinical and practical topics, increased motivation for discussion and learning during CL. Topics commonly associated with differences of opinion (e.g., patient management) also facilitated learning. In these situations, learning occurred as group members had to discuss different perspectives and ideas, which provoked them to think:

> I think making the topics more scenario based is really good for learning in groups because it's not something you can just rote-learn and you can kind of cover everything, so I think in the later years now we've got more treatment planning questions which is good because that's a really big area that you can discuss a lot. . . . That's where I learn a lot when it's that understanding conceptual work rather than just theory, theoretical nitty-gritty details. ($F_4$1)

Tutor Support

The final facilitating factor was that support from a leader/tutor/facilitator was necessary. Students expressed the need for someone to provide guidance and knowledge and direct them to the right path. Students frequently used

terms suggesting that their view of the role of the tutor was "to direct the discussion" ($F_4$10), "to have read up before" ($F_4$7), "to teach us properly" ($F_1$14), to provide "direct feedback" ($F_1$22), and to manage the dominant students and "shut them down" ($M_1$4):

> Yeah, or I mean it even stems down from the quality of the lecturer that we had or the quality of the tutor that we had and whether we thought if we haven't been given someone that we can understand or who cared enough to teach us properly we are not really going to care enough to learn this properly. ($F_1$14)

On the other hand, students reported six *inhibiting factors* that negatively affected their learning:

- Workload: course requirements and commitments.
- Difficult personalities: presence of students whose behaviors were not collaborative.
- Limited participation: group members not sharing/participating.
- Assessment: being assessed on their participation by a tutor.
- Tutor-provided answers: having a tutor give them the answers.
- Competition.

In certain situations, the effects of these negative factors led students to prefer learning individually; they considered learning in groups a waste of time because they lost control of their own learning:

> I find that if the leader is too rigid and inflexible in what they want, so they expect this by a certain time, like no flexibility at all, I find that tends to stress me out a lot because I feel really pressured to get it just right by a certain time. ($F_4$4)

Workload

Due to the perceived course workload, students distributed the work from their CL activities among the group members, thus aiming to finish the requirements in the time given, as it was "a lot more efficient to just split it up rather than do it as a group" ($F_4$2). However, students reported that these arrangements were done at the expense of learning, as the distribution of the task was done primarily to finish the task and hand it in on time:

> Just want to get it done and hand it in. This is really bad but it is not necessarily a learning process where you are trying to learn about everything, it is more of—like, I think a lot of people consider it as something you have to do and hand in. ($F_4$10)

Difficult Personalities

Students recognized that the presence of difficult behaviors or a "forceful person who forces their ideas on the whole group" ($F_4$4) was an inhibiting factor for their learning:

> If it's just like one person who has a dominant voice voicing their opinions it has a tendency of other people I guess just not contributing or not participating as a result. ($M_4$1)

Limited Participation

Students indicated that a lack of participation negatively affected their learning. They also noted the presence of quiet or "slack" students who are "not pulling their weight" ($F_4$2) in terms of participating in discussion and sharing of information and/or who came to the group meeting without preparation:

> I guess the main issue with group work would be if some people are not pulling their weight or if some people are having to make up for when people aren't, I guess, contributing their fair share. ($F_4$2)

Assessment

Students considered that the presence of a tutor "keeping a close eye on you" ($M_1$3), especially when assessing their participation, was a stressful situation that made the environment uncomfortable and, in turn, restricted their participation:

> Maybe not just the tutor but the sense that if you're being assessed you get worried that if you don't do something it's going to reflect badly, so it's not the sense that you want to do something but the worry that something is going to happen if you don't. ($F_1$15)

Tutor-Provided Answers

A few students thought that being provided with answers by the tutor was an unhelpful aspect in relation to their learning processes:

> I think being asked to do the questions and being asked in the group is better than the tutor just telling us on the day, "These are the answers," because if you have to answer them you have to do your own research but as well, as it goes around to everyone else, you see everyone else's view on the question as well and then the tutor, to wrap up, tells you and adds anything that is missing or corrects anything that's wrong so that is really good because you have to be thinking about it and then you get everyone else's opinion and then you get kind of the right opinion. ($F_1$13)

Competition

A minority of participants indicated that the presence of competition between students had limited sharing of information and made the group atmosphere uncomfortable, which hindered students' learning:

> The competitiveness between group members really impacts. In one of my groups everyone was really competitive and sort of wanted to be the best themselves which I found really quite stressful because it was just hard to work together and people would keep things to themselves more, whereas another group has been a lot less competitive and very open with sharing resources and picking up on each other when we have a knowledge deficit which makes it much more relaxed and then, if you're relaxed, you learn more and then you enjoy it more. ($F_1$17)

Theme 2: Group/Learning Interactions

Students noted that interactions involving *sharing* students' inputs subsequently helped them to learn and broaden their knowledge:

> Everyone can share and kind of contribute. So it's like a very big database of knowledge all coming together and everyone can kind of pool into that. ($F_4$1)

Students also perceived that their learning was strongly mediated by *questioning and explaining to each other*. Students' preparation prior to and sharing of knowledge during group activities allowed them to learn through questioning and explaining. These interactions helped in *confirming and challenging their knowledge* and *filling the gaps*:

> I strongly feel that learning via teaching is a very effective and efficient mode of learning. . . . I think it is all too easy to fall into the trap of feeling like you "know" the topic, but to explain the topic to another person you have to have a good grasp and full understanding of the concept. ($F_4$2, e-mail)
>
> I also find that just the act of articulating my understanding of a topic helps me improve my confidence in the area and helps me spot any gaps that I may have in my understanding. This improved understanding, confidence, and identifying weaknesses in understanding is further enhanced by questions that I may receive. ($M_1$3, e-mail)

Theme 3: Group and Learning Processes

Students explained that their learning processes involved *managing knowledge conflicts* (see Table 5.3), *active thinking and processing* about links and their relevance, and *comparing and linking* what they already knew to new information.

Students reported that questioning and explaining to other students facilitated and reinforced their understanding. Key processes they used included *visualizing, reorganizing, and linking information* into a simplified story when teaching or explaining:

> If you are talking to someone it's a conversation so it's active: you have to be thinking and actively processing and analysing what you're trying to talk about.
>
> You need to have someone there and be trying to teach them and then they can tell you or ask you questions back and that's the thing that makes you think and then makes you remember and actually understand what you're studying. ($F_4$6)
>
> For me I like to read and when I read something I would understand it because I visualise it in my head. I am a very visual person, I understand things through maybe mind maps, that helps

TABLE 5.3 *Students' Strategies to Manage Conflicts of Knowledge*

Subcodes	Description
"Talk it out"	The group managed differences of opinion through further discussion of these opinions to resolve the conflict.
"Research it"	The group managed conflicts in ideas by doing further research to resolve the conflicts.
"Different correct ways"	Students perceived that there was an advantage in differences of opinion, which confirmed that these conflicts in ideas only demonstrated "different correct ways" and ideas and only related to different understandings of the same thing or different approaches to managing an issue.
"It's up to the majority"	The group managed differences of opinion where a decision of the majority was what they agreed with.
Accepting it	The group managed conflicts in ideas by accepting a compromise solution and avoiding conflicts, which was sometimes used as part of respecting other students' inputs or to avoid the strong personalities.
"Headstrong" and true until proven otherwise	Students perceived that there were difficulties in convincing the "confident students" about another opinion. This section also showed one student's attitude of persisting with his opinion and continuing with convincing other group members that this opinion was the correct answer until they could prove the opposite.

> me to memorise facts, but to actually understand a process I would visualise it very abstractly and then it is more like a story process and when I explain it to someone I go through that story, it's like telling a story, not really memorising the facts but more of creating my own story in my own way and conveying it to the other person. ($F_1$21)

When students from FGs 1–7 were asked in follow-up e-mails about these learning processes, they confirmed that these processes applied to them. Some students reported that they visualized the information by drawing diagrams and pictures, while others visualized it by writing information in different forms, such as dot points and tables. An illustrative comment is that "they must be very self aware of their thought processes to evaluate this" ($F_4$1). This comment helps explain students' difficulty in articulating their thought processes during FGs. These learning-focused

thought processes were not readily accessible to students, as it was difficult to elicit these elaborations during the initial FGs and required further FG modifications and follow-up e-mails.

Theme 4: Outcomes

This theme represents students' perceptions of both the positive and negative outcomes and the value of groups for their learning. These included the positive outcomes of experiencing knowledge conflicts, the learning outcomes of questioning and explaining to each other, the value of learning in groups, and the negative effects of learning in groups (see Table 5.4).

TABLE 5.4 *Summary of the Perceived Outcomes of Learning in Groups*

Positive outcomes of experiencing knowledge conflicts	Learning outcomes of questioning and explaining to each other	Value of learning in groups	Negative effects of learning in groups
Clearing up any confusion they had. Expanding their knowledge and facilitating a broader mind-set about the discussed topic. Reinforcing the information in their minds and enhancing their ability to recall this information. Being beneficial for everyone's learning. Being in the patient's best interest.	Clarification of any doubts and improvement in their understanding. Confirmation of their knowledge. Improvement in their ability to remember what they learned.	The heterogeneity of group members, which enhanced students' learning. Being an effective approach that reduced the time required for managing their learning. Keeping students focused. Development of a network with and having support from other students. Training for the future work environment.	Making their learning in groups a waste of time when negative issues were present (e.g., other students not interested in learning, the absence of sharing and participating, lack of premeeting preparation, large group size, group members having no common aims, and unclear group goals). Losing control of their learning compared to learning by themselves, especially when other group factors were absent (e.g., preparation before group meeting, being on the same page).

Overall, the students valued CL in several aspects of their learning. However, they identified various positive and negative conditions that influenced their group learning context:

> Hearing them explain it can enhance your learning and it can get you out of your tunnel vision sort of thing. So the differences in opinion offers up that other opinion. ($F_1$14)
>
> I find it's really helpful to be able explain something to someone else as well. If I think I know a process, in tutorials if I explain it to someone, it solidifies it for myself as well and then I remember it. ($F_1$17)
>
> Some people don't study and they just come and then maybe someone just keeps teaching them and wasting their time teaching, repeating and repeating, because they have no background knowledge of what they are talking [about] or what they are asking. ($F_4$7)

Students noted that supporting positive conditions and controlling negative conditions could enhance learning and improve their group learning experience, which would subsequently lead to better learning outcomes:

> The only thing is individual learning is a slower but more guaranteed process. Group learning is more of a gamble but when it pays off it pays very well. ($M_4$2)

DISCUSSION

This study, which aimed to address the gaps in our understanding of CL that were identified in a systematic review of CL (Almajed et al., 2014), has provided answers to the four research aims of understanding when and how group learning works, what students' goals for CL are, and what the role of knowledge conflicts in CL is for students. The results, presented as four themes relating to the theoretical basis of CL (Dillenbourg, 1999), have been discussed and linked to the study aims. For students in this study, CL occurred best when certain group-facilitating contextual features were

present. Groups needed to have particular features, such as differences and similarities among group members' attributes and behaviors, and an ideal group size to enable positive CL interactions. Learning together involved particular interactions and processes, which students sometimes had difficulty describing. As discussed previously, the learning-focused thought processes were difficult to elicit during the initial FGs and required further FG modifications and follow-up e-mails. Finally, students identified clear positive goals for CL, such as enhancing their learning via group engagement. This included engaging productively when knowledge conflicts were seen as relevant to learning, although sometimes group strategies to deal with conflicts involved avoidance rather than engagement.

There was a strong similarity in students' responses across the main themes in both first- and fourth-year levels, apart from a few exceptions. These exceptions mostly related to the nature of the scenarios and having more scope for multiple patient management approaches for the fourth-year students. One exception related to the positive effects of having knowledge conflicts; the fourth-year students indicated that these conflicts helped them recall and reinforce their knowledge in addition to helping them to find the best approach for caring for their patients. First-year students did not report these positive effects. The second exception related to the value of learning in groups. First-year students noted that learning in groups simulated their future work environment and also provided them with academic and social support. In contrast, fourth-year students did not comment on this aspect of learning in groups. Both groups had participated in team-building activities early in their first year. However, by their fourth year, the major focus for students was on individually providing care for their own patients. They had limited opportunities for managing or providing patient care in teams. In addition, fourth-year students pointed out that the increase in their course workload and deadlines inhibited their learning. First-year students did not report this as an issue with their learning experience. First-year students had a lighter clinical load than fourth-year students, which may explain this difference.

Context

Addressing the first aim of this study, dental students reported that the diverse social and academic nature of their groups, with respect to group members' background and experiences, were key factors in successful experiences in a CL context. The findings from this study build on the outcomes

from previous studies (reviewed in Almajed et al., 2014); however, these previous studies were limited in terms of their methodology and reporting.

The current study's findings are consistent with the theoretical basis of group heterogeneity as necessary to facilitate "constructive controversy," knowledge building, and problem solving in group meetings (Johnson & Johnson, 2009, p. 348; Scardamalia, 2002). Vygotsky (1978) argued that the "zone of proximal development (ZPD)" surrounds individual core knowledge and represents the area to which the individual can extend his/her knowledge with further guidance and help. In a group of students, ZPDs overlap and enable shared zones to be wider, especially when students learn in diverse groups that contain heterogeneous group members' experiences and skills (Bruffee, 1999).

The motivating aspect of heterogeneous groups described by the participants in the current study also aligns with CL theories. These findings are consistent with the "role of social comparison": the presence of other students with different academic abilities facilitates and motivates other students' learning, as they compare their abilities with those of other students (Johnson & Johnson, 2009; Littleton & Häkkinen, 1999, p. 28). Similarly, from a "motivational perspective" position, when group success depends on group member performances, students work harder and help each other to get a better result (Slavin, 1996). Students become intrinsically motivated if they are interested in the topic or context (e.g., related to being a dentist), are challenged, or complete the task, which in turn increases their sense of satisfaction (Hmelo-Silver, 2004). For the students in this study, being a member of a group of hardworking and successful students created a challenge, and they aimed to match other students.

While learning in a heterogeneous group was clearly of value for students, they also valued certain group member attributes as being similar. These findings are consistent with previous studies, such that being friends and having similar personalities, motivations, and goals were beneficial (reviewed in Almajed et al., 2014). However, these studies were limited, being derived from students' ratings of a restricted range of survey items. The issue of dissimilarity of these attributes and the inhibiting effect of inappropriate student behaviors on the learning of other group members has also been reported (reviewed in Almajed et al., 2014).

These findings of similarities regarding group attributes were not unexpected theoretically. To establish a collaborative setting, students must be comparable in actions, knowledge (similarity in opinions is not required),

and status; have shared goals; and do tasks together (Dillenbourg, 1999). CL is based on the notion of social interdependence, in which students share similar goals, resources, roles, rewards, and tasks, and individual success depends on and is affected by each other's activities (Johnson & Johnson, 2009). This is consistent with a "motivational perspective" of CL, in which linking students' success with their group's success facilitates students' motivation and collaboration (Slavin, 1996, p. 44). For students in the current study, the importance of commitment to group work, demonstrated by preparing before group meetings, also fits with CL theories. Students' accountability via preparation and working toward group tasks is one of the basic elements of social interdependence and cooperation in CL (Johnson, Johnson, & Smith, 2007). Therefore, we conclude that it is important to encourage student preparation before group meetings so that constructive sessions that facilitate student participation, in terms of sharing, discussing, and explaining, are possible. It is important to note that preparation enables all students to engage, which includes verbal contributions as well as moments of silent engagement and participation (Jin, 2012; Remedios et al., 2008).

Other findings about when learning happens and group context include the importance of having a small group to facilitate and having clearer directions and goals to enable better organization. These findings are consistent with the reported group sizes recommended for meaningful interactions (two to four members) (Johnson et al., 2007). It has also been reported in a meta-analysis of studies in psychology that large group sizes lead to reduction in both students' performance and group cohesiveness (Mullen & Copper, 1994).

In contrast to the positive effects of a small group, students noted the negative influence of group choices about how they managed their course workload. Theoretically, the process of dividing a group task can facilitate workload reduction without reducing collaboration between students to accomplish tasks (Dillenbourg, 1999). Dillenbourg (1999) differentiated between "collaboration" and "cooperation": in a "collaborative" situation students may split their tasks and be required to coordinate with each other to accomplish their group tasks ("horizontal" division), while in a "cooperative" situation students split their tasks and work independently ("vertical" division). Students in this study mentioned that the stress of their increased workload across the year led them to divide the tasks vertically, which meant that they cooperated by completing the

tasks independently, despite recognizing that this was not useful for their learning.

Students also said that learning collaboratively was enhanced when topics were more relevant and less certain. Topics leading to discussing different ideas (e.g., patient management) increased interest and facilitated learning. This study provides support for a previous study in which students expressed preferences for selecting topics and content of interest to them (Gleeson, 2010). This enhanced learning is explained by "situated learning" theory, in which learning is situated in an authentic context that involves realistic use of that knowledge (Littleton & Häkkinen, 1999).

The final contextual aspect of when CL occurs related to the tutor. Students perceived the role of the tutor as someone to provide direction, knowledge, and guidance and manage students' behaviors (i.e., dominant and quiet behaviors). However, students also reported that having tutors assess individual performances made group environments stressful and uncomfortable. Students perceived that this caused them to dominate discussions to demonstrate their competence. However, students in this study also noted that assessment is necessary to keep them committed to the group work and encourage them to prepare. These results build on those observed in earlier studies, which found that students preferred having a tutor to monitor, guide, focus, and encourage participation in their group (reviewed in Almajed et al., 2014). The reported need of students in this study for tutors to manage inappropriate behavior and the effects of competition on their learning are congruent with the basis of CL. It is important for students to feel safe to participate and discuss their opinions, which is enhanced by the "cooperative context" and hindered by the "competitive context" (Johnson & Johnson, 2009, p. 348).

Interactions and Processes

The second aim of the study—what CL involves—was explained under the two themes of interactions and processes, described by Dillenbourg (1999). For students in this study, key interactions that supported group learning were sharing information and resources, which included variations in perspectives and understandings. They also explained that questioning and explaining to each other enhanced their learning. They indicated that both participants in the explanation process (the individual who explained the information and the one who was provided with the explanations) learned from this process. This required them to prepare information and organize

ideas, enabled their ideas to be challenged, and supported their identification of gaps/misunderstandings, thus modifying and shaping their ideas. In this study, students explained that they used a number of cognitive processes such as visualizing and reorganizing material to understand and communicate it better.

Students in other studies perceived that sharing information and explaining positively affected learning (reviewed in Almajed et al., 2014). These findings are consistent with CL theories. Learning must be a "constructive" and "collaborative process" in which students' elaborations and interactions support learning (Dolmans, De Grave, Wolfhagen, & Van Der Vleuten, 2005, p. 732). To learn collaboratively, students should share goals and responsibilities, be reciprocally reliant on each other, and interact with each other to reach common agreement on their ideas (Dolmans et al., 2005; Johnson et al., 2007). In CL contexts, students' construction of understanding is explained by social constructivism and sociocultural theories of Vygotsky's social development theory (Littleton & Häkkinen, 1999; Smith & MacGregor, 1992). In this social context, students' collaborative interactions (e.g., analyzing, arguing, explaining, comparing, and linking) help to create different ideas and understandings (Littleton & Häkkinen, 1999; Smith & MacGregor, 1992). Similarly, from a "developmental perspective" of CL, collaborative interactions develop students' understanding and knowledge (Slavin, 1996). Therefore, in CL contexts, students are at the center of the learning process, constructing their knowledge through their interactions and processes, in contrast to the teacher conveying information to the student. Furthermore, other studies have reported that the students practiced "active" silence during CL to process and think about the explained information (Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014; Jin, 2012; Remedios et al., 2008). Also, Jin (2012) reported that students' silence might be a signal of allowing the person with more knowledge in a certain topic area to lead and control the discussion.

With regard to learning processes, students in the study perceived that their learning was enhanced by certain thought-related learning processes. These processes included visualizing and linking information together and comparing and linking any new information to what they already knew. It was noteworthy that students' levels of awareness of their thinking processes during learning made it difficult for them to explain these processes. Students' elaborations of their thinking processes were achieved only after extensive questioning and probing, including revision of questions during

FGs and in follow-up e-mails. In response to these changes, students did note that they actively thought about and processed information when learning. The difficulty that students had explaining their thought-related learning processes suggests that these processes were not readily accessible when they were questioned. Students confirmed that they practiced these processes subconsciously.

It is of note that most of the students in this study considered knowledge conflicts opportunities for further learning by exposing them to different opinions and aspects of knowledge. These findings addressed the fourth research aim, about the role of knowledge conflicts, which was a gap in previous studies (Almajed et al., 2014). This is consistent with the theoretical underpinnings of the "socio-cognitive conflicts" of CL (Littleton & Häkkinen, 1999, p. 21), namely that conflicting opinions between peers elicit learning and provide alternative opinions to their original positions. Furthermore, conflicts between students produce a "conceptual conflict" in a student's mind as the new/other ideas challenge the student's original ideas and create a situation of ambiguity, which leads to "epistemic curiosity" that enhances students' searching and learning (Johnson & Johnson, 2009, p. 343). This process of curiosity fits with the "situational interest hypothesis," which states that formation of this gap in a student's knowledge leads to an increase in the student's interest in exploring the topic further (Schmidt, Rotgans, & Yew, 2011, p. 794). Generally, the students were aware that differences of opinion were not personal conflicts; however, a few students indicated that they avoided these conflicts out of respect for their colleagues' contributions. This raises the importance of the tutor's role in guiding students so that opportunities for learning from knowledge conflicts are not lost.

Effects

Effects of CL processes and activities, presented as the results in "Theme 4: Outcomes," comprise the fourth element of CL (Dillenbourg, 1999) and address the third research aim, about students' goals for group learning and the value of CL. Overall, students in the current study appreciated and valued their collaborative learning experiences in terms of learning in homogenous groups in relation to their group member attributes, having knowledge conflicts, and being involved in questioning and explaining to each other. Only first-year students indicated that learning in groups provided them with social and academic support and simulated their future

work environment. These benefits may be more relevant for first-year students, as many were experiencing their first year away from home.

While students reported experiencing CL in ways that are consistent with theoretical ideas about when it works effectively, they did not always have positive experiences. Students' inappropriate behaviors and heterogeneity in terms of their attributes and approaches toward group work affected their learning negatively. Specifically, students noted that in certain situations their group did not work well, such as when the group had dominant students or group members did not have the same level of motivation and aims. In these situations, students considered that learning in groups was a waste of their time. Moreover, students reported that in group learning, the control of their learning transferred from themselves to the group as a whole. Students considered this a disadvantage, especially if the group activities were not aligned with the learning focus for all group members. Some students considered this effect a consequence of not having the "right batch of people," as this situation led to a less-productive group dynamic. Specifically, not having the "right batch of people" subsequently delayed/changed the progress of their learning compared with learning individually, whereby they could study the required information without having to rely on other group members. As a result, the effects of having negative group dynamics led to a feeling of losing control over learning and wasting time.

Limitations

This study found evidence related to previously identified gaps in our knowledge. However, protocol restraints (e.g., a small sample of students from one program/time and available resources) limit the findings. In addition, students' perceptions of learning collaboratively are likely to be influenced by their previous CL experiences, as part of either their current program or previous programs (Prosser, 2004). A summary of participants' previous CL experiences was not obtained in the current study. Therefore, in subsequent studies, clarifying students' current perceptions about their learning processes and outcomes against their previous CL experiences would improve our understanding of factors necessary to address issues from previous CL experiences and maximize students' learning experiences in subsequent CL settings. The current study used a purposive sampling of volunteers (Coyne, 1997), but they may not be representative of their cohorts (e.g., in the current study, fewer male students participated by

comparison with the first- and fourth-year cohorts). It is known that volunteers in medical education studies are often better-performing students, resulting in positive selection bias (Callahan, Hojat, & Gonnella, 2007). Therefore, these findings must be interpreted carefully. Further exploration of the current findings in a larger sample from more than one program (e.g., using surveys as part of a mixed methods approach) is required to increase the representativeness of these findings across a range of CL contexts (Creswell, 2003).

It is also important to recognize the limitations of FGs in understanding individual thoughts and experiences, as individual participation could be affected by the social context of the FG (Krueger & Casey, 2002). However, in the current study the focus was on students' constructed understandings more than on the individual lived experiences. Therefore, this perspective should reduce the limitation of using FGs. In addition, this study was an exploratory study; hence, a qualitative approach with FGs was appropriate to address the research aims.

Implications for Practice

The findings from the current study have implications for the implementation of CL. These include aspects of student, tutor, and course development. Students may collaborate and learn more effectively in heterogeneous groups if they are supported to develop social and cross-cultural knowledge and communication skills (Johnson & Johnson, 2009; Pearson, 1999). Homogenous groups with regard to CL-appropriate attitudes can develop through enhancing students' interdependence and linking individual success and increasing accountability (Johnson et al., 2007; Slavin, 1996). Staff must monitor workload so that students can balance individual and group study and learning demands, enabling collaboration over cooperation (Dillenbourg, 1999). Tutors/group members need to be supported to monitor group discussion and establish cooperative rather than competitive environments, highlighting the value of managing knowledge conflicts through further questioning, discussion, and elaboration (Aarnio, Lindblom-Ylänne, Nieminen, & Pyörälä, 2014). Students must be supported in their learning interactions and processes, including developing skills in questioning and explaining to each other, managing conflicts in knowledge, and analyzing their underlying thinking, to facilitate their current and future group and individual learning (Johnson et al., 2007). Prosser (2004) indicated that it is important to support students' understandings

of their course design and how that is related to their learning context to improve students' adopted approaches and learning outcomes.

CONCLUSIONS

This study has explained students' perspectives about key factors for facilitating positive learning experiences in an inquiry-based CL context. These include recognizing which aspects of a CL group ought to be heterogeneous and which homogeneous, such as having diverse backgrounds but similar dispositions toward learning in groups; encouraging balanced participation and interactions, especially questioning, explaining, and addressing knowledge conflicts; and helping students to identify and understand their thought-related learning processes. These student perspectives are consistent with key theoretical elements of CL. Assisting students to understand the role of these factors and the consequent positive impact on their learning could improve their CL experiences and outcomes. Further exploration of the current findings across a range of CL contexts is required.

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CHAPTER 6

Breaking the Ice

How Students Present Themselves to the Group in an Interprofessional Problem-Based Learning Context

Sally Wiggins,* Madeleine Abrandt Dahlgren, Mattias Ekstedt, Eva Hammar Chiriac, and Tove Törnqvist
Linköping University, Sweden

The first time that students meet for a problem-based learning (PBL) tutorial is important for setting the framework for the rest of the PBL process (Hempel & Jern, 2000). This occasion typically involves introducing themselves, meeting the tutor, writing a group contract, and starting work on the first scenario or case. When students are working in interprofessional groups—with peers from other educational programmes—there is the additional complexity of establishing common ground while maintaining one's own professional focus. It is within this context of interprofessional health education that the current chapter is based. We provide a discursive analysis of the early moments of the first tutorial in which students introduce themselves to their fellow group members. The research question is: How do students present themselves in the first tutorial of a new PBL group in which they come from different professional programmes? In the remainder of the introduction, we situate this work within a broader theoretical and empirical context of work on interprofessional learning and communication, group formation, and academic identities.

INTERPROFESSIONAL LEARNING AND COMMUNICATION PRACTICES

In health care organisations, interdisciplinary or multiprofessional teamwork is becoming a common way to organize services (Blomqvist, 2009;

* Corresponding author.

Sjøvold & Hegstad, 2008). In medical education, interprofessional learning (IPL) or interprofessional education, in which students work in groups across different medical programmes, is also gaining momentum (Wilhelmsson et al., 2009). IPL has also been combined with PBL (Dahlgren, 2009; Jewell, D'Eon, McKee, Proctor, & Trinder, 2013), since the aims of both approaches are often well aligned. The benefits and challenges of IPL are similar to those of PBL, though there is an additional concern that students should not only learn to become socialised into their own profession but also be able to understand the perspectives of another profession and combine this effectively for the tasks in hand.

A particular challenge noted in the IPL literature is the development of communication practices in teamwork (Thistlethwaite, 2012). Interprofessional communication and collaboration skills are promoted by the World Health Organization as important capabilities that health professionals need to develop during their training in order to facilitate positive patient outcomes and improve safety; IPL is considered an effective approach to accomplishing these objectives (WHO, 2010). The capabilities include being able to communicate effectively and respectfully with colleagues in other professions: to listen, negotiate, manage and resolve conflicts, and explore and respect others' values (Rogers et al., 2017). In other words, students need to learn not only how to work with other professionals but also how to communicate effectively on specific tasks. In IPL tutorials, students must be aware of and have the skills to navigate a task while also working effectively with other students who have different roles and objectives (Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014). At the same time, economic and organisational factors (e.g., Abu-Rish et al., 2012) or occupational or gendered status hierarchies (Bell, Michalec, & Arenson, 2014) can hinder effective group work in an IPL context.

It has been suggested that some of the communication challenges facing health-care professionals may lie within differences in how newcomers are socialized into the practices of professional work (Braithwaite et al., 2016). Some authors claim that nurses are trained to "view the patient from a holistic perspective, which is complex, systems-oriented and steeped in emotional intelligence, while physicians are trained to value an objective/cognitive approach to patient care which is structured, objective and succinct" (Foronda, MacWilliams, & McArthur, 2016, p. 39). These differences are also seen as entangled within hierarchical power relationships that are likely to impact how interprofessional communication

develops. Similar arguments have been put forward concerning how physicians are trained, claiming that the goal of medical education is to professionalise physicians to function under stress, be task focused, and make the right diagnosis. Physicians may be taught to suppress emotions and block 'natural' responses to what they see and what they must do, particularly during residency (MacArthur, Dailey, & Villagran, 2016). Interprofessional communication training therefore plays an important role in building professional identities for physicians, in terms of how different professions can develop a shared responsibility for health care and mutual trust and respect (MacArthur et al., 2016).

Despite the importance of communication in IPL, there is still very little research that examines *how* students work in IPL tutorials and how they develop the skills of working interprofessionally. What does it mean to communicate or interact with students from other professions? To answer this we need to examine the literature on group processes, and it is to this that we turn next.

Group Formation

Within social psychology, research on small groups—such as tutorial groups—has illustrated the ways in which groups develop and mature over a period of time. For instance, Wheelan's (2005, 2009) linear progressive theory describes how groups typically progress through five stages, with each stage corresponding to different group dynamics and efficacy: forming, storming, norming, performing, and adjourning. In this chapter we focus on the early formation stage of a group's life (forming), which is characterised by dependency and inclusion. During this stage group members typically orient themselves to each other and the task, striving for security, acceptance, and belonging in the group. The group can also be highly dependent on the leader, and there is a tendency for caution and courtesy among members within communication practices. This early stage of group development is considered to be important for the effectiveness of the group over a longer period of time. It has been argued, for example, that groups will benefit if, during the formation phase, members show interest in each other without being overly friendly, examine experiences present in the group, and discuss the group objectives and tasks (Hempel & Jern, 2000). In early work using the group formation process as a feature of both the process and content of PBL, what was particularly noted was the speed with which students readily distinguish

themselves as "us" when forming a group (Hammar Chiriac, Rosander, & Wiggins, 2018).

In other social psychological work on groups, it has been shown that the tasks on which students are engaged can also influence the interactional dynamics of the group (Hammar Chiriac, 2008). Group dynamics can then be understood as related to the ways in which task management is organised and develops across tutorials. This combination represents a new way of categorising group processes; it provides a better understanding of interactional dynamics in groups and provides greater explanatory value with respect to group processes. Furthermore, Sjøvold's (2007) work using spin theory has considered interdisciplinary teams in hospitals and the effects that existing professional stereotypes and dominance can have on group performance and the quality of work.

Despite evidence from group research that the formation or early stages of group interaction can be important for the outcomes of group work, there is still minimal guidance on how to manage the first tutorial of a PBL course. While suggestions have been made (e.g., Duch, Groh, & Allen, 2001; Azer, 2005) about how to introduce PBL as a concept to students, there is no known literature on the way in which the interactional dynamics of the first PBL tutorial might be managed. Exceptions include observations of tutorials that have illustrated how the tutor can be a model or scaffold for students' learning processes and how the students are often highly focused on the tutor in the initial stages (Lycke, 2002). The emerging picture from social psychological research, however, is that the early stages of group development can be crucial to how that group proceeds (Wheelan, 2005). How we start, then, is important for how we continue. In terms of the IPL challenge of learning to communicate with other professions, we need to investigate how those early moments of group work are negotiated interactionally.

Academic Identities in Interaction

To summarise, we have noted that one challenge of IPL is to maintain one's own professional identity while communicating and working with peers from other disciplines. Research into group formation also notes the importance of the early moments of group work for the way in which a group can develop and a tendency in the first instance for there to be more polite conversation and reliance on the tutor to guide the interaction. A final theoretical issue of relevance here is research on how academic

identities are managed interactionally and how students might refer to themselves *as a student* or as a *particular kind* of student when working with fellow students.

It was noted earlier that one of the outcomes of IPL is for students to become socialised into a professional practice, to learn the values, roles, and goals of their profession and their own transition in this process. There is a transition process from higher education to working life (Abrandt Dahlgren & Hammar Chiriac, 2009), and regular PBL tutorials can be a central part of how this process becomes manifest. The literature on professional identities at times blurs the distinction between identity as a lived experience or cognitive state and as an interactional or discursive achievement. Identities can be understood, therefore, as something fairly fixed or more transient: as an experiential state (e.g., Frost & Regehr, 2013) or as a discursive framework (e.g., Traynor & Buus, 2016). In this chapter we use a discursive approach to identities (Benwell & Stokoe, 2006), in which one's identity is accomplished through discursive practices, such as talking *as* a student or being *characterised* as a student in talk or text. That is, we focus on the social interaction as a context within which identities are enacted or produced in talk, without making any claims about cognitive or experiential states.

The literature on discursive and interactional research has begun to examine academic identities in particular. Academic identities are defined as those that foreground educationally relevant concerns (being engaged in learning activities, having knowledge, attending classes, and so on). These are the ways in which students "do being a student amongst other students" (Attenborough & Stokoe, 2012; Stokoe, Benwell, & Attenborough, 2013). The emergent literature on native-English-speaking students in UK institutions has shown how, when interacting with their peers, students often resist or ironise their academic credentials (Stokoe et al., 2013). They "play down" their achievements, attending to norms against self-praise and boasting (Pomerantz, 1978). When considered in an interprofessional context, these academic identities might highlight a specific profession (being a physiotherapist or nurse, for example), since they are not all engaged in the same education (Adams, Hean, Sturgis, & Macleod, 2006). In this chapter we refer to "professional identities" as those instances in which students refer to themselves or their activities in a way that specifies a particular educational programme. This does not preclude the use of more generic academic identities, but rather suggests that there is a way in which

identities can be negotiated to differentiate between different kinds of academic identities. Our concern here, therefore, is to examine how students discursively manage their identities—professional or otherwise—in an interprofessional context. How do students present themselves in the first tutorial of a new PBL group when they come from different professional programmes?

METHODS

The data for this chapter are taken from around 50 hours of video-recorded PBL tutorials in an IPL programme in a medical faculty at a Swedish university. Full ethical approval to record the tutorials and use sections of the anonymised data (transcripts and still images) in publications was provided by participants and the local authority. Data are in Swedish and translated into English. This context involves medical and health professional students (from doctor, nursing, physiotherapy, occupational therapy, and speech therapy programmes) in their first year at university working together in groups using PBL for six weeks. In total, four groups of students, each with between 7 and 9 students (30 students in total), were video-recorded during each of their seven group meetings. The students taking part in these tutorials had been studying in their respective programmes for less than six months. Some of them had met in the days before the tutorial, but this was the first time they had met together as a PBL tutorial group with their tutor.

Two or three video cameras were used to record each group in order to capture different angles and the physical orientation of group members, as well as to deal with any technical failures. During the first group meeting, cameras were switched on after the students and tutor had entered the room and returned the consent forms to the researcher, who then left the room to limit intrusion into group processes and to maintain a more naturalistic setting. The collected video data were later transcribed orthographically and translated into English; para- (intonation, pauses, etc.) and extra-linguistic (eye gaze, hand gestures) features were then added to those sections that were analysed in detail (see the Appendix for transcription conventions). The analysis in this chapter is based on data taken from approximately the first 20 minutes of each of the first group meetings. Discursive psychology (Edwards & Potter, 1992; Wiggins, 2017) was

the analytical approach employed, as it enables a focus on how identities are constructed and negotiated discursively (Benwell & Stokoe, 2006). Discursive psychology theorises psychological issues (such as identities) as primarily socially organised rather than as reflecting mental states or cognitive processes.

ANALYSIS

We consider each of the four PBL groups (labelled A to D) in turn, illustrating how the introductions were structured and how the students presented themselves. While there were differences in how this was managed, what was common across the groups was that each student was asked to say something about himself/herself so that the participants could "get to know" each other as a group. This kind of ice-breaking activity is recommended in PBL guidance (e.g., Duch et al., 2001), but as yet we know of no other research that examines the interactional details of how this process occurs in practice.

Group A

In this group, the tutorial begins with the tutor outlining the activities planned for this meeting (introductions, group contract, the case) and asking the students to write their names on paper to help her remember them. She then initiates the introductions by stating her work role and providing a detailed account of her hobbies. She asks the students if there is anything else that they would like to know about her, and the student seated directly to her left (Jonathan) asks about her favourite food. The tutor then verbally suggests the students continue the introductions, using only minimal eye gaze and head-turning movement to prompt one of the students seated immediately beside her:

Extract 1

1. Tutor: .pt o↑kej: (0.4) >ska vi< gå vidare?
   .pt o↑kay: (0.4) >shall we< move on?
2. (3.6) *((tutor looks down at notebook,*
   then looks briefly right and left; see Figure 6.1))
3. Jonathan: >ska jag köra<
   shall I go

4. Tutor: ja [nån (.) tack
yes [anyone (.) thanks
5. Jonathan: [ah (0.2) °mm° (0.2) ja
[ah (0.2) °mm° (0.2) yes
6. (0.2) Jo[nathan heter jag
(0.2) my name's Jonathan
7. August: [°£hh£°
[°£hh£°

Despite being one of the more vocal students in the group so far, Jonathan's first turn in the introductions round is still tentatively achieved. During the long pause (line 2), the tutor looks down at her notes, and some of the students glance down at their own work, though many continue to keep their gaze on the tutor. The tutor then turns her head briefly to the student immediately to her right, and then to her left, with some of the students also following her gaze (see Figure 6.1). While the student on her right does not directly meet her gaze, Jonathan looks up at the tutor as she looks at him. He then utters "shall I go" (line 3) and thus initiates the student introductions. While there is no verbal selection of the next speaker, the eye gaze of the tutor serves as an embodied means through which the student could then take the opportunity to self-select (Lerner, 2003). Since the student on the right of the tutor does not make eye contact at the moment when the tutor looks in her direction, the floor is open to the other student seated immediately on her left instead.

We can also note that Jonathan's turn is a request for clarification that he is the implied or suggested next speaker. By formulating his turn in this way, he directs it as a question to the tutor rather than as an a priori expectation that he has the right to go next. In terms of the sequence of the interaction, the head turn and eye gaze of the tutor might be seen as

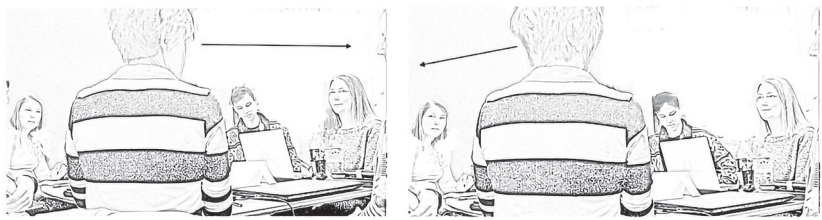

Figure 6.1 Tutor turns head; line 2 in Extract 1.

the first-pair part of selecting a speaker, and Jonathan's turn is then the second-pair part as the response (Fasel Lauzon & Berger, 2015). The tutor then simultaneously confirms that he can continue, but not that he was specifically selected ("yes, someone, thanks"; line 4). The quiet laughter particle and smiling from August (line 7) also potentially orient to the ambiguity of Jonathan's first move here and the tutor's reception of this ("thanks"). While there was no verbal discussion of who should begin the student introductions, the use of eye gaze enabled the students to pick up on potential cues for next-speaker selection and in so doing avoid making the first move themselves (Fasel Lauzon & Berger, 2015; Lerner, 2003). As also noted in models of group formation (Wheelan, 2005), the students are visibly focused on the tutor (who in the first PBL tutorial, at least, is more likely to be regarded as the leader) and look to her to guide the group discussion.

Following this introduction, the students then proceed in a clockwise direction to introduce themselves. Many of them pick up on issues raised by the tutor—the types of exercise they do, the food they enjoy—and for some of them, their profession is stated alongside the first things they say about themselves. Extract 2 immediately follows from Extract 1:

Extract 2:

1.	Jonathan	(0.2) eh:: (.) pluggar läk första terminen (0.8)
		(0.2) eh:: (.) studying medicine first semester
2.		19 år gammal (.) eh gillar också att träna
		19 years old (.) eh also like to exercise

Extract 3:

1.	August	eh ja (.) jag heter August och jag är 20 år
		eh yeah (.) I'm August and I'm 20 years
2.		gammal kommer från: eh (.) från (City) (0.4)
		old, come from eh (.) from (City) (0.4)
3.		eh går också T1 på läk som Jonathan
		eh also in first semester medicine
		like Jonathan

In this instance, the mention of the professional programme is part of a list of things to say about themselves: their age, where they come from, what they are doing. In Jonathan's case, it is the first thing mentioned after his

name. As such, it is treated as a relevant piece of information for the rest of the group to know, as a way to situate themselves within the group context. In Extract 2, Jonathan's "also like" phrase makes an association with the tutor's expressed interest in exercise and is a way to initiate a commonality that reaches beyond the tutor-student distinction. In Extract 3, August does something similar by making a connection with Jonathan using the same abbreviated "läk" (line 3; short for "läkare," which translates as doctor or medicine programme in this context) and thus orients to a shared professional identity from the very start.

Not all introductions in this group, however, place the educational program first. In Extract 4 Selma mentions her study programme just as she is finishing off her introduction. Again, we see the management of shared interests (exercise) and the construction of a "doing being normal" identity with hobbies such as exercising and reading:

Extract 4:

1.	Selma	annars gillar jag att typ träna, (0.4) läsa,
		otherwise I like to, sort of, exercise (0.4) read
2.		(2.0)
		(2.0)
3.	Selma	ah-
		yeah-
4.		(1.0)
		(1.0)
5.	Selma	>sjuksköterska programmet med< (.) än-
		with the nursing program (.) but-
6.	Jonathan	>hhmm<
		>hhmm<
7.	Selma	om ni inte visste det
		if you didn't know it

Not only is the mention of the nursing programme tagged onto the end of Selma's introduction, but the way it is formulated ("with the nursing program"; line 5) further reduces the student's agency. That is to say, one can be "with" a program or "studying for" a profession or be "as" a profession; different ways of formulating the professional program can serve to increase or decrease the sense in which one's own identity is connected with

the profession. As students at the start of their education in this particular field, it would be difficult to claim that they "are" a nurse, or a physiotherapist, and so on. They have limited rights to be able to make those claims, but how they do present themselves is noticeable within a group in which others come from related but very distinct fields.

To briefly summarise Group A: the tutor began the presentations round with a fairly lengthy and anecdotal account of her own work and hobbies, then used a combination of eye gaze and an open verbal invitation to direct the continuation of the introductions toward the student immediately on her left. The students then presented themselves individually, with most (but not all) referring to their professional identity as one of a list of things to say about themselves, thus highlighting their hobbies as much as their academic affiliation.

GROUP B

Group B demonstrates a similar structural pattern to Group A, in that the tutor begins by telling the group what tasks they will be doing that morning (introductions, group contract, coffee break, then first case). She then says "I can start" and provides a fairly lengthy introduction about her research projects and interests, as well as different jobs that she has had in her career. As the tutor in Group A did, she uses anecdotes or small details about her varied career and interests, some of which the students briefly comment on. As she says "presentations round," she makes a circular, clockwise movement with her hand (starting with Ludvig, seated immediately to her left; see Figure 6.2).

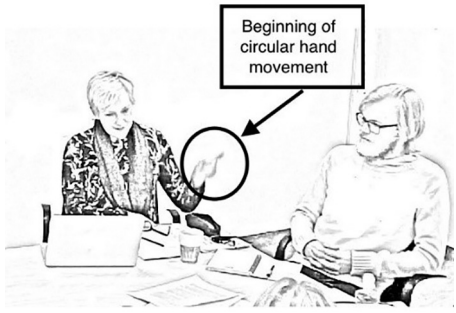

Figure 6.2 Tutor makes circular hand movement.

Once she has completed the hand gesture, the tutor suggests that they also write down their names to help her remember who they are. Another student briefly comments on the interesting things she has done, and then after a brief pause, the move to the student introductions begins at Extract 5:

Extract 5:

1.	Tutor	ah?
		yeah?
2.		(1.0)
		((Tutor looks at Ludvig, see Figure 6.3))
3.	Tutor	kan du [börja (0.4) Ludvig
		can you [*start (0.4) Ludvig*
4.	Freja	[heh heh
		[*heh heh*
5.	Ludvig	ah- jag kan fortsätta då
		ah- I can continue then
6.	Tutor	mm,
		mm
7.	Ludvig	eh: (0.4) i min: (0.6) bas:grupp (.) andra basgrupp
		eh (0.4) in my (0.6) tutorial group (.) other tutorial group
8.		av nån anledning så går vi åt andra hållet
		for some reason we go the other way around
9.		(.) jag vet [inte varför
		(.) *I don't know why*
10.	Freja	[just det jus-
		Right, right
11.	Hanna	[heh heh
		Heh heh
12.	Ludvig	de:t (.) så: (0.2) ja- jag tycker man ska gå
		it (.) so (0.2) I- I think you should go
13.		med klockan
		clockwise

Despite the tutor's earlier preemptive hand gesture, direct eye gaze, and verbal request, Ludvig still does not begin without first confirming ("I can

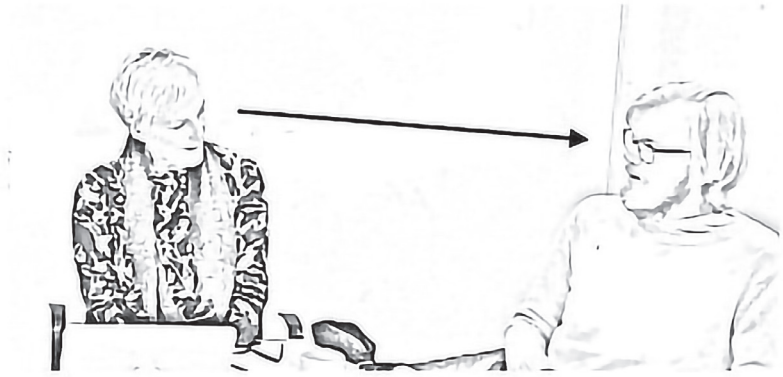

Figure 6.3 Tutor looks at Ludvig.

continue then"; line 5). He also glances briefly at the tutor, then back to straight ahead, then back to the tutor immediately prior to this turn. Unlike many others in the group, he was not already looking directly at the tutor, so this flicked eye movement then signals a visible "check" of where the discussion is heading. Once Ludvig has the floor, he continues to manage the assumption that he should go first. In fact, his use of the term "continue" rather than "start" groups together his introduction as the second rather than the first (thus including the tutor as part of the group presentation round). The additional "then" ("då" in Swedish, often used to soften the directness of an utterance) contributes to this construction as a suggested follow-up of the tutor's introduction rather than an assumed place in the conversational order. Ludvig then provides an account (lines 7–9) of how the introductions in his other tutorial group went in a counterclockwise direction, thus also potentially accounting for why he may have expected not to be the next speaker. In combination, the flicked eye gaze (rather than already watching the tutor and so visibly expecting to go next), the "I can continue then," and the brief account of whether it should go clockwise or counterclockwise all help to manage the delicate situation of "going first."

The student introductions then continue to highlight their study programme and other education or work previously conducted. Mirroring the tutor's account of career changes, some of the students note how they made a specific move from a different programme to their current one. We return again to Ludvig's introduction:

Extract 6

1.	Ludvig	sen: (0.6) ja- jag har alltid velat bli läkare
		then (0.6) yeah- I have always wanted to be a doctor
2.		(0.6) och: (0.4) ja sen jag var- (0.2) så länge jag
		(0.6) and (0.4) yeah since I was- (0.2) as long as
3.		kan minnas i princip (0.4) och nu kom in
		I can remember basically (0.4) and now come into
4.		på läkareprogrammet då (0.2) efter jag har
		the medicine programme then (0.2) after I had
5.		jobbat: (0.4) ett långt tag inom hemtjänsten
		worked (0.4) a long time in the home service

Extract 6 presents the almost iconic phrase "I have always wanted to be a doctor" (line 1), which, as the first of the students to present themselves, is rather a bold move to make. In Group A, for instance, it was common for students to only mention which programme they were taking as part of a list of things to say about themselves. By contrast, Ludvig begins with details about his age and where he comes from, and then, after a reasonable pause, begins the section that we see in Extract 6. This part of the introduction acts as if it were an additional piece of information rather than the first thing to know about him. A similar pattern is noted with another student in Group B:

Extract 7

1.	Freja	umgås med kompisar *((laughs))* kolla på serier och-
		hang out with friends ((laughs)) watch TV series and
2.		(1.4)
3.	Freja	så där (0.4) jah, (0.2) vad ska man saga mer (0.2)
		like that (.4) yeah (0.2) what should one say more (0.2)
4.		eh:m (0.4) jag vill också bli barnmorska
		eh:m (0.4) I also want to become a midwife

Immediately prior to this extract, Freja has stated how old she is, where she has lived, and her hobbies. As with Ludvig in Extract 6, her announcement

about what she wants to become is tagged on after a reasonable pause (line 2) and a voiced "what should one say more" (line 3), as if trying to think of what to say next. In Extracts 6 and 7, not only do both students reveal something that puts themselves forward as having a particular professional identity, but they do this at just the point when their turn might have passed to the next speaker. This works well to manage the potential that they might be treated as "taking this too seriously" or as asserting their professional identity over other shared, common interests such as hobbies or sports (Stokoe et al., 2013). As in Group A, Freja here connects with the tutor's stated career history (working as a midwife) with the use of the word "också" ("also"; line 4) and thus helps to make her stated professional aspirations about what they have in common, rather than what Freja is specifically interested in.

In Group B the tutor's detailed account of her working life and career provided an interactional space in which the students could (and did) construct their professional identity beyond the "I'm studying nursing" type of statement. Even so, when students did orient to such an identity, they did so in a way that appeared as a more casual statement, mentioning this after information about their hobbies or where they had lived. This allowed them to situate themselves both professionally—as following distinct career paths—and as just another student in a PBL group.

Group C

The structure of the introduction is rather different in Group C. The tutor has begun the process in which she asks the group members to introduce themselves, but she does so by writing on the whiteboard (see Figure 6.4) a list of things that the students should say: name, educational programme, where they live, any jobs outside of university, hobbies, special career interests, what they would do if they won a million kronor, or what animal they would choose to be. The list therefore includes both professional and private life examples, as well as more unusual things to talk about.

This process takes some time; a few minutes pass in silence as she writes this list, reading it aloud as she does so. Those students facing the board watch the tutor for some time, while those whose backs are to the board (see Figure 6.4) typically look down at the table or sporadically turn around to look at the board. Soon after the tutor returns to the table, she invites one of the students to begin:

Figure 6.4 Tutor writes on the board.

Extract 8

1.	Tutor	mm (.) vem vill börja då
		Mm (.) who wants to start then
2.		(2.0)
3.	Lovisa	.tch ah jag kan börj(hh)ar (.) eh (jag) heter
		.tch ah I can sta(hh)rt (.) eh I'm
4.		Lovisa jag är från (*city)* men bor här
		Lovisa I'm from (city) but live here
5.		i (*town)* i (*specific area)*
		in (town) in (specific area)

Of all the introductions, this is perhaps the one that is most risky for the group members in terms of putting themselves forward to "go first." Note that—in contrast to Groups A and B—both the tutor and Lovisa refer to this being the start rather than a continuation of the introductions (lines 1 and 3), since the tutor has not yet given her full presentation. At the beginning of the tutorial, the tutor has briefly noted that she knows Lovisa from

a previous group. This then provides for Lovisa to be the one to step forward and take the lead. We can also note the interpolated or plosive laughter on line 3, positioned in exactly the word that is potentially troublesome, start ("börjar"); not only does this mark a source of interactional trouble, but it also manages a speaker's stance on this (Potter & Hepburn, 2010). In other words, it enables Lovisa to use the same term as the tutor, rather than reformulating it (e.g., by using "continue"), as well as to orient to the term as a delicate interactional matter without directly stating this. What is noticeable, however, is that there is no checking with the tutor—no further tutor input at this point—and so while Lovisa slightly ironises her initiation of the task, it is not so tentatively achieved as in Group A or B.

Lovisa then continues to state her educational programme, in line with the list on the whiteboard, and so the student follows a more structured way of introducing oneself than was seen in Groups A and B:

Extract 9

1.	Lovisa	ah- jag pluggar till SSK asså sjuksköterska
2.		*yeah, I'm studying in SSK, I mean nursing*
3.		(.) eh (.) har även pluggat och pluggar
4.		*(.) eh (.) have also studied and study*
5.		medicinsk biologi
6.		*medical biology*

The immediate reference to the professional programme—in this case, nursing—is therefore likely to be strongly influenced by the list on the whiteboard, where "education" is top of the list. As in Extracts 2 and 3, the shortened version of the programme ("SSK," short for nursing in Swedish) is used before stating the name in full. In this interprofessional context, then, students are already aligning with a professional identity, however minimally that may be. The shift from the abbreviation (SSK) to the full name (sjuksköterska) then also orients to the others in the group; this would not have been necessary in a group in which all students were studying in the same programme. Following Lovisa's introduction, the tutor then repeats her name and her education ("Lovisa, SSK"), which she says will help her to remember each person in the group. That this is a larger group, with nine students, is one of the reasons the tutor uses to highlight the difficulties in remembering details about everyone.

The rest of the students in this group then follow the same pattern, checking regularly with the list on the board, and almost all start with their names and professional programmes, for example:

hm jag heter Anna: (.) går sjuksköterskeprogrammet
hm I'm Anna (.) studying nursing

jag heter Ellinor (.) pluggar läkarprogrammet
I'm Ellinor (.) studying medicine

eh jag heter Wilma och går på sjuksköterskeutbildningen
eh I'm Wilma and studying nursing education

ah heter Adam och går läkarprogrammet
ah I'm Adam and studying medicine

Note that there are variations in the verbs used in Swedish (går, går på, pluggar), but the English translation is the same for each. Through the combination of the whiteboard list and the explicit repetition by the tutor of the first student's name and study programme, the structure of the introductions has been reinforced to include the professional identity immediately following the students' names. In the same way that a hometown or nationality can become a way to introduce oneself (e.g., I'm Anna and I'm from Sweden), so here the close association between name and professional identity is established in this first meeting of the interprofessional programme.

The pattern in Group C is notably different from those of Groups A and B. The students, without exception, provide information on each of the points noted in the list on the whiteboard. At times this feels mechanical, as if checking off items rather than providing interesting personal details, though there are points at which a student refers to an interest similar to a previous speaker's. While the list includes specific career aspirations—and so technically provides an opportunity for students to assert a professional identity—most of the students say that they don't know what they specifically want to focus on in their careers.

Group D

In the final group, the pattern is different again. Here the tutor opens the tutorial with a very brief "my name is" introduction, before saying that

Figure 6.5 Tutor gestures toward Carolina.

they will begin with a brief presentation round. As in Group C—and in contrast to Groups A and B—the students do not hear much about their tutor before they are asked to say something about themselves. In this case, they are asked only to say one thing about themselves. Instead of asking for volunteers, the tutor instead uses a hand gesture toward the student on the right (see Figure 6.5) as a direct nonverbal request for the next speaker:

Extract 10

1.	Tutor	man kan säga (0.6) sitt namn och säga en sak som
		one can say (0.6) their name and say one thing
2.		de tycker om
		they like
3.		(1.0) *((tutor gestures to Carolina; see Figure 6.5))*
4.	Carolina	eh: ja (0.4) jag heter Carolina (0.2) och jag gillar
		eh yeah (0.4) I'm Carolina (0.2) and I like
5.		att rita
		to draw
6.		(1.0)
7.	Tutor	mm
8.		(1.0)
9.	Mattias	jag heter Mattias (0.4) jag gillar ehm:: (0.6) se på film
		I'm Mattias (0.4) I like ehm:: (0.6) to watch movies
10.		(0.8)
11.	Tutor	mm
12.		(0.6)
13.	Rose	eh:: jag heter Rose (0.8) ehm jag tycker om att laga mat
		eh I'm Rose (0.8) ehm I like to cook

14.		(1.0)
15.	Rasmus	jag heter Rasmus (.) jag tycker om opera och piano *I'm Rasmus (.) I like opera and piano*
16.		(0.8)
17.	Tutor	mm
18.		(1.0)
19.	Ulrika	jag heter Ulrika (.) jag tycker om att resa *I'm Ulrika (.) I like to travel*
20.		(1.0)
21.	Stina	jag heter Stina och jag gillar: (.) djur *I'm Stina and I like:: (.) animals*
22.		(1.0)
23.	Tutor	mm (.) jag heter Natalie och jag gillar balett *mm (.) I'm Natalie and I like ballet*

This form of introduction is thus very different from the previous three groups'. The presentation of all of the students and the tutor lasts less than 1 minute, in contrast to around 10 to 15 minutes in the other groups. While the tutor asks them to state only one thing they like, it is clear that each of them chooses something that could be defined as a hobby or nonwork activity, and this pattern is adhered to for the whole group. While this does not allow for any expansion on their experiences or interests, it does allow the group to very quickly learn one thing about their fellow group members that they might not otherwise have known.

The tutor then talks through some practical issues—as happens in the other groups—such as stating her phone number, so that they can contact her if needed. She then introduces an "ice breaker" in which the (inter) professional identities are explicitly introduced. On the whiteboard, the tutor draws a circle and marks sections to demarcate the different professional programmes; the students are then each asked to say their names when she reads out the different programmes. The circle, she notes, then represents some of the things that they have in common and some things that they will bring in terms of specific knowledge.

In Group D the structure of the introductions is clearly guided by the tutor and delays any reference to the professional programmes until the interprofessional focus of the group work is discussed more explicitly. The tutor sets the limits regarding what can be said by the students, and her own introduction is then provided after the students'. There is minimal opportunity for the students to claim a professional identity at this point.

DISCUSSION

The analyses presented here provide a unique insight into the opening moments of the first PBL tutorial in an IPL programme. While each of the groups demonstrated different ways of structuring the introductions, a common pattern was that the students' responses closely followed those of the tutor. This occurred not because the students were asked to respond in a particular way (they were told directly in Groups C and D what to say, but not in Groups A and B), but rather because the tutors provided the interactional context in which one or other type of response was appropriate. The students therefore presented themselves in a manner that was provided for by the tutors and that maintained a fairly normative pattern to not overtly position oneself in a professional identity over an academic identity. In other words, "being a student" seemed to be the norm in this context over "being a student from a specific professional programme." Within this broader framework, finer patterns could be identified, such as the delicate multimodal management of being the first to speak through gestures or eye gaze and whether one's professional identity was included in a list of relevant items or as a feature in itself.

These findings provide support for research noted in the introduction. First, they add further evidence for work on group formation (Hempel & Jern, 2000; Wheelan, 2005), which notes that in the early stages of group development, members are likely to be more cautious and guided by the leader in terms of what is appropriate. Second, they contribute to research on academic identities and the risks of being treated as "too engaged" in the academic process (Stokoe et al., 2013). Not only does the analysis demonstrate that members might be more cautious in their conversational practices, but it also begins to show *how* this cautiousness was achieved interactionally. Finally, in terms of the literature on communication in IPL contexts, our analysis suggests that in these early stages of the tutorial group, professional identities were not so prominently discussed nor visible. We speculate that it might be during later stages of group development that these identities would become more apparent. At that point, it may be a greater concern to understand how one's role fits with that of other group members, and at that point conflicts are more likely to arise. There is therefore much to be done in terms of examining further moments in which students' professional knowledge or identities are made relevant and consequential in PBL interaction. This would be useful both for IPL programmes, in which the explicit aim is often to create a more effective and cooperative working environment, and for PBL

more generally. One of the benefits of recording a number of PBL groups for the duration of their course is that we can examine group and interactional processes as these develop over time. Recording multiple groups also enables a comparison of how groups can vary even when engaged in apparently identical tasks. Further research into PBL might then consider how to develop a collection of examples that could then drive forward research into the longitudinal processes that can be difficult to see in "snapshot" studies of brief moments from one PBL tutorial.

We also see considerable potential in the development of collaborative research within and across disciplines to enable new theoretical and practical insights into PBL tutorial interaction. There is a considerable divide between social psychological research into group processes and PBL research (Öystilä, 2006; Wiggins, Hammar Chiriac, Larsson Abbad, Pauli, & Worrell, 2016). Our own research aims to bring together research on group formation processes with discourse and interaction research to examine how the mechanics of introducing oneself to the group can illuminate these broader processes, and we hope to have begun to illustrate not only the potential of interactional analyses but also the combination of this with other areas of research.

CONCLUSION

Our analysis begins to detail how the early moments of a PBL tutorial group are managed interactionally. It can be challenging to put oneself forward as a student in an interprofessional context, so it is much less problematic if the tutor initiates this discussion. If not, it can be much more difficult interactionally for students to take the initiative and introduce new points of interest. Similarly, by suggesting that introductions be "in the round" (i.e., one person at a time, starting with a student sitting next to the tutor and moving around in a circle), and through subtle eye gazes or hand gestures, tutors can provide the interactional cues necessary for the students to speak out without appearing to be taking the lead.

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APPENDIX: TRANSCRIPTION CONVENTIONS (Adapted from Hepburn & Bolden, 2017)

(.)	a micropause of less than two-tenths of a second
(0.4)	a silence measured in tenths of seconds
[	the onset of overlapping talk
£	smiley voice
°yeh°	quiet speech enclosed in degree symbols
?	clear rising intonation at the end of a word
,	slightly rising intonation
hh	audible outbreath
(hh)	plosive laughter within a word
heh	laughter particle
>yeah<	speeded up talk
<right>	slowed down talk
yeah-	cut-off sound indicated by a hyphen
eh::	stretched sounds within or at the end of a word
(city)	anonymization of specific details
((tutor))	comments on the transcript

CHAPTER 7

Interactive Discourse in Interprofessional Tutorial Groups

Dealing With Conflicting Views and Meaning Construction

Rintaro Imafuku, Chihiro Kawakami, Takuya Saiki, Masayuki Niwa, Yasuyuki Suzuki, and Kazuhiko Fujisaki
Medical Education Development Center, Gifu University

INTRODUCTION

In a clinical setting, interprofessional collaboration is a practice in which individuals from two or more professional backgrounds meet, interact, learn together, and/or practice, with the client at the center of care (Prentice, Engel, Taplay, & Stobbe, 2015). The World Health Organization (2010) highlighted a significant role played by interprofessional education and collaborative practice in mitigating many of the challenges faced by health systems around the world, concluding that working in interprofessional teams is critical to the provision of safe, efficient, high-quality, patient-centered care that meets the complex needs of aging, globalized societies. However, studies have revealed that health professionals often encounter barriers to successful interprofessional collaborative practice, such as difficulty in sharing the vision of an organization within which the collaboration takes place, leadership ambiguity and power relationships in teams, and individual motivation (e.g., van Dongen et al., 2016).

To address societal needs and overcome barriers and allow interprofessional practice to flourish, the importance of providing interprofessional learning opportunities for students in health professions education, including both pre- and postqualification programs, is evident. The purpose of interprofessional education (IPE) is to develop the knowledge, attitudes, and skills needed for interprofessional decision making, problem solving, and collaboration (Barr, 1998; Ross & Southgate, 2000). In fact, a growing number of institutions have incorporated IPE into their undergraduate

curricula to help students develop explicitly as future interprofessional team members. IPE is defined as occasions when "two or more professions learn with, from and about each other to improve collaboration and the quality of care" (CAIPE, 2002).

In IPE, student-centered interactive strategies are commonly adopted as key teaching and learning strategies; in particular, inquiry-based instructional approaches related to problem-based learning (PBL), case-based, team-based, and project-based learning have been viewed as best-fit ways to deliver IPE (e.g., Chan et al., 2017; Thompson, 2010). In interprofessional PBL, students from different professional fields are expected to engage in group discussion to identify and solve problems regarding a patient and/or his/her family members as described in case scenarios. Interprofessional PBL shapes students' learning processes and ways of contributing to discourse and creates a highly interactive dynamic in tutorial groups (Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014).

Previous studies have contributed to evaluation of learning outcomes of PBL, such as attitude toward interprofessional teams and patient-centered care proficiency (Darlow et al., 2015) and improved self-efficacy (Nørgaard et al., 2013). However, as Reeves et al. (2016) showed in a systematic review, most studies on learning outcomes of IPE have used a quasi-experimental or experimental research design; although quantitative research methodologies are useful for establishing the effectiveness of an IPE intervention, they cannot provide a rich description of the complexities of teaching and learning processes in IPE from an emic perspective. In particular, little is known from a classroom discourse perspective about the process by which students from different disciplines collaboratively solve the care problem and negotiate social roles in an interprofessional group. Within the small body of process-driven studies on interprofessional PBL, our research team (Imafuku et al., 2014) identified two main interaction patterns in knowledge building: (1) coconstruction between students from different disciplines and (2) elaboration between students from the same disciplines. This study aims to further explore student participation patterns during interprofessional PBL tutorials, including collaborative processes of constructing knowledge and dealing with conflicting views. To do this, we developed the following research questions.

1. How did students from different fields of study work together and deal with conflicting views to develop a treatment and care plan for a patient?

2. What learning outcomes did they perceive they had achieved through the process of interprofessional learning?

METHODS

Setting of the Study

Gifu University provided a voluntary, extracurricular, two-day case-based seminar on interprofessional care for undergraduate students, which was developed by 16 academic staff members from five institutions of medical and health sciences and was open to students from those institutions (Kawakami et al., 2015). To recruit as many student participants from the institutions as possible, whoever was interested in learning interprofessional collaboration was welcome in this extracurricular seminar. As a result, in the 2013 seminar, 38 students (from year one to year four) from seven different disciplines participated (see Table 7.1). They had not been offered any previous formal IPE. All the participants consented to participate in this study.

This IPE seminar consisted of three tutorial sessions, each of which lasted 75 minutes (see Figure 7.1). The theme of the basic scenario, carried across these three tutorial sessions, was Lewy body dementia. Academic staff members were asked to take on the tasks of time management and promoting effective group functioning if needed. The goals of the seminar were to construct a treatment and care plan for a patient

TABLE 7.1 *Participants in the IPE Seminar*

			Gender		Year			
Discipline		*n*	Male	Female	One	Two	Three	Four
1	Medicine	6	4	2	1	2	1	2
2	Nursing	4	–	4	–	–	4	–
3	Pharmaceutical sciences	6	1	5	–	–	–	6
4	Dentistry	1	–	1	–	–	1	–
5	Dental hygiene	8	–	8	2	–	4	2
6	Physical therapy	7	4	3	–	–	7	–
7	Occupational therapy	6	2	4	–	–	6	–
Total		38	11	27	3	2	23	10

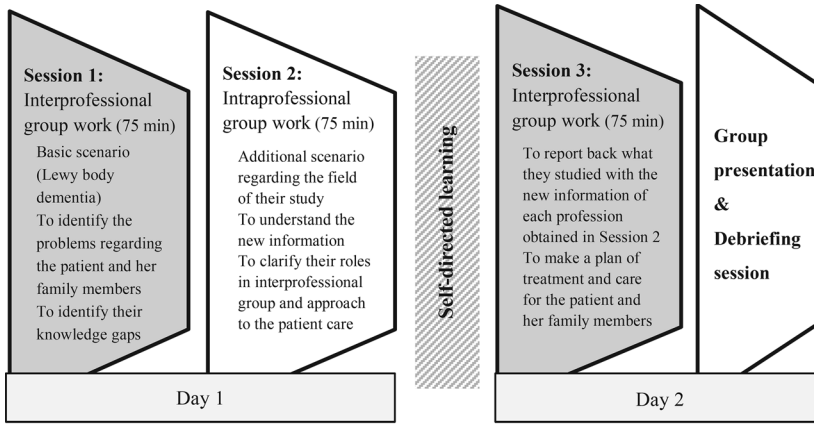

Figure 7.1 Process of the IPE seminar.

and a support plan for her family members through discussion in an interprofessional group.

In session 1, 38 students were allocated into five interprofessional groups to discuss the patient's problems, which were described in a clinical scenario on Lewy body dementia (see Appendix 1) and task materials, such as blood and urine test results and X-ray images. Through sharing knowledge related to the theme with members from other disciplines, they were expected to gain various perspectives on the patient's problems. Furthermore, they were encouraged to identify gaps in their knowledge.

In session 2, the students were regrouped and allocated into six intraprofessional groups (i.e., medicine, nursing, dentistry and dental hygiene, pharmaceutical sciences, occupational therapy, and physical therapy). The tutorial rooms were reassigned to accommodate these different groups. In this intraprofessional group work, students were provided with additional information related to their particular discipline (see example in Appendix 2). This session was important for students (particularly those in years one or two), not only to obtain the disciplinary knowledge that could be used to find a solution to the problem but also to have a chance to discuss the roles of their professions and their own approaches to the patient with tutors and their peers. After session 2, we encouraged students to conduct self-directed learning on the identified issues, which included complex interdisciplinary problems.

In session 3, conducted on day 2, students returned to their interprofessional groups from session 1, where they were asked to share what they

had discussed in session 2 (i.e., intraprofessional group work) and what they had found in their self-directed learning. Subsequently, they were asked to create a patient-centered care plan as a product of learning in this seminar. At the end of the seminar, we offered students an opportunity to present their care plans to the full seminar group (38 students and 15 staff members).

Data Collection and Analysis

This study was part of a wider IPE research project. The analysis presented in this chapter focuses on students' participation in the interprofessional group (student n = 8) in sessions 1 and 3. Purposive sampling was used to select a typical case of student interaction in this seminar based on criteria of gender, areas of study, and year of school. All participants' first language was Japanese, as was the medium of instruction. The participants' demographic data are provided in Table 7.2.

The three successive PBL tutorial sessions were video-recorded, and all video material was watched and transcribed by the first author; the transcription symbols used in this study were adapted from Jefferson (1984) and ten Have (2007) (see Appendix 3). Drawing on the analytical procedures developed by Aarnio, Lindblom-Ylänne, Nieminen, and Pyöräla (2013), this study analyzed the transcripts on two levels: utterances and episodes. van Boxtel, van der Linden, and Kanselaar (2000) defined an utterance as an individual message unit that is distinguished from another utterance through a "perceptible" pause, comma, or full stop. They provided several mutually exclusive and exhaustive categories of utterance, including statements, arguments, evaluations, questions,

TABLE 7.2 *Research Participants*

Student	Gender	Area of study	Year
M	M	Medicine	Four
N	F	Nursing	Three
P	F	Pharmaceutical sciences.	Three
DH1	F	Dental hygiene	Four
DH2	F	Dental hygiene	One
PT1	M	Physical therapy	Three
PT2	F	Physical therapy	Three
OT	F	Occupational therapy	Three

requests, proposals, confirmations, rejections, repeats, orders, and off-task utterances.

An episode has been defined as a series of interactions dealing with one topic and ending when the topic changes (Aarnio et al., 2013). Here, we identified and extracted significant episodes of coconstruction of reasoning and/or of conflicting views from the two 75-minute segments of interprofessional group work. A reasoning episode is understood here as a sequence of utterances in which definitions, observations, or hypotheses about concepts are related to each other (van Boxtel et al., 2000). Coconstructed reasoning is then reasoning constructed by contributions from multiple participants. A conflict episode is characterized by nonconfirmations, counterarguments, and critical questions. According to van Boxtel et al. (2000), a conflict is "elaborated" when one student explains or justifies his or her statement or when both students contribute to the resolution of the conflict through argumentation about the solution.

Further, semistructured interviews in which stimulated recall was incorporated with eight students from the same group were conducted after the IPE seminar to elicit qualitative reflective data. Questions regarding their experience and perception of learning in IPE included the following:

- What did you learn through discussion in this IPE seminar?
- What difficulties did you find in working together with people from other fields?
- How did you relate your experience in this IPE seminar to your future learning/career?
- What do you think about leadership in interprofessional collaboration?

During the interviews, recorded discussion data were replayed to prompt the participants to recall thoughts they had had while participating in the discussion. These stimulated recall interviews aimed to elicit information about their cognitive processes during specific moments of interaction. Students were asked to voluntarily give comments or answer the researchers' questions, such as the following:

- How were you feeling about a group member's opinion here?
- What were you thinking during this long silence?
- Why did you decide to share your opinion at this stage?

The reflective data were analyzed using the thematic analysis approach to generate categories of perceived learning outcomes gained through interaction with students from different disciplines (Braun & Clarke, 2006). Through the systematic reading of transcripts, the data were broken down into small units according to meanings, actions, events, or ideas expressed by the participants. Each of these distinct units was labeled and grouped into more abstract categories through the comparison of similarities and differences. These steps were repeated in an iterative procedure to ensure that the researchers' interpretation was congruent with the presented data.

FINDINGS

Our discourse-analytical account of IPE segments yielded a description of how meanings were coconstructed and negotiated among students from different disciplines. Collaborative processes of both construction of knowledge and management/resolution of conflicting views among the members were found in interprofessional group work. We have selected two episodes that best represent distinctive interaction patterns of how the students engaged in the inteprofessional learning activities.

Episode of Constructing Meaning in Interprofessional Interaction

All the group members shared information related to their respective disciplines, obtained in intraprofessional discussion in session 2, and discussed how they could on that basis provide the patient with comprehensive care before and after discharge. Excerpt 1 shows a dental hygiene student (DH1) and a nursing student (N) discussing how they could collaboratively engage in the patient's oral care in the hospital. DH1 pointed out some problems regarding the patient's oral care, sharing information from the dentistry team with N (Turns 1–3). Subsequently, DH1 emphasized the importance of blowing exercises to strengthen the patient's cheek muscles, since she did not have enough power to rinse out her mouth (Turn 5). A medical student (M) asked for confirmation of the effectiveness of blowing exercises, and DH1 offered clarification (Turns 10 and 11). The medical student's request for clarification effected a topic shift regarding who would take charge of providing oral care for the patient (Turn 12). This was thus a key utterance, giving rise to discussion of collaboration among dental hygienist, nurse, and physician. In fact, subsequent to Turn 12, DH1 and

N negotiated their roles in giving the patient instruction on oral health. N proposed that she would first learn the blowing exercise and oral care procedures from DH1 (Turn 15), who gave a positive response to N's suggestion (Turn 16). In particular, louder speech and repeated expressions of agreement by DH1 indicated her favorable stance toward N's proposal of collaboration between nurse and dental hygienist (Turns 16 and 18).

Excerpt 1

Turn	Speaker	Content (Translated)	Content (Japanese)
1	DH1	I would like to ask a question to the nurse.	看護に質問なんですが
2	N	yes	はい
3	DH1	umm. you ((*N*)) said that the patient can do oral care by herself (.) right?	さっき、自分で口腔ケアができるくらいはあるっておっしゃいましたよね。
4	N	((*nodding*))	((うなづく))
5	DH1	I forgot to report the information of DH in my turn. but (.) because her cheek muscle is weak ((*referring to the scenario*)) she can't rinse out her mouth. so (.) she can keep water in her mouth but doesn't have enough power to blow it out. she needs to practice on it (.) by the blowing exercise. in my opinion (.) in order to rinse out her mouth, her cheek muscles need to be strengthened preferentially. hmm (.) [she has enough physical strength? ((*looking at OT*))]=	さっき話すのを忘れちゃったんですけどただ頬の動きがほとんどないので((資料参照))ぶくぶくうがいが今できない状態なんですね。なので水を口に含む程度で、吐き出す勢いがないので、その練習だけさせて(.) ブローイングっていうやり方で(.) ぶくぶくをちょっと強化するのをやらないといけない、優先的には、と思いました。で、[筋肉は大丈夫ってことだったので((OTを見る))]=
6	OT	((*nods his head*))	((うなづく))
7	DH1	= [to brush her teeth, doesn't she?]=	=[たぶん歯磨きはできるんだと思う。]
8	NR	[I see (.) she can do it]	[できるんですね]
9	DH1	= so we need to focus on strengthening her cheek, cheek muscles which needs to be improved **(Statement: observation)**	なので、ぶくぶくですね。頬の動き、頬の筋肉はちょっと弱いってことなので
10	M	by doing this exercise (.) [will her condition be improved?]	それは訓練することで[回復していくっていうこと？]

11	DH1	[yes (.) we have an approach called blowing] it'd take time but doing continuous blowing exercise enables her to rinse out the mouth on her own. I want to set our goal related to this point.	[はい。ブローイングっていうやり方があるので] 徐々にですが、自分でぶくぶくをできるようにさせる。それも目標に入れたいです。
12	M	who can actually give her the instruction on the blowing exercise? **(Asking for clarification)**	実際にその指導っていうのは、どなたが？
13	DH1	err whichever ((*DH or N*)) (.) ((N: ha-ha)) (.) but I can do it. yes I can.	あーどっちでもいいって言ったらあれですが私でもできます。できます。
14	M	before this (.) we have to [assess her condition]	これをする前に [アセスメントしないとですね]
15	N	[umm but I think (.)] first of all I'd like to ask a dental hygienist to teach me about it. so::: at the beginning [I'll observe what the dental hygienist is doing]= **(Proposal)**	[でも衛生士さんに] 最初指導 [して頂いてそれを一緒にみて]
16	DH1	[oh (.) yes yes yes. doing TOGETHER TOGETHER. for me it's N::O problem] **(Agreement)**	[あ、そうです。それを一緒に一緒に] そうです。私は問題ないので
17	N	=and (.) after that nurses may take over [the role of blowing exercise for the patient] **(Proposal)**	そのあと日常は [看護師がみるのかもしれないですけど]
18	DH1	[yes (.) I agree agree (.) through collaboration] **(Agreement)**	[はい。それでも、全然大丈夫なので、連携で]

M commented on his contribution (Turn 12) to this discussion:

When I listened to the discussion between nurse and a dental hygienist, I could realize the importance of oral care for this patient and learn what dental hygienists can do for the patient care. To be honest, I didn't know the roles of dental hygienists in long-term patient care at all. So, I'd like to clarify how we, as a team, can provide oral care for the patient, like who would do what and how regarding oral care.

M's contribution in Turn 12 was made not merely to understand the roles of dental hygienists but also to discuss how oral care should be provided as a team. Thus, asking for clarification by M here brought a perspective of team-based care to this group, which focused not on understanding the roles of each health profession in this group but on finding a better way to collaborate for comprehensive patient (oral) care.

As DH1 reflected in the interview:

> At first, all members agreed that the patient could brush her teeth on her own. However, the scenario of DH said that her cheek muscles don't have enough power for washing her mouth. . . . The nursing member said, she needed my assistance in order for the patient to rinse out her mouth on her own. I was really happy that she accepted and respected my opinion, and asked for my guidance on the blowing exercise. Through this interaction, I could better understand what interprofessional collaboration is as a dental hygienist.

The fact that each student had different information about the patient and her family members, as given in session 2, increased their sense of responsibility as health professionals in the interprofessional group. This encouraged DH1 to share information on the strength of the patient's cheek muscles, which then led to the discussion on ways of collaborating between nurse and dental hygienist. Moreover, as seen in DH1's comments, the discussion on how members from different professional fields could collaborate helped the learners appreciate the importance of interprofessional patient care. In particular, DH1 was impressed by N's acceptance of and respect for the viewpoint of DH1 as a dental hygienist.

As N reflected in the interview:

> Through participation in the IPE seminar, I've learned that dental hygienists are deeply committed to oral health and swallowing in patient care. I think nurses are one of the professionals who often directly communicate with patient, but we also have limits to what a nurse can do. By working together with a dental hygienist, I think a nurse can effectively provide the patient with an opportunity for oral rehabilitation on a daily basis, which is an advantage of interprofessional collaboration.

N said that through this discussion she had gained a better understanding of the role of dental hygienist and the limits of her own professional role. Comments by M, DH, and N in the interview show that they realized that interprofessional collaboration led health professionals to provide comprehensive care that is beyond the limits of each professional. The reflective data indicate that students could effectively negotiate their own role(s) as health professionals and came to better understand the importance of interprofessional collaboration in interactions with others in health-care practice contexts.

Episode of Dealing with Conflicting Views in Interprofessional Interaction

This study demonstrates the processes by which students dealt with conflicting views about the patient care plan among interprofessional group members. For instance, Excerpt 2 shows that medical and physical/occupational therapy students felt it difficult to build consensus on whether they should prioritize promoting the patient's activities of daily life (ADL) or ensuring her safety after discharge from the hospital. M asked a critical question about the necessity of the patient's walking with a stick at home and elaborated an argument that emphasized the risk of her breaking a bone if the patient fell down (Turns 1 and 3). In contrast, a physical therapy student (PT1) argued that the patient was motivated to do housework to some extent, and as a physical therapist, wanted to meet the patient's desire (Turn 4). Responding to PT1, M put forward the suggestion that the patient might be able to use a wheelchair at home (Turn 5). However, an occupational therapy student (OT) offered the counterargument that a wheelchair could not be used in the home due to the narrowness of passages between rooms and the many steps in the house (Turn 6), and that restriction of the patient's ADL only for the purpose of fall prevention might result in depriving her of vitality in daily life (Turn 10). M made another suggestion, that the patient could walk not at home but in a day-care facility, which would ensure her safety, and emphasized the possibility that falling down would cause serious problems that could confound the patient's current condition (Turns 11 and 13). PT1 claimed that promotion of ADL would be essential to sustaining the patient's sense of balance and muscular strength and suggested that they could select an appropriate stick for the patient's condition from various types, such as the quad cane, T-cane, and walking frame with wheels (Turn 15). M suggested that the priority of their approach to patient care should be to ensure the patient's

safety, and they could allow the patient to walk at home depending on the results of the reassessment of her condition (Turn 16). OT's response implied that she partially agreed with M's suggestion, but complete group consensus was not reached (Turn 17). Eventually, however, the group members adopted M's suggestion as a group opinion.

Excerpt 2

Turn	Speaker	Content (Translated)	Content (Japanese)
1	M	have a minute? I'm still unclear about the purpose of encouraging the patient to walk with a stick in our previous discussion. why do we encourage her to walk at home? = **(Critical question)**	ちょっといいですか。杖歩行の目指すところってどういうところなのかなって。どうして屋内で＝
2	PT1	umm (.) yeah	うーん。そうですね。
3	M	=using the stick indoors (.) might have a high risk of stumbling. people who will possibly take care of her are (2.0) her husband and daughter (.) right? umm but I don't think that they could afford the full in-home assistance. s::o for example when she visits a daycare facility, she should undergo the rehabilitation of walking with assistance from a specialist (.) but there is a great risk if she walks with the stick at home by herself. for example when she stumbles (.) there would be a high possibility of breaking her bone due to her age. I'm really afraid of this kind of accident. if possible (.) umm I think I'd like her to refrain from moving around at home. I'm sure that it's important for her to train her muscles necessary for the transferring motion to use a portable toilet, but umm (.) I rather doubt the necessity of walking with the stick at home. **(Counterargument)**	＝屋内で杖を使ってていうことですけどリスク高いですよね。家の中で介助をされる方は旦那さんと娘さんなんで、すごく支えがしっかりされている方ではないので、例えばデイケアに行った時にどなたかしっかりとした方がついてもらって杖歩行の練習をするのがいいって思うんですけど。屋内でご自身でされるのはかなりリスクが高くなるかなと。で、例えば転倒された時に年齢的なものもあるし、骨折のリスクも高くなるので、あまり家の中で動き回るのはこわいかなって思うんですよ。で、家の中では安定したポータブルトイレを置いて動作っていうのは必要だとは思うんですけど、家の中での杖歩行の必要性はどうなのかなって
4	PT1	umm (.) I see (4.0) I'm not confident in this point (.) well (.) but she desires to do housework. umm her husband has never done it and her daughter is under such a situation ((*having her daughter is assessed that she is borderline intellectual functioning*)). umm (.) but I think her daughter may mainly manage the household in that situation. so she ((*the patient*)) needs to help her daughter. she said she doesn't want to cause her family members a great deal of trouble (.) and desires to do housework by herself in the near future (.) [umm so:::] **(Counterargument)**	そうですね。ちょっとそこらへんがしっかりしてないんですけど、ただこの方が家事に戻られる感じが強いので、うーん。旦那さんがやらないっていうか、娘さんがあれなので、メインは娘さんになると思うんですけども、その補助とかで少し動いたりする感じ、ま、イメージというか。家族に迷惑をかけたくないと言われてるので、手伝いそうな傾向はみられるんですね。[うーん、なので]

5	M	[can we introduce] a wheelchair to her? is it difficult?	[車いすを導入する]っていうのは厳しいですかね
6	OT	there're many steps and the house is a bit small (.) particularly the width of the passages would not be enough for the wheelchair. I can't surely say about that because we don't have info on the house layout.	段差が、幅が、横幅が狭いと使えないので、間取りがないのでなんともいえないですけど
7	M	umm (.) I'm just worried about the risk of her walking indoors. **(Counterargument)**	なんかちょっと怖い感じが、家の中でね。
8	PT1	umm (.) ye::s	うーん、そーですねえ
9	M	providing handrails in the house can be the next step for the patient care (.) but (.) at this stage (.) personally I'm a bit reluctant to let her walk with the stick at home. in my opinion **(Counterargument)**	手すりとかっていう話になると思うんですけど、ゆくゆくは。としても現段階ではそこまで進めるっていうのは怖いかなっていう気持ちがあるんですけど、僕は。
10	OT	because her symptom is progressive (.) her condition will be possibly getting more serious. so (.) if we can equip her house with handrails (.) we have to do that. it's true that using the handrails can be safer than the stick in walking around indoors (3.0) but for fall prevention (.) if we strictly restrict her walking distance at home per day (.) we can't enhance her motivation. so I wonder if saying "please don't walk for your safety" is a good idea [in terms of her qol (.) I'd like her to walk as frequently as possible.] **(Counterargument)**	進行性っていうことなので、ここから悪くなることも考えられるので、やっぱり手すりをつけれるんであればつけておいた方がいいかなと思うので、屋内では手すりを使ってもらった方が杖よりは安定するかなとは思うんですけど、転倒があるので移動距離を狭めようとすると、意欲とか活動性っていうところの低下も見られてくるので、まあ危ないから動かないでほしいっていうのは[QOL的な面でもできるかぎりは動いてもらった方が
11	M	[of course (.) she can do that in a day-care facility which ensures her safety.]	[もちろんデイケアとか行った先で安全が確保できる所でっていうのがほしいっていうか
12	OT	((*nods her head*))	((うなづく))
13	M	I'm really afraid of the possibility of causing her serious problems due to her falling over at home. after this accident (.) her ADL may abruptly decline. **(Counterargument)**	うん、こけられると本当に怖い、その後が、またADL下がってくる可能性があるので
14	OT	Ha-ha (.) yeah	ははは、そうですね。

15	PT1	as a way of dealing with this issue (.) we can give her family::: members instructions on the lines of flow in the living space (.) and we have to identify the proper walking distance for her (.) walking with the stick (2.0) taking such points into account it's important to keep a balance between her safety and activity (.) but she appeared to be decreasing motivation for ADL. our instructions such as (.) what you said before (.) like "don't walk" may result in a decline in her muscular strength. in addition (.) a decline in her sense of balance would cause a situation where she can't keep standing and sitting positions properly. to ensure her safety (4.0) well there are some types of stick such as a quad cane which has a larger bottom (2.0) or using two t-canes. if she has considerable difficulty in walking (.) we'll then introduce a walking frame with wheels. (.) so::: we have to define her situation and maintain her muscular strength by helping her walk with some assistance, which are PT's and OT's approaches to patient care. **(Counterargument)**	家庭の生活空間の導線の指導とか無理な距離というか、それを見定めながら短い距離に対しての杖歩行。そういう所も加味して。バランスのことがやっぱり重要だとさっきも言ったんですけど、意欲の低下がみられるので、「動かないでください」みたいなニュアンスの指導になると結果的にまだ4ある筋力がさらに低下していく可能性があって、バランスに加えて筋力で、今度は立位も座位もっていうことになりかねないので。安全(4.0)まあ、杖でも四点杖とか、なるべく接地底面の広いものとか、二本杖というか、両方にT字杖とか、難しくなれば歩行車っていうふうに考えるんですけども(.)手押し車みたいな。そういう所も見定めながら歩行による筋持久力、筋力の維持っていうアプローチにしたいなっていうのはPTと、あとOTの。
16	M	umm o:::kay (.) so::: as our tentative plan (.) well (.) basically(.) she undergoes rehabilitation in hospital first (.) and when she goes home we have to carefully check her condition (.) in accordance with the results, we then encourage her to walk at home in a safe environment which we have ensured. so at that time we might need to reassess her condition. ok?	まあー、ひとまず、そうですね。まあ、あのー、病院内でリハビリをしていただいて、家に帰るときに状況をみて、できるだけ安全な方法で動いていただくという方向で。そのときにまた再度評価ということで対応していきましょうか。
17	OT	hm:::m (2.0) OK	うーん (2.0) はい。

Reflecting on this episode in the interview, M said that although he understood the importance of ADL, he wanted other members to pay more attention to the high risk of the patient's falling down at home:

> They ((PT and OT)) tended to think that moving about actively at home is good for the patient's ADL. It's true, but, we have to also think about the patient's condition after the activity. At that time, I wanted to confirm if the members have a long-term vision of patient care. . . . As a medical student, my role is to manage

> a group discussion, particularly when they have focused on only one aspect of the patient. And, I also need to let them know if their discussion doesn't adequately cover the patient's problem. . . . I think that doctors have to make a clinical decision aptly and immediately in a setting of acute medical care, but this time was in a situation of chronic illness care. I felt that what doctors could do was limited and we needed more contributions from other health professions. Given this situation, it's important for doctors not to take the initiative in the discussion as a team leader but to manage the discussion as a moderator.

As a medical student, M saw himself as a moderator in this interprofessional group discussion and took the role of encouraging the other members to analyze the patient's condition and discuss the care plan from different perspectives. Specifically, in the interview, M pointed out that there was less discussion of the patient care from a long-term viewpoint, leading M to ask a critical question about the necessity of walking around with a stick at home. However, as OT remarked regarding M's contribution to this discussion in the interview:

> In medical member's opinion, walking with a stick at home is highly risky for her. However, from the viewpoint of an OT, if we restricted her ADL, her motivation and QOL ((Quality of Life)) would decline sharply. I understand the importance of fall prevention, but I also wanted him to understand my opinion better. I found it really difficult to balance both medical and OT's opinions. However, this experience allowed me to think about the importance of teamwork and building a group consensus.

OT felt that M did not accept the approaches of occupational therapists and physical therapists. OT's experience in this discussion led to a feeling of the difficulty of integrating or compromising among different approaches to patient care used by different professionals in an interprofessional team. At the same time, the importance of teamwork and building a group consensus were acknowledged by OT.

PT1 perceived this experience differently from OT. As PT1 reflected in the interview:

> The medical student cast doubt on the necessity of walking with a stick at home. His question gave me a chance to deeply rethink my opinion. I realized that the viewpoints of different health professionals allowed me to comprehensively understand the patient's problem.

PT1's comments imply that knowing viewpoints of other disciplines is connected to a better understanding of one's own viewpoint and roles/responsibilities. Through dealing with conflicting views in an interprofessional group, their attention was directed to the importance of critical thinking, building a group consensus, and decision-making skills. Moreover, they, particularly OT, realized the necessity of negotiating power relations in terms of professional autonomy.

DISCUSSION

This process-driven study of interprofessional PBL shows that students actively negotiated meaning and coconstructed knowledge related to patient care in highly interactive discourse. Even in conflict episodes, they reflected that they could achieve meaningful learning and gain a new awareness, such as realizing the importance of interprofessional collaboration and (re)negotiating their roles/responsibilities as health professionals in their group. Although this IPE seminar is only a single educational intervention, it has a pedagogical impact on students' perceptions of interprofessional collaboration. To some extent, the findings of this study are congruent with those of the previous studies exploring perceived learning outcomes in an IPE curriculum (e.g., Imafuku et al., 2018). The participants' perceptions of the learning outcomes they experienced in the IPE seminar, as they emerged from the interview data analysis, are summarized here:

- Critical thinking process (e.g., comments from PT1)
- Importance of interprofessional collaboration and provision of comprehensive care (e.g., comments from DH1, N, and PT1)
- Leadership (e.g., comments from M)
- Teamwork and building a group consensus (e.g., comments from OT)

- Understanding of one's own professional group's roles and responsibilities (e.g., comments from M, N, DH1, PT1)
- Understanding of other professionals' roles and responsibilities (e.g., comments from N)

As the findings described show, the seminar had a positive impact on the learning of the students, who had never previously experienced IPE. Therefore, the findings of this study suggest that providing IPE learning opportunities, even just a single intervention, is essential to improving students' understanding of interprofessional collaboration. However, as the approach offered here indeed involves only a single intervention, opportunities to facilitate students' interprofessional socialization process cannot be offered continuously or systematically. For further educational development, IPE thus needs to be integrated in a stepwise, systematic manner in education programs (Imafuku et al., 2018; Wilhelmsson et al., 2009).

This study corresponds to the findings of the previous studies that analyzed coconstruction processes of knowledge in IPE or PBL (e.g., Almajed, Skinner, Peterson, & Winning, 2016; Hmelo-Silver & Barrows, 2008; Imafuku et al., 2014). First, as shown in Excerpt 1, a plan to provide oral care for a patient in the hospital was constructed collaboratively among M, DH1, and N. This discussion included negotiation of professional roles/responsibilities between nurse and dental hygienist. Through their mutual engagement in discourse around interprofessional PBL, the patient's oral care was discussed deeply but practically, and the group's collective understanding was improved (Hmelo-Silver & Barrows, 2008).

At the same time, this study found some conflict episodes in the discussions. A conflict process in interaction is not always seen as a negative event; as Wenger (1998) elucidated, the process by which a newcomer becomes a full participant (i.e., legitimate peripheral participation) is not necessarily characterized only by a harmonious process but also by a conflictual process of negotiation and transformation in a community of practice. Disagreement, challenges, and competition can all be forms of participation (Wenger, 1998, p.77). As PT1 mentioned, students have learned many things regarding interprofessional collaboration from their experiences of handling conflict with professionals from different backgrounds: critical thinking, a better understanding of their own professional roles, and teamwork and building a group consensus in a team. This is in line with van Boxtel et al. (2000)'s resolving conflicts dimension, which

reflects a productive, elaborative discourse. However, we need to note that if students perceive conflicts as unproductive and competitive discourse, they are more likely to avoid conflicts (Visschers-Pleijers, Dolmans, Wolfhagen, & Van der Vleuten, 2005). Johnson and Johnson (2009) also argued that challenging each other competitively can be perceived to be threatening and may weaken relationships among students in a group. Aarnio et al. (2013) thus suggested that students and tutors be alert to competitive orientations in group discussions.

Methodologically, this chapter contributes to the understanding of discourse-based qualitative research design in PBL. Jin and Bridges (2016) pointed out that the majority of the literature in their review used self-reported participant perception designs, and that ethnographically oriented studies such as analyzing video recordings of classroom interactions were fewer in number. This study attempted to explore both PBL in action and participants' perceptions of learning by combining data analyses of classroom interactions and stimulated recall interviews. The methodology used in this study enables researchers to provide a richer description of what actually happens in PBL from an emic perspective.

CONCLUSION

In summary, this chapter sheds light on how learners can gain more from their learning experiences in IPE. It corroborates the previous studies on small group discussions in a PBL setting; moreover, it adds a new perspective, in that its focus was directed at both collaborative processes of knowledge construction and conflict management in interprofessional PBL. However, there are also some limitations to be noted in this study. First, we investigated students' participation in only a single intervention, and the results are not generalizable to all pedagogical contexts due to the small number of participants. It also needs to be noted that the participants were highly motivated students who are not representative of the general population of students in health professions education. For transferability of the findings, we need to investigate a variety of cases of students' learning processes in an interprofessional tutorial setting. Furthermore, this study did not focus on tutors' perceptions of student learning in the IPE seminar; even though tutors were not expected to participate actively as facilitators in this seminar, it remains important to investigate their perspectives in a

seminar context to provide pedagogical implications, that is, to show how they can facilitate students' learning more effectively, particularly when the students are dealing with conflicts. Further research should thus examine changes in students' perceptions of interprofessional collaboration in health care and the process of identity formation as "interprofessionals" from a longitudinal viewpoint.

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APPENDIX 1

Scenario (basic information)

Patient

Yoshiko Yasuda (aged 79, female)
Lewy body dementia
Day 10 of hospitalization

Her family members

Husband: Amputation of fingers of his left hand due to a serious accident during his work in a factory
Elder daughter: living far away from the patient's home
Younger daughter: Intellectual quotient (IQ) score 70 (borderline intellectual disability)

Yoshiko has not slept well for these several years, and has experienced visual hallucinations which sometimes cause panic disorder, for the past several months. The day after she has this symptom, she seems not to feel well in the daytime. Recently, she started to have urinary incontinence at night. Moreover, when she feels a need to urinate, she cannot make it to a toilet in time. Now, she has no choice but to use an undergarment for incontinence.

10 days ago, she was hospitalized for examination and was diagnosed with Lewy body dementia. During the hospitalization, her blood sugar level was controlled effectively. Her family members want to have her discharged as soon as possible due to the high cost of hospitalization and the difficulty of staying with her in hospital. A care manager was introduced to them to take care of her after discharge, but her husband said that he does not need support from the care manager, because he can manage and provide care for her by himself and their daughter is also there to give support.

These past few days, she has had fits of coughing, and this symptom was getting serious like pneumonia. As SpO_2 was 93%, she was given an antibiotic agent intravenously and used a nasal oxygen cannula. Because we need to see how her condition develops and if it will stabilize, her hospitalization is lasting longer than planned. . . .

Discuss and make a plan of treatment and care for Yoshiko and her family members.

APPENDIX 2

Additional information (for students of dentistry and dental hygiene)

Yoshiko has used dentures for a long time, but they were left at home during her hospitalization. We asked her family to bring them to hospital. Due to poor denture fit on the upper jaw and gums, they come off during chewing sometimes. Yoshiko can take a meal on her own without any support. However, the oral activity is very slow. When five to ten minutes have passed since she has starting eating, she cannot swallow food which is in her oral cavity, and she becomes "out of it" and closes her eyes with the food in her mouth. In such a case, she will wake up when we call out to her. However, she needs care for meals, and leaves about 30% of her food every time. Soft textured foods are used, but because her dentures do not fit properly, she tends to wash them down with green tea or soup.

Yoshiko brushes her teeth if we have prepared a toothbrush and paste set. However, brushing time is usually only 10 seconds. Movement of cheeks cannot be observed as she rinses out her mouth; she can just hold water in her mouth and spit it out feebly . . .

APPENDIX 3: TRANSCRIPTION SYMBOLS (Adapted from Jefferson 1984 and Ten Have 2007)

[	beginning of an overlap
]	end of an overlap
(.)	a brief pause
: : :	prolongation of an utterance
((*italic*))	the transcriber's comment or nonverbal activity
?	rising intonation
.	falling intonation
CAPITAL	the speaker is emphasizing the speech
(1.0)	the time (tenths of seconds) of a pause in speech
=	no gap between utterances
ha ha	laughter

CHAPTER 8

Are You Still With Us?

Managing Mobile Phone Use and Group Interaction in Problem-Based Learning

Gillian Hendry
University of the West of Scotland
Sally Wiggins
Linköping University
Anthony Anderson
University of Strathclyde

INTRODUCTION

One of the challenges of implementing problem-based learning (PBL) is ensuring that group members work effectively together (Dolmans, De Grave, Wolfhagen, & van Der Vleuten, 2005). As technology develops, it is particularly important that group members can function appropriately while using mobile technologies, such as mobile phones,* tablets, and laptops, in classroom settings. Mobile phones in particular have the ambiguous status of being a tool for both work and leisure purposes, given that their primary function is communication and in most cases they also provide access to the Internet. They are also personal and discreet; others in the group may not be able to see the screen activity in the same way that a laptop or tablet is visible, and therefore using mobile phones in an educational context presents a problem of interpretation for group members in terms of whether the phones are being used for work or leisure purposes and thus whether a group member is still engaged with the group. In this chapter we utilize discursive psychology to examine the use of mobile phones in PBL student tutorial interaction at the exact

* This chapter uses the term "mobile phone" to refer to cell phones, smartphones, wireless phones, etc.

moment in which a phone is picked up, analyzing what impact such an action can have on a group. This approach contrasts with mainstream psychology's treatment of interaction by focusing on talk as performing a social action, such as how a phone user and other group members attend to the accountability of using the phone in the tutorial. In doing such in-depth analyses, we can shed further light on the intricate interactions that take place within PBL settings and how group dynamics are managed by the individuals involved.

MOBILE TECHNOLOGIES IN THE (PBL) CLASSROOM

The development of mobile wireless technologies has generated great interest within higher education due to its potential for shifting the academic environment from traditional to mobile learning settings (Kim, Mims, & Holmes, 2006), as part of what has sometimes been referred to as the move from mobile learning (m-learning) to "ubiquitous computing" (Laru, Naykki, & Jarvela, 2015; Weiser, 1991). Having the function of Internet access is particularly useful in teaching settings where there may be limited computer availability, and social media services such as blogging, Twitter, and Instagram have opened up new possibilities to encourage and facilitate student learning (Adelman & O'Brien-Weiss, 2014). Research has also suggested that mobile phone use in education can increase interaction and group cohesion (Davies, 2014) and enhance social connectedness (Wei & Lo, 2006), but those advantages are counterbalanced by the concern that such technology is at best a distraction (Organista-Sandoval, Serrano-Santoyo, McAnally-Salas, & Lavigne, 2013; Tindell & Bohlander, 2012) and at worst a tool for plagiarism (Braguglia, 2008; Campbell, 2006; for a summary of this discussion, see Barry, Murphy, & Drew, 2015).

Research in this field has predominantly focused on evaluating the effectiveness of use of mobile technology in the classroom (e.g., Ahmed & Parsons, 2013; Wu et al., 2012) or surveys measuring the frequency of reported use of mobile technologies by students (e.g., Barry et al., 2015). By comparison, very little research examines how students actually use mobile technology in classroom settings, and what there is focuses on accounts of students' experiences of mobile use (Gikas & Grant, 2013) rather than observations or recordings of student behavior and interaction. As a result, while we are gaining a growing picture of patterns of mobile

phone use in educational settings, we still know very little about how this use plays out in practice.

Within PBL settings specifically, there has also been interest in the use of online technologies as an additional form of support for student learning and increasing access to resources (Hmelo-Silver & Bromme, 2007), alongside the possibility of mobile phone use having a direct effect on group dynamics (Hmelo-Silver, 2013; Jin, Bridges, Botelho, & Chan, 2015). Chan and colleagues (2015), for instance, have reported facilitators' concerns that the use of mobile phones would disrupt tutorial discussion or reduce interaction between students, even though they noted that students typically self-regulated their mobile phone use for academic purposes rather than social media, phone calls, or texting (Chan et al., 2015).

Mobile phones present a particular dilemma in classroom settings, acting as they do as a bridge between formal (i.e., classroom-based) and informal (i.e., unstructured and unanticipated) learning, even when the phones are used within a classroom setting (Gikas & Grant, 2013). Since they have an ambiguous status as both a personal and a work object, they also bridge the divide between what might be understood as intentional or unintentional learning. That is, even if a student is using a mobile phone to go off topic, he or she may still be learning through information found. The mere act of orienting to a mobile phone, however, can be perceived as demonstrating an individual's disengagement from group interaction and thus change the group dynamics. In interacting with a mobile phone, an individual's attention is drawn to the device instead of the group, suggesting that the individual is not fully immersed in the group environment and as such is violating norms through social loafing, making less of a contribution due to being engrossed in his or her phone (Dolmans, Wolfhagen, van der Vleuten, & Wijnen, 2001).

MOBILE DEVICES IN INTERACTIONAL RESEARCH

In order to better understand the role of mobile phone use in PBL tutorials, literature on human-computer interaction as well as ethnomethodological and conversation analysis studies in the use of objects in interaction provides fruitful insights (e.g., Haddington, Keisanen, Mondada, & Nevile, 2014; Nevile, Haddington, Heinemann, & Rauniomaa, 2014). For example, in their analysis of mobile phone interaction, DiDomenico and Boase

(2013) likened the act of orienting to a mobile phone's "chime" (receiving a text message) to the notion of responding to a summons (Schegloff & Sacks, 1973), whereby the mobile phone user may be summoned by a ringing phone so that he or she may engage in conversation (orally or textually) with the caller. Crucially, however, the authors demonstrated that unlike a voice call summons, a text message summons allows the mobile phone user to respond without suspending the copresent interaction, an important point for negotiating the availability of turns at talk (DiDomenico & Boase, 2013).

If we treat PBL tutorials as being as much about social interaction as about learning and cognition, then we need to address not only how often or for what purpose mobile phones might be used in PBL tutorials but also the way in which these objects are oriented alongside conversation. While the use of technology in educational settings has a long and established history (e.g., Cuban, 1986), research that examines the discursive and embodied practices (sometimes referred to as "multimodality") around mobile devices within social interaction has only developed since mobile technology itself became more readily available (Lundin, Lymer, Holmquist, Brown, & Rost, 2010). For instance, Brown, McGregor, and colleagues (Brown, McGregor, & Laurier, 2013; Brown, McGregor, & McMillan, 2015) note how the mobile phone is an "occasioned" object in interaction; that is, it arises in interaction through being occasioned, or made relevant, by the surrounding talk and interaction. Their research examined mobile devices in mobile interaction (e.g., when people are walking around museums or finding their way around a city), but there is relevance here in that such devices can in theory be used at any point in an interaction (see also Weilenmann, Normark, & Laurier, 2014). One of the key findings from this area of research is that mobile phone use is closely interwoven with social interaction. In other words, people do not use their phones randomly or with little regard for conversation; instead, the phone is *part of* the complex interplay among talk, interaction, and objects in the social space.

In this chapter we therefore develop existing research into the use of mobile phones in PBL tutorials and combine this with a discursive approach to interaction, drawing on insights from ethnomethodology. This also contributes to a growing body of work that examines discursive practices in PBL tutorials (Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014; Jin et al., 2015; Koschmann, Glenn, & Conlee, 1997; Visscher-Pleijers et al.,

2006) and as such sheds further light on the "black box" of PBL settings (Hak & Maguire, 2000), since we are focusing on the routine, naturalistic interactions that are often overlooked in PBL research but can have an immense impact on group dynamics. Specifically, we investigate what happens to group interaction at the point at which a group member picks up and begins to use his or her mobile phone during PBL tutorials *by focusing on how the phone user and other group members attend to the accountability of using a phone in a tutorial*. We examine the turn-by-turn management of the mobile phone in the group interaction in order to provide an insight into how technologies are used *in practice* in PBL settings and their location within the group dynamics and communication processes.

METHODOLOGY

Participants

The data used for this study come from a corpus of naturalistic video-recorded PBL student groups from two UK universities. Data were collected between October 2012 and December 2013 from 23 psychology (University A) and 8 interdisciplinary science (University B) students, totaling eighty-five hours of interaction (for details regarding the groups featured in this chapter, see Table 8.1). Recruitment consisted of identifying possible PBL classes and/or components in which potential participants could be approached. Four PBL modules were identified across the two universities, and an announcement was made in person at the start of each module to recruit individuals or groups voluntarily to the project. The PBL models used at both universities were broadly based on the Aalborg model of PBL (Kolmos, Fink, & Krogh, 2006), whereby groups followed the seven steps of PBL, beginning with starting to unpack the problem and ending with reflecting and applying newly gained knowledge to the problem.

For the psychology students at University A, PBL was a relatively new approach to learning; although they had experienced one block of PBL (five hours) in the previous year of their degree, this was the only class in the psychology curriculum that was fully taught in this way. These classes were timetabled, and as such recordings lasted for the length of the PBL block, whether a whole semester (i.e., groups in Extracts 8.1, 8.4, and 8.5) or over only a couple of sessions (i.e., the group in Extract 8.2). Groups

were overseen by a floating facilitator who visited each group numerous times during each session but didn't stay for the entire time. The interdisciplinary science students (University B, Extract 8.3), conversely, had been using PBL since the start of their degree, and as such it was an established teaching method in their department. These groups did their PBL sessions at times arranged by themselves—for however long they wanted—outside of the timetabled teaching sessions, and as such there is a large variance in terms of hours of recorded data, not only across these interdisciplinary science groups but also between them and the psychology groups. Unlike at University A, the groups from University B were not facilitated by a staff member; instead, a staff member could attend "drop in" sessions if the group encountered any problems while undertaking the task. No facilitators are present in any of the extracts detailed in Table 8.1.

Informed, written consent was gained from all participants, including consent to use static images and video recordings in research publications and presentations, due to the nature of the data and the necessity to analyze close-up peer interactions. No demographic data, such as age or gender, were obtained from any participants, but in consenting to take part in the study, participants revealed that they were at least 18 years old. The study received full ethical approval at university level. The video data were transcribed to words-only detail in the first instance before a data corpus was compiled, and those extracts chosen for further analysis were subjected to Jeffersonian transcription notation (Jefferson, 2004; Appendix 1).

ANALYTIC PROCEDURE

In order to analyze the data, the data corpus was first searched for instances of interaction in which a group member picked up his or her mobile phone, of which there were discernibly 326 (see Table 8.2 in Appendix 2). The distinction between actually picking up a mobile phone and otherwise orienting to it (e.g., pressing or touching the phone) is important, as picking up marks a distinct shift in attention as opposed to touching or glancing at a phone, which might be similar to, for instance, looking at one's watch or a clock on the wall. Such picking-up instances were broadly categorized as happening during opening, middle, or closing stages of a PBL tutorial. This distinction is also important, because the impact of interacting with a mobile phone in the middle of a session is potentially

TABLE 8.1 *Group Information.*

Extract	Class/university	Overview of whole PBL component	Specific task featured in extract	Number of hours recorded	ECTS credits for class
1	Final year "Qualitative Methodologies in Practice" University A	Reading qualitative psychology journal articles to become familiar with different methodologies, arguing strengths and weaknesses of each, analyzing qualitative data, collecting and analyzing own qualitative data.	Analyzing raw transcript data pertaining to the theme of friendship.	21 hours: 7 weeks @ 3 hours per week	20
2	Final year "Conceptual and Historical Issues in Psychology" University A	Devising a research proposal containing no ethical constraints.	Brainstorming ideas for a psychology research project that does not have to adhere to ethical constraints.	2 hours: 2 weeks @ 1 hour per week	20
3	Final year "Interdisciplinary Science" University B	Devising a podcast for an evolution exhibit at the local natural history museum.	Discussing ways in which to record the podcast.	7.3 hours	20
4	Final year "Qualitative Methodologies in Practice" University A	Reading qualitative psychology journal articles to become familiar with different methodologies, arguing strengths and weaknesses of each, analyzing qualitative data, collecting and analyzing own qualitative data.	Reporting back to fellow group members about self-study that has been undertaken.	21 hours: 7 weeks @ 3 hours per week	20

(*continued*)

TABLE 8.1 (*Continued*)

Extract	Class/university	Overview of whole PBL component	Specific task featured in extract	Number of hours recorded	ECTS credits for class
5	Final year "Qualitative Methodologies in Practice" University A	Reading qualitative psychology journal articles to become familiar with different methodologies, arguing strengths and weaknesses of each, analyzing qualitative data, collecting and analyzing own qualitative data.	Reporting back to fellow group members about self-study that has been undertaken.	21 hours: 7 weeks @ 3 hours per week	20

more problematic than at the start or end, when groups are settling down and finishing up, as the middle is intuitively when the focus should be on the work (e.g., Hmelo-Silver, 2004).

Middle instances were the focus of the analysis and were identified as being the moment at which a break in group collaboration might occur, the starting point for any potential trouble in the functioning of the group. Different issues are at stake, for example, when a group member looks at, touches but does not pick up, or puts down a mobile phone.

A conversation analytic (CA) and discursive psychological (DP) approach was used to analyze the data, methodologies that have previously been used to analyze tutorial talk (e.g., Attenborough & Stokoe, 2012; Gibson, Hall, & Callery, 2006; Koschmann et al., 1997). CA was developed by Sacks, Schegloff, and Jefferson (1974), demonstrating how conversation is interactively constructed by looking at its basic properties, such as turn taking, speech acts, and repair. DP is a form of discourse analysis that focuses on the management of psychological issues in talk and text (Edwards & Potter, 1992). The approach does not align with conventional values of psychology in which individuals' speech is regarded as being indicative of internal consciousness; rather, it assumes that talk has an action orientation and is used to perform particular social functions, achieved through a variety of rhetorical strategies (Wiggins & Potter,

2007). Discursive devices were used to examine the construction of talk in interaction, focusing on how issues around accountability are managed through turn-by-turn conversation. The analytical focus was therefore on those instances in which group members first picked up their mobile phones and how they did—or did not—account for doing so in situ.

In the analysis we demonstrate the ways in which group members orient explicitly to the use of the mobile phone: by positioning its use as being beneficial, by demonstrating its priority over current group interaction, and as an invitation to follow a particular course of action. In this way, group members clearly mark their mobile phone use as being an accountable, and thus potentially problematic, activity in PBL settings; the accounting process marks the phone use *as requiring* an account. The following extracts have been chosen for analysis, as they are commonly observed patterns across the dataset, and to conclude we provide an example of a deviant case: the less common occurrence when group members did not account for or attend to their mobile phone use explicitly and were subsequently held to account by another group member or members.

Analysis

To begin the analysis, we detail how group members routinely account for their mobile phone use in some way by stating a reason for picking up their phones and how this is often done at the exact point at which the phone is picked up. In Extract 8.1 the group is on task working, despite member Jackie having just arrived late by around 30 minutes (one-quarter of the whole session). The focus of their discussion is on analyzing transcript data pertaining to friendship.

This first example provides an illustration of how a group member explicitly orients to the use of his or her phone for work purposes. Here, we see Nadia account for her shift in attention by apologizing to her peers before explaining what she is doing. This course of action appears appropriate here: her last utterance (lines 1–4) was not overtly supported or challenged by any of her peers, and so it makes sense for Nadia to access her phone as a way of obtaining an additional resource to be used in the discussion; that is, what can be accessed on the Internet to look at "that" (line 11).

Nadia's utterance "sorry" at line 7 is of particular interest. It could be interpreted as a verbal display of accountability for interrupting the discussion not only by ceasing to talk but also through her actions: putting

1	Nadia:	cuz these are frien'ships that a:re (.)
2		jus' due
3		to the fact that they're forced to live
4		together
5	Regina:	°mm hm°
6	Nadia:	*((gazing down))* that kin'a thing
7		*((1.0: Jackie sits down))*
8	Nadia:	*((looks down/ puts pen on table and*
9		*reaches into jacket pocket))* °sorry°
10		(.) >°gonna take ma° phone out so I can
11		go on the interne'< and look at that=
12	Jackie:	=ah texted ya
13		(0.5)
14	Nadia:	did you
15	Jackie:	£uh [huh
16	Nadia:	[sorry

Extract 8.1 **(a)** Clockwise from left: Jackie, Jocelyn, Nadia, Ally (hidden), Regina. (Although group members explicitly consented to having their images included in publications, screen grabs have been modified slightly to encourage anonymity and better highlight embodied gestures.) **(b)** Lines 8–9: Nadia reaches into the left pocket of her jacket (circled) to retrieve her phone.

her pen down and searching in her pockets. Instead of saying she's going to research on the Internet, Nadia states that she is "gonna take my phone out so I can go on the internet and look at that" (lines 10–11), detailing the three processes involved: first, producing her phone; second, accessing the Internet; and third, researching the topic. This step-by-step detail presumably serves to assure her peers that in producing her phone, she is not

social loafing or removing herself from the group; rather, she is sticking to the rules and using her phone for a beneficial purpose. Jackie's immediate comment ("ah texted ya," line 12) consolidates the pertinence of the phone in that she makes relevant an appropriate action that Nadia might have made (to reply to the text message or refer to this when talking to Jackie). Alongside the lack of response by the other group members, this orientation to the phone as being an appropriate object for discussion effectively smooths over the introduction of the phone and allows the group to proceed with their conversation.

This is a rather simple example but demonstrates clearly how group members mark their mobile phone use in the dataset. The second example again demonstrates how group members orient to the use of their phones within the PBL setting, though here it is being explicitly used for nonacademic purposes. As we join them (see Extract 8.2), the same group is again on task, and all the group members' mobile phones are on their desks. They are discussing ideas for a task in which they must produce a psychological research proposal with no ethical constraints.

The extract begins, as before, with the group on task. At lines 19–22 there is an episode of overlapping talk, and as such we see group member Jocelyn raise her voice while also activating her phone (pressing a button to unlock it and thus gain access to its functions), therefore indicating that although she is attempting to regain the turn at talk, further phone interaction may soon occur, displaying a split in her attention to her peers. Jocelyn's actions from lines 21 to 35 are of interest because of the way in which she continues her turn in the discussion but is also visibly occupied by her phone, apparently due to the fact that her mother has called her. Jocelyn very quickly accounts for why her attention has been turned to her phone (line 27), but instead of solely focusing on returning the call (as she goes on to do), she thrice attempts to make her point in regard to the PBL task.

The way in which Jocelyn accounts for why her focus has veered to her phone is in stark contrast to the episode in the previous extract, in which Nadia apologized before procedurally explaining that she was going to interact with her phone and why. Here, Jocelyn does almost the exact opposite by shifting the focus from herself to her peers, telling *them* to "hold on," as "my mum's phoning me." This is a potentially serious group dynamic issue for PBL; Jocelyn is effectively prioritizing her personal call over the group discussion. In asserting that the group should do so, Jocelyn

17 Ally: what we know [today
18 Nadia: [mm hm
19 Ally: [(inaudible) *((looks at Jocelyn's*
20 *phone))*
21 Jocelyn: [*((pressing phone to activate screen))*
22 [AH THINK WE pro'ly are meant to do
23 somethin'
24 Nadia: like- [*((picks up phone, begins*
25 *'Googling'))*
26 Jocelyn: [that's- *((picking up phone))*
27 °>hold on ma mum's phoning me<°
28 *((2.0: places phone to ear))*
29 Jocelyn: that is unethical because em
30 *((Jocelyn puts phone to ear))*
31 *((3.0: Ally gazes at Jackie, and begins*
32 *to smile, then looks at Nadia))*
33 Jocelyn: because it is about chi-
34 *((takes phone away from ear and looks*
35 *at it))*
36 Jocelyn: °oh f'r God's sake mum hhh°
37 (1.0)
38 Jocelyn: she phone' me an' straight t'answer
39 phone
40 (1.0)
41 Ally: [she's maybe tryin' to phone you back
42 heh
43 Jackie: [she's tryin' to phone you £back
44 Ally: £heh
45 Jackie: £ahuh
46 *((6.0: Ally twiddles her pen, Nadia*
47 *scrolls on her phone, Jackie continues*
48 *eating her lunch))*
49 *((Jocelyn puts the phone to her ear*
50 *again, before an answer phone message*
51 *can be heard faintly))*

Extract 8.2 **(a)** Clockwise from left: Jocelyn, Ally, Jackie, Nadia. **(b)** Line 28: Jocelyn puts her phone to her ear while still attempting to hold her turn at talk. (The students in Extract 8.2 are the same as those in Extract 8.1 [minus one]; these are two different PBL classes, but they wanted to work together again.)

posits herself as still owning the turn at talk, but the phone call takes priority, and as we see, she regains this over a series of turns as she juggles the task of getting her point across while trying to contact her mother. In this way, she tries to manage the apparent transgression by continuing to contribute to the group discussion, albeit in a stunted and disjointed manner.

Although Jocelyn has accounted for why she is on her phone, it is interesting to observe the responses of her peers. At line 31 there is a three-second lapse in the interaction while she has the phone to her ear as she tries to return her mother's call. At this point we see that Ally's gaze goes from Jocelyn's phone to Jocelyn herself and then to Jackie, and then Ally begins to smile. This entire interaction happens fairly quickly and subtly, almost like a nonverbal tracking of the disruption to the group interaction. Ally's gaze toward Jackie here and the subsequent smile are reminiscent of Kidwell's (2005) work into gaze as social control, where "problem conduct" behavior is acknowledged through gaze. Kidwell's research demonstrated that even young children can differentiate between a passive gaze and a gaze with meaning, and although we can't see Jackie's reciprocal actions here, the fact that Ally begins to smile while holding her gaze is suggestive that their shared look carries meaning—possibly a sense of "this is inappropriate"—presumably because Jocelyn is making a phone call in the middle of a group work session. While it is possible to continue contributing to group interaction at the same time as, for instance, texting or accessing the Internet, conducting a phone call is different and more troublesome. It can, for instance, interrupt the talk of other speakers, whereas the aforementioned practices are done silently and thus are less likely to suspend the copresent interaction (DiDomenico & Boase, 2013). As we see at the end of the extract, the other group members refrain from talking while Jocelyn is still interacting with her phone. Therefore, while Jocelyn may *account* for her mobile phone usage, this does not necessarily *excuse* it within the remit of group interaction.

These first two extracts have illustrated that while students may verbalize their orientation to their phones, it is done in a somewhat understated way. In both of these examples, the speakers lower their voices and speed up their speech, almost as an aside from the group conversation—a clear removal from the usual conversational tone, suggesting that such orientations to mobile devices are, like the way in which they are delivered, unusual or irregular. In Extract 8.3, however, we see a student who accounts for his mobile phone use in the opposite manner; instead of diminishing

```
52  Donald:     >°w'll° have ↑either've you< [tried iPhone
53              speaking
54                                           [((picks up
55              phone, looks at Phillip))
56              (0.5)
57  Rachel:     ((looks at Donald))
58  Phillip:    ((looking at Donald, shakes head)) °no°
59  Rachel:     we should try
60  Phillip:    [could do
61  Donald:     [I will try (.) right now
62  Rachel:     (good)
63  Donald:     I'VE GOT- I've e:ven got a recording app on
64              my phone
65              ((1.5: Phillip reaches into pocket))
66  Rachel:     ((looks at Donald)) doesn't ev'ryone
67              ((1.0: Phillip retrieves phone from pocket))
68  Donald:     £shut up Ra(h)chel [heh heh heh
```

Extract 8.3 **(a)** Clockwise from left: Phillip, Donald, Rachel. **(b)** Line 54: Donald picks up his phone as he highlights its relevance in potentially contributing to the group task.

the orientation to his phone, he involves it as being part of the task. As we join them, the group members are discussing possible ways in which to record a podcast for the PBL task.

In this third extract, we see group member Donald account for orienting to his mobile phone midtutorial but in a somewhat different way than in the first two examples. Instead of explicitly stating what he is doing (like going on the Internet to research or answer a call), Donald constructs his account as a "news announcement," directing the topic of conversation to the possibility of recording on an iPhone and thus justifying his orientation to it. This is very similar to the way in which Brown et al. (2015) noted that the interaction occasions, or makes relevant, the mobile phone use. In this instance, the mobile phone is collectively treated as relevant ("we

should try," line 59; "could do," line 60) by the others in the group, and so its use is made part of the ongoing interaction.

Schegloff and Sacks (1973) reported that talk tends to occur in pairs such as question and answer, offer and acceptance/refusal, and compliment and response, and as such, in asking whether his peers have "tried iPhone speaking," Donald is inviting a response. As he picks up his phone—concurrent with his asking the question—he looks directly at Phillip, which indicates that he expects an answer. This is of interest, because Donald holds Phillip accountable for answering the question. If Phillip had answered that he had, Donald's action of picking up his phone might not have been accepted because it was presumably not going to be beneficial for the group (since someone had already tried that course of action). In answering as he does, Phillip allows Donald's actions to be accepted within the remit of the group, as he is potentially solving the issue of how to record the group podcast. As such, the accounting is subtle; although Donald does not say outright to his peers, for instance, "I'm going on my phone to try the record app," his embodied action of lifting the phone up into sight of the group suggests that his question preempts—and accounts for—his course of action.

As Donald pursues his interaction with his phone, he goes on to tell his peers about the recording app his phone has (line 63), which further justifies his being on his phone within the tutorial. However, group member Rachel responds to this by minimizing the importance of it through suggesting that Donald's recording app—which is currently justifying his interaction with his phone—is something that "everyone has" (line 66), and it is at this point that Phillip too takes his phone out of his pocket, an action noted in another study as being made normative through the actions of others (Jin et al., 2015). Although we do not know if Phillip has an iPhone (and therefore, presumably, the same app that "everyone" with an iPhone does), it is possible that he retrieves his phone in order to investigate whether his has the same function. There is no verbal orientation to or justification for producing his phone, possibly because the action takes place behind his laptop screen and as such is not visible to the whole group.

Next, we see another example of mobile phone interaction serving as an invitation to follow a particular course of action. In Extract 8.4 we join a group of students just at the moment when they have veered off from the PBL task and are talking about Katy's daughter Carly.

69	Katy:	Carly's writin' a feminist essay
70	Helen:	[is she
71	Chloe:	[*((picks up phone))*
72		*((33.0: the rest of the group chat as Chloe*
73		*interacts with her phone underneath the*
74		*table))*
75	Katy:	Lucy's like tha' "she's never gonny ask you
76		fur help again" °ah was like° (inaudible)
77		(1.0)
78	Hannah:	put 'er off [£hm hm
79	Chloe:	[heh
80		*((11.0: Katy picks up her notes, Deborah*
81		*appears to be reading, unclear what Hannah*
82		*is doing))*
83	Chloe:	*((not looking up from phone))* will we've a
84		break
85		*((1.5: Deborah looks at Chloe's phone))*
86		*((Chloe looks to Deborah))*
87	Deborah:	*((looking at Katy, smiling))* °yeah° *((nods))*
88		(3.0)
89		*((Hannah stands up to leave room, Deborah*
90		*produces her phone))*

Extract 8.4 **(a)** Clockwise from left: (a) Katy, Hannah (hidden), Deborah, Chloe. **(b)** Lines 80–82: Group appears to be refocusing on the task, while Chloe is on her phone under the table.

Whereas in the previous extract Donald's accounting for his phone use was to propose that they use it for their task, here Chloe makes her actions relevant by suggesting that the group take a break. As we join the group, Katy holds the turn at talk—discussing her daughter's exam revision—and Hannah and Deborah have been cofacilitating the conversation, until there is a lull at line 80. At this point, we see Katy orient to her notes in front of her, pulling them toward her and apparently reading them, while Deborah

does the same. Chloe, on the other hand, is still interacting with her phone, albeit covertly under the table.

Although a suggestion of a break may appear to come at an appropriate time—since the group has been off task anyway—her peers' actions within the period of silence do not indicate alignment with Chloe's subsequent proposal at line 83. In "doing academia" (i.e., shuffling papers, reading, picking up pens), Chloe's peers display behaviors that are "socially accountable" (Buttny, 1993)—that is, that are relevant to the interaction. In reading and orienting to the papers in front of them, the rest of the group demonstrates the relevance of their actions; they are in a PBL tutorial and so are doing PBL-relevant activities. The silence that follows is therefore problematic, since some of the group members are demonstrating that they are back "on task," while other group members demonstrate exactly the opposite. Any one of the group members could initiate the next turn at talk and as such direct the topic of conversation, and it is at this point that Chloe accounts for her interaction with her mobile phone by uttering "will we've a break" (as in "will we have a break").

As was noted in the previous extract, the fact that Chloe turns her head to look at Deborah suggests that she is looking for a response; in doing so, she holds Deborah (or at least *some*one in her group) accountable to answer. Suggesting that the group take a break at that precise moment in time therefore demonstrates the relevance of her phone interaction—that it is acceptable to use a phone during a break—which is perpetuated by Deborah's immediate orientation to her own phone once the break has been confirmed (line 87). However, it also highlights Chloe's acknowledgment that being on the phone when not officially on a break is inappropriate (supported by the fact that her phone interaction was under the table and thus not explicit), and so to rectify this transgression, as soon as the official break begins she is not accountable anymore for not contributing to the group.

Deborah's response here is reminiscent of Ally's in Extract 8.2 as she gazes at another member of the group and smiles, possibly acknowledging the irony that Chloe has suggested having a break despite behaving in a way consistent with already being on a break for the past short while. Nonetheless, the group members move smoothly into their break without further discussion.

This extract was different from the previous ones because of the delay in accounting for mobile phone use. In the first three extracts, accounting coincided with orientation to the phone, whereas here there was a long period of interaction before this happened. Although the accounting did

finally come, the next section details what can happen within a group if a mobile phone user does not account for his or her actions.

To conclude, we detail an example in which students do not account for their mobile phone use and as such are held accountable by another group member. Such activities are less common and more tricky to manage, as they raise issues regarding whose responsibility it is to address such transgressions. In this interaction (Extract 8.5), the group members are

91	Kate:	*((to Raymond))* right do you think your
92		paper should be in the-
93	Raymond:	*((looking at Ella))* me:::h yeah [with
94		changes
95	Ella:	[(inaudible) yeah
96		changes (.) >I jus'- I jus'< think
97		there should be more data BUT I did
98		like it
99		[*((Kate reaches for biscuit))*
100	Raymond:	[yeah it was g- it was interestin'
101	Annabel:	°yeah°
102	Raymond:	jus' a larger sample size
103	Kate:	*((turns to Ava))* what's wro:ng
104	Raymond:	prob'ly
105		*((all look at Ava))*
106	Ava:	*((not looking up from phone))* eh am
107		try'a like find a way of setting up
108		Google mail
109	Annabel:	ah liked our paper like I liked it when
110		I got into it

Extract 8.5 **(a)** Clockwise from left: Ella, Annabel (hidden), Raymond, Kate, Ava. **(b)** Line 105: Kate's turn initiates the others' gaze toward Ava.

discussing whether a journal article should be included in a fictional conference, as per the PBL task. Group member Ava is openly interacting with her phone.

This example demonstrates what happens when a group member does not account for his or her mobile phone use. As we join the group, the members are on task, reporting back to each other about the worthiness of certain journal articles they have read. The lack of discernible pauses or hesitancies indicates a fluid conversation, positioning this group as competent and able; however, one group member is not contributing, and this needs to be addressed. As such, Kate orients to Ava's lack of input, formulating it as being problematic and needing to be addressed within the group environment. Kate could have simply asked what Ava was doing or quietly spoken to her in an aside, but by asking "what's wrong" (line 103) in the midst of the group discussion, she highlights the immediacy of the situation; Ava has not voluntarily accounted for her shift in attention, so she is asked about it immediately, not when there is a lull in the conversation.

Kate's formulation that something is "wrong" constructs Ava's actions as troublesome, as something out of place in the regular group dynamics, and despite being a peer, Kate demonstrates the appropriateness of holding Ava accountable for her actions. Ava responds but without looking up, indicating that her attention is so focused on her phone that she disregards the impact of this on her group. Although she answers, she does not change her actions, indicating that she orients to "setting up Google mail" (line 108) as more important than contributing to the discussion, which is returned to and continued by the other group members.

This extract demonstrates the ability the group has to function when faced with a problem without input from, for instance, a facilitator. The self-monitoring here initiated by Kate shows that group members are held accountable for their actions and that despite the absence of the facilitator, groups don't automatically begin slacking off, which is of particular interest considering that such self-monitoring is beneficial for academic achievement in PBL (Loyens, Magda, & Rikers, 2008). However, the quick reorientation to the on-task discussion suggests that while the group members do not sanction Ava for her actions, it is treated as problematic, and they do not engage further about it, evidencing the more troublesome environment when mobile phone orientation is not accounted for by the user.

DISCUSSION

These extracts illustrate actual student interaction in PBL tutorials and the processes involved in accounting for mobile phone use while in an academic context. To begin, we saw how accounting for phone use by the phone user was done at the time of the interaction—a common occurrence, as it diminishes the likelihood that said user will be held responsible for disrupting the group dynamic by diverting the members' attention. If phone users detail immediately why they shift to their phones—for instance, to answer a call or to search for an article—they are preempting being asked. In the fourth extract we saw an example of a student accounting for her mobile phone interaction by situating it as an invitation to take a break. This extract was different in that the accounting came after a delay, but when it did come, it served a function for the group, so the phone user escaped potential criticism. In the final extract we saw that if a phone user did not account for her mobile phone use, she was made to do so by a peer. One of the conclusions of this essay, then, is that in our dataset, mobile phone interaction did not go unchecked in PBL tutorials; either the person using his or her phone or one of the other group members attended verbally or through gaze to the relevance of the mobile phone *at just that moment in the interaction*. That mobile phones will be used in PBL settings is perhaps inevitable, providing as they do a source of information checking and increased accessibility to resources, but we can examine how group members deal with this usage *as a group*, thus demonstrating the impact it can have on group dynamics.

As noted by Chan et al. (2015), for instance, facilitators may have concerns that mobile phones could disrupt discussion or reduce interaction between students and as such may be resistant to the use of mobile technology in PBL tutorials. Our analysis supports Chan et al.'s (2015) and Jin et al.'s (2015) finding that students self-regulate and normalize their phone use, providing additional evidence to show *how* this self-regulation is managed as part of the discussion. Like Brown et al. (2015), we also suggest that mobile phone use in interactions need not be considered detrimental to discussion and that the group members in the PBL tutorials remain oriented to and included in the group interaction, even when their immediate attention is turned elsewhere.

This analysis contributes to research into the use of ubiquitous computing in educational contexts by illustrating how students might begin

to self-regulate their learning and use of mobile devices while working with others (Laru, Naykki, & Jarvela, 2015). For facilitators, this chapter may provide reassurance that students will, in some situations, self-police their mobile phone use or sanction their group members if they fail to do so themselves. For students, the fact that fewer mobile phone interactions happened in the opening and closing stages of the tutorial than in the middle stage suggests that mobile phone interaction perhaps takes a backseat to general chat and thus socialization between group members. The data show that students spend more time conversing while settling down and packing up as opposed to being on their phones, indicating that the turn to mobile phone interaction happens for a reason—such as searching for a journal article or answering a telephone call—and not just for something to do.

Despite the knowledge gained about students' mobile phone interactions, it is of course crucial to highlight the limitations of this study. Despite the large dataset of 58 PBL tutorials spanning 85 hours, this analysis was limited to two UK university contexts, one in which PBL was not the main form of teaching approach used. As such, other universities and cultural contexts may reveal different normative behaviors around phone use, which would be worth investigating. In addition, this chapter only examined the immediate interactional context after the pick-up of the mobile phone; it would also be of interest and importance to examine other aspects of student-phone interaction: what happens when the phone is put away, for example, or what happens when a facilitator enters the room. Conducting more research into these practices would allow further insight into the discrete interactions taking place in the PBL setting, which in turn would position us as educators to be able to support more effective learning.

Finally, the analysis developed in this chapter opens up possibilities for further research on the use of technology in PBL settings, complementing the work of those already publishing in the area (e.g., Bridges, Green, Botelho, & Tsang, 2015). For instance, the analysis demonstrated how group members accounted for their mobile phone use at a specific moment in the interaction—that is, when the phone was picked up. Specifically, we suggest the following as areas that require further exploration:

- Use of mobile phones at different times during the PBL tutorial (i.e., at the start, in the middle, or during the closing phases of the tutorial) as well as different stages during the PBL process

(e.g., while the problem is first explored, when group members are reporting back, or when new findings are applied to the problem; for discussion of the applications of mobile technology at each PBL stage, see Chan et al., 2015; Jin et al., 2015). Each of these moments holds different accountabilities for group members in terms of their involvement in the group, according to the task they are engaged in and the collective orientation of the group as a whole.

- What happens when mobile phones are put away or put down: the moment of disengagement from technology and back to the group.
- How the use of mobile phones or other mobile devices might differ according to group size. The groups in our study were between four and five members; with larger groups the flow of conversation may be fragmented into subgroups, and the use of mobile phones might not impact group engagement in the same way.
- How mobile phones are used in different PBL settings (i.e., different models of PBL, whether the facilitator is present or not, and in different disciplines). Are the patterns of accountability seen in this study culturally specific or pertinent to the particular models of PBL used in these classes?

CONCLUSION

This chapter demonstrates what happens within group interactions at the point at which a group member picks up and begins to use his or her mobile phone during PBL tutorials. This act tends not to go unacknowledged; normative practices show that the mobile phone user will account for why he or she is producing the phone at that moment—whether it is to benefit the group or invite a particular course of action—and if the phone user does not, another member of the group will orient to it. This suggests that despite the increase in mobile phones in the classroom (e.g., Barry et al., 2015), interacting with a phone within the group setting is still not considered straightforwardly acceptable. The accountability of mobile phone use in PBL tutorials provides further evidence for the importance of social interaction in learning; what is important here is the group member's

attention within the group rather than necessarily the specific activity on the phone. Through subtle verbal and nonverbal acknowledgments, therefore, group members were able to ensure that the phone user was still with the group to ensure continued focus on the tasks at hand.

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APPENDIX 1: JEFFERSON NOTATION SYSTEM

((action))	nonverbal action
(.)	just noticeable pause
(1.0)	timed pause
.hh	in-breath
wor-	cut-off word
>word<	faster speech
<word>	slower speech
WORD	louder speech
°word°	quieter speech
word	emphasised speech
£word	"smiley" speech
wo(h)rd	(h) denotes laughter bubbling within word
wo:rd	: denotes stretching the preceding sound
Speaker A: word=	= denotes no discernible pause between two
Speaker B: =word	speakers' turns
Speaker A: word [word	overlapping talk
Speaker B: [word	

*Adapted from the system developed by Jefferson, printed in J. M. Atkinson and J. Heritage (Eds.), *Structures of social action; studies in conversation analysis* (Cambridge: Cambridge University Press, 1984), ix–xvi.

APPENDIX 2: MOBILE PHONE PICK-UP INSTANCES

TABLE 8.2 *Mobile Phone Pick-up Instances from 58 PBL Tutorials/85 Hours of Recordings*

Opening stages: Before facilitator has been to see group or a group member initiates focusing on work	**Middle stages:** Between facilitator checking in with group at start and last visit from facilitator at end	**Closing stages:** After facilitator has visited for final time and orients to finishing up
82 (25%)	82 (25%)	48 (15%)

Note: This information is as accurate as possible, dependent on camera angles, obscured views, and recording quality. In addition, some individuals remained interacting with their phones for long periods of time, which is not reflected in such instance counting.

CHAPTER 9

Students' Strategies for Managing Social Loafers in Problem-Based Learning

Interactional Means of Dealing With Unequal Participation in Group Work

Robert McQuade*
University of Strathclyde
Esther Ventura-Medina
University of Strathclyde
Sally Wiggins
Linköping University
Gillian Hendry
University of the West of Scotland
Anthony Anderson
University of Strathclyde

INTRODUCTION

In this new era of education, employers are looking for graduates who are not only academically proficient but also possess a variety of attributes, such as being communicators, leaders, and networkers (Davidson & Major, 2014). As well as technical and practical subject knowledge, today's students of the Information Age (Lee, Huh, & Reigeluth, 2015) must be capable of working with others and jointly making decisions, regardless of the unpredictable work-based challenges that they may face (Woods, Briedis & Perna, 2013). Essentially, employers demand the professional skills that gear graduates directly towards industry needs, and these competencies must be cultivated by educational institutions throughout the world (Imafuku, 2012). Problem-based learning

* Corresponding author.

(PBL)—a group-based pedagogical approach wherein students are placed at the core of their learning—has been shown to foster these very skills (Boud & Feletti, 1997).

As a student-centred pedagogy, PBL is in clear contrast to the authoritative dynamics of traditional didactic teaching; students are no longer forced into a passive learning role and are instead empowered to be accountable for their own learning (Kindler, Grant, Kulla, Poole, & Godolphin, 2009). Through its modern theoretical foundations (Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005), students must work actively, and collaboratively, if they are to develop resourceful solutions to the problems at hand. Through its focus on authentic scenarios, PBL aligns with the realities of graduate employment, recognising the necessity of socialising learners towards professional identities and functioning autonomously (Imafuku, 2012). In turn, PBL is associated with positive cognitive effects, including deep learning, critical thinking, enhancement of intrinsic motivation, and the ability to more readily integrate knowledge with applied problem tasks (Dolmans & Schmidt, 2006).

One major challenge in the implementation of PBL and other forms of group work, however, is dealing with the social loafer: a group member who continuously disengages with the tasks at hand yet seeks academic reward from the efforts of his or her peers by freeloading (Aggarwal & O'Brien, 2008). The social loafer concept derives from social psychology (Latané, Williams, & Harkins, 1979) and is classed as a critical incident in PBL tutorials (de Grave, Dolmans, & van der Vleuten, 2001), one that leads to dysfunctional groups as a result of chronic tardiness, absenteeism, and a lack of commitment (Kindler et al., 2009). Previous research has illuminated the detrimental consequences of social loafers in impeding the effectiveness of group work (Elder, 2015; Kindler et al., 2009); even highly motivated team players become worn down, and serious relationship conflicts often ensue (Lee et al., 2015). These issues of uneven participation have been linked to the primary reasons for student dissatisfaction with group work (Aggarwal & O'Brien, 2008) and may be one reason students feel short-changed when exposed to PBL, despite attaining their learning goals more successfully than in traditional teaching (Warnock & Mohammadi-Aragh, 2016; Yadav, Subedi, Lundeberg, & Bunting, 2011). In short, social loafing is a main contributor to dissatisfaction with group work and has major implications for the successful implementation and overall productivity of PBL.

While it has been established that social loafing is the principal complaint associated with student group work (Woods, 2001), very little research has considered the social processes of PBL in action (Imafuku & Bridges, 2016). This is problematic, as previous studies have demonstrated the importance of the intricacies of student interactions (e.g., Hendry, Wiggins, & Anderson, 2016; Imafuku, 2012; Jin, 2012; Skinner, Braunack-Mayer, & Winning, 2012), and therefore they must not be overlooked if we are to meaningfully determine what works in PBL (Imafuku & Bridges, 2016). For instance, in studies of traditional group work, British students showed clear resistance to "doing academia," in which maintaining alliances with fellow students was prioritised over educational endeavours, and they were heavily reliant on the tutor dealing with any arising social challenges on their behalf (Benwell & Stokoe, 2002; Sharma, 2013). In contrast, PBL encourages the students themselves to develop the necessary competencies required to smooth out their difficulties (i.e., instances of social loafing) if they are to thrive as a functional group (de Grave et al., 2001; Woods, 2001).

The presence of social loafing is an especially prominent concern in tutorless (Woods, 1996) and floating facilitator (Duch, Groh, & Allen, 2001) PBL models, in which the self-regulatory skills of students are more explicitly called upon to effectively manage team interactions (Lee et al., 2015). The floating facilitator PBL model is becoming more widely implemented in light of increasingly large cohort sizes in educational institutions and limited tutor numbers (Delaney, Pattinson, McCarthy, & Beecham, 2017). In this approach, one facilitator "floats" between several PBL groups and only intermittently offers face-to-face contact with the students, leaving the students to plan, organise, and monitor the vast majority of their PBL progress (Dolmans et al., 2005). This may seem like an impractical pressure to inflict upon student learners, but these expectancies are no different from the social requirements of employment today (Marra, 2012). That is, alongside their core knowledge of the discipline at hand, graduates must possess the necessary professional skills to disagree—both appropriately and effectively—if they are to maintain their position within workplace communities (Woods, Briedis, & Perna, 2013; Marra, 2012).

Despite the fact that the processes within tutorless PBL environments remain largely unexplored by interactional research, it is often assumed that student groups have no capacity for self-managing social problems (Clouston, Westcott, Whitcombe, Riley, & Matheson, 2010), and that

interpersonal complications override any meaningful gains from PBL itself (Elder, 2015). In turn, short-term solutions tend to be adopted by inexperienced tutors (e.g., transferring problematic group members to other groups or premature/overly directive intervention), inhibiting the adaptability of students for future novel situations and differing learning styles (Woods, 2001). By removing student ownership of managing difficult incidents, not only are the values of PBL abandoned—the need to actively participate in, negotiate, and positively manage group interactions (Dolmans et al., 2005)—but the developing learner identity is obstructed from its opportunity to learn from these occurrences and to develop strategies for what is inevitable in real-life work (Kindler et al., 2009).

AIMS

In summary, whilst the goal of PBL is to promote collaborative and equal engagement in the discussion of problem tasks, this does not always happen. Uneven participation is a significant challenge in tutorless PBL, but it is also important to recognise that PBL itself is deliberately ill structured and thus some degree of pressure is necessary if students are to gain from their experiences (i.e., acquire the generic skills necessary for teamwork) (Imafuku, 2012). Students need to learn how to collaborate—this is just as critical as the knowledge itself—and so some trial and error is inevitable (Lee et al., 2015). In this chapter we raise important questions of how students self-manage instances of social loafing (if at all), alongside delicate issues of learner identity and pressures to fit in as part of the PBL team. The analysed data come from projects utilising the floating facilitator approach (Duch et al., 2001), which is predominately student driven and forces accountability for PBL onto its students.

METHODS

Participants

Twenty-two chemical engineering undergraduates comprising four groups (October 2015–March 2016; 30 hours) and five psychology students in one group (October–December 2012; 21 hours) were voluntarily video-recorded during PBL tutorials at a UK university. In order to encapsulate

all visual and auditory elements of the interaction, students were filmed in private meeting rooms during their tutorials. Both sets of data were transcribed with reference to the Jefferson (1984) system (see Appendix). Full approval was granted by the ethics committees of both departments whose students participated in the study.

Students were exposed to the floating facilitator PBL model (Duch et al., 2001), in which a distanced stance is taken by the PBL tutor, who only intermittently participates in the monitoring of academic tasks, acting as the scaffolding of support (Wiggins & Burns, 2009). With this newfound autonomy for groups comes the responsibility to self-manage social difficulties (e.g., social loafing), and it is these tutorless fragments that are examined in more depth here.

ANALYTICAL APPROACH

Conversation analysis (CA) allows a microanalysis of the sequential organisation involved in the student-driven PBL experience (e.g., the management of educational business without the continuous support of the tutor) (Antaki, 2011). Through its systematic focus on what emerges from naturally occurring interactions, attention was given to how students attend to the institutional demands of "being" a PBL learner (and "doing education") alongside social pressures to fit in as part of the team (Schegloff, 2007; Benwell & Stokoe, 2002). With that in mind, it was noted that two groups (one from each of the separate datasets) had issues with a group member who was repeatedly late for PBL sessions, failed to adequately prepare for meetings, or did not fully contribute during tutorial meetings. The analysis therefore centres on instances taken from those group meetings in which participation in group work was explicitly addressed. The discussions with and about the "problematic" group members (pseudonyms Regina and Callum) are then the focus of the analysis (Extracts 2–6), with Extract 1 included as an insight into the management of one-off occurrences of social loafing (e.g., pseudonyms Sharon and Linzi, who only once failed to contribute to the PBL task preparations). Through CA, we were able to examine the interactional strategies used by students as recipients of loafing behaviours, as well as the typical patterns of talk presented by those engaging in loafing behaviours themselves (Schegloff, 2007).

Analysis

The analysis illustrates how the issue of social loafing is managed within PBL tutorial interaction by students when there is no tutor present. Extract 1 follows immediately from a brief conversation in which Linzi and Sharon admit to having failed to prepare for the current PBL session. It is at this point that Craig, who is chairing this session, asks whether others have prepared:

Extract 1: PBL Group A

1	**Craig:**	did anyone else do anything (.) did anyone even do their
2		research?
3	**Linzi:**	I've already [said
4	**Craig:**	[outside now Linzi£
5	**Linzi:**	I'll accept a verbal warning
6	**Sharon:**	so will I accept a verbal [warning
7	**Craig:**	[actually it's a written£
8		warning now
9	**Annie:**	e:m no but how can we: what can we improve on as a team?
10	**Craig:**	do: the research£
11		*((group laughing))*

This first extract elucidates the somewhat playful negotiation of social loafing. Initially, Craig's utterances emphasise the significance of the situation ("did anyone else do anything," line 1); his requests to the group call for some degree of conversational uptake ("did anyone even do their research?," lines 1–2). In response, Linzi reiterates her admission of failing to prepare ("I've already," line 3), as though she has already been forthright and her accountability has been established through earlier discussions. As we move to line 4, note how Craig's overlapping turn teasingly scolds Linzi; he acts as the disciplining teacher by asking his student to leave the classroom ("outside now Linzi£"). In doing so, as someone who has actually prepared for the session, Craig alleviates the seriousness of the previous interactions. This is also shown through Linzi's and Sharon's readiness to accept their punishment ("I'll accept," 5; "so will I accept," 6), and Craig's humorous upgrade ("written£ warning now," lines 7–8), as though escalating forms of punishment will ensue if social loafing continues. In this way, the offending students are forced to acknowledge their failure to contribute, and that

boundaries do exist, but use coconstructed humour to avoid a hostile PBL environment, which would be detrimental in the long term.

In line 9, Annie's participation in these discussions orients to the sole purpose of the PBL session: the necessity of doing education (Stokoe, Benwell, & Attenborough, 2013). Annie opts not to engage in the group humour ("e:m no but," line 9); these utterances call attention to the seriousness of the matter at hand (i.e., that PBL is not running as it should). Note how Annie also makes repeated reference to the collective group ("we:"; "improve on as a team," line 9), and thus each member holds a duty to ensure they complete their fair share of the workload. This is reciprocated by Craig's blunt response ("do: the research£," line 10), but again he ends on a laughing note (line 11). This allows the problem to be addressed without being too authoritative, which could be damaging to team morale and could cast Craig or Annie as substitutes for the absent tutor, a prominent issue in these tutorless occurrences.

In summary, this first analytical extract shows how the students of group A negotiate the direct implications of social loafing through shared humour, coupled with subtle orientations to warning talk, and the notion of 'being in it together' (Benwell & Stokoe, 2002). Let us now explore another instance of loafing behaviours as we visit Group B in a similar scenario:

Extract 2: PBL Group B

1	**Jackie:**	we're just trying to decide just now like what-
2	**Nadia:**	what we're doing and how [best to like do it
3	**Regina:**	[yeah . . . I've been so:: unwell-
4		like really really unwell
5	**Jackie:**	so have we:£
6	**Nadia:**	I feel like I'm gonna throw up any minute-I'm glad I can see
7		the bin£ *((Nadia laughs))*
8	**Regina:**	really? oh God I'm just-I'm still doped up on pain killers
9		but I couldn't even really work I-(.)read the first one right-
10		I'll just be honest with you-I read the first one and I've
11		read half of the [the other one
12	**Nadia:**	[I've only read one and I was like what
13		is this?
14	**Regina:**	it's so difficult . . . just didn't want yous to think I wasn't

15 bothering
16 Nadia: no I-no-I never even got onto the second one

Lines 3–4 follow on from Regina's late arrival to the meeting, where she offers an emphatic excuse for her tardiness ("been so:: unwell-like really really unwell"). Jackie and Nadia immediately align with Regina's account and, as seen in Extract 1, laughter is used to maintain a relatively informal learning environment, each adding an upgraded assessment of her respective health status. As such, they not only manage their identity as sharing similar experiences but also project forward to their accountability for not having been able to do their work. Ill health provides a morally justifiable reason for not having completed the work, one that is difficult for others to challenge or refute. For instance, Regina prefaces her admission that she has not completed the required reading for the week ("still doped up on pain killers"; "couldn't even really work," lines 8–9), as though her having failed to complete the required preparations is justified by her unavoidable health state and not something she would normally do (i.e., these are extreme circumstances).

Moving to line 10, Regina makes reference to her candidness regarding her lack of preparation ("just be honest"). This "honesty formulation" works to assert her sincerity (Edwards & Fasulo, 2006), as though she is fulfilling an obligation to remain transparent with her team ("with you"). However, Regina makes clear that she has attempted at least *some* of the work ("read the first one"; "read half of," lines 10-11). This is critical, as her peers have also verbalised their unwellness but have still attended the session on time and may have come fully prepared, too. For Regina to have made no contribution at all, the validity of her excuse would be put into question, and her loafing may not be so smoothly defused.

The ensuing lines work in Regina's favour, as Nadia provides her own admission of having "only read one" (beginning line 12) of the required articles. What is particularly marked here is Nadia's orientation to the complexity of the reading materials ("I was like what is this?," line 12), which coconstructs the 'difficulty' (line 14) of the academic tasks as being to blame, rather than the group's own lack of effort. These strategies align with previous student interactional research (Hammar Chiriac, 2008; Benwell & Stokoe, 2002) and are congruous with the present analysis, in which cohesion is maintained by projecting accountability outside the group (e.g., onto the academic institution). This is shown through Regina's further display of allegiance to her team ("didn't want yous to think I wasn't bothering," lines 14–15: the plural 'yous' emphasising group alliances), and her excuse

is legitimised once more by Nadia's final assessment ("no I-never even got onto the second one," line 16).

Therefore, as shown in the previous extracts and throughout the data corpus, one-off instances of social loafing were treated as relatively minor group offences when they occurred in early PBL meetings, as they were not in close proximity to the pressures of the final PBL group assessment. In the next extract, however, we revisit Group B several weeks later as they face an imminent joint deadline. Rather than having committed only one offence, Regina has persisted in her lateness and inadequate preparation for PBL sessions. Let us first consider the discussions prior to Regina's entrance, in which gossip talk is used as an interactional strategy to manage the group's struggles:

Extract 3: PBL Group B

1	**Ally:**	Regina'll probably be late
2	**Nadia:**	walk in late or train won't get in 'til £five past
3		*((group laughing))*
4	**Nadia:**	that's what she says every single day so why don't you get
5		the *((inaudible swearing—Jackie and Ally smile))*
6	**Jocelyn:**	*((to Nadia))* that's like us-like we get here on the dot
7	**Ally:**	if she needs to get her kids to school or whatever
8	**Nadia:**	she puts them in breakfast club
9		*((group laughing))*
10	**Ally:**	oh so there's not really much reason then
11	**Nadia:**	and she goes runs before she comes in
12	**Ally:**	hhhh *((laughing))*
13	**Jocelyn:**	are yous getting annoyed already?
14	**Jackie:**	yeah we have been-was nearly having a nervous breakdown£

In briefly examining these interactions that occur prior to Regina's arrival, we see how the group members engage in a series of gossiping behaviours, in which active voicing (Wiggins, 2017) is used to mock Regina's commonly used excuses ("train won't get in 'til £five past," line 2; "what she says every single day," line 4). Typically, groups direct this teasing talk towards external parties and in turn strengthen their own cohesion as a united team (Hendry et al., 2016). In this case, however, by projecting these negative evaluations onto an absent Regina, her status as a fellow in-group member is threatened. For instance, in line 6 Jocelyn references her own train journey with Nadia ("that's like us-like we get here on the dot") and how

they ensure their punctuality; personal pronouns ("us"; "we") emphasise their dissimilarity to Regina. That is, by constructing Regina as the group other, the remaining peers further their sameness and power through the uneven PBL participation that has been inflicted on them (Stokoe, 2000).

From Extract 3 it is also apparent that Regina's continuous loafing tendencies are not the only complaint of the group about Regina. In line 7, for example, Ally raises the challenges of Regina's role as a mother ("if she needs to get her kids to school"), but her sympathies are quashed by Nadia's questioning of Regina's authenticity ("she puts them in breakfast club," line 8). The ensuing lines more firmly construct Regina's excuses as disingenuous ("not really much reason then," line 10; "she goes runs before she comes in," line 11), which raises the burden being placed on the group ("getting annoyed," line 13; "nervous breakdown," line 14). If we now shift to Regina's eventual arrival at the PBL session, we gain insight into the group's management of face (Goffman, 1955). Notice how the humorous atmosphere is very quickly dissolved as the group members focus on the educational business at hand, but institutional politeness (Brown & Levinson, 1978) persists:

Extract 4: PBL Group B

1		*((Regina knocks at the door))*
2	**Jackie:**	↓enter£
3		((*Nadia, Jackie and Jocelyn laugh))*
4	**Regina:**	HIYA:
5	**Nadia:**	why don't we just get to the aims then (.) then the
6		methodology then findings and write notes for each of them?
7	**Jackie:**	yeah
8		*((Nadia, Jackie and Jocelyn chat amongst themselves))*
9	**Nadia:**	who's being the chair then?
10	**Regina:**	I'll be the chair
11	**Nadia:**	okay
12	**Regina:**	right quickly run over how we're doing this again?
13	**Nadia:**	we're just gonna go through each one again and just get the
14		main points out of it so we all like understand
15	**Regina:**	mhmm okay
16	**Ally:**	first of all how did you find it ↑Gina?
17	**Regina:**	emm the-well I was only focusing on that man-the one-

18	**Ally:**	the "man face" (article)
19	**Regina:**	yeah yeah, I mean obviously-I mean you weren't here last time
20		but I burst into tears
21	**Nadia:**	heh heh
22	**Regina:**	'cause I was finding it really £difficult em but yeah em this
23		one it took me-although this was the easiest it took-
24		me a long time
25	**Nadia:**	mhmm
26	**Regina:**	still but I think I got the main gist of it

When Regina knocks on the door, Jackie speaks in a low-pitched, laughing voice ("↓enter£," line 2) but does not project her utterances loud enough for Regina to hear; this is an intentional move, with the joke being shared amongst the in-group only. Furthermore, despite her knocking at the door and energetically greeting her peers ("HIYA:," line 4), the group continue their ongoing discussions of the PBL tasks and display no acknowledgement of Regina's presence. These conversations are lengthy (line 8), and it is not until Regina actively works herself into the interactions ("I'll be chair," line 10) that she is verbally involved by her peers. By promptly volunteering her acceptance of the chairperson role, Regina orients to the fragility of her identity as a group member and the need to restore her connection with her peers.

However, Regina's gesture of goodwill receives only minimal response ("okay," line 11) and is made more problematic by her request for clarification ("quickly run over," line 12), which makes it clear that she has no inkling what the PBL role actually entails. In turn, Ally's interjection in line 16 questions Regina's ability to proceed as chairperson ("first of all how did you find it ↑Gina?"). This checking formulation (Stokoe, 2000) serves to determine whether Regina has completed the required preparation work but is delivered in such a way (e.g., using the intimate "Gina" nickname) that it avoids being too probing. In line 17, Regina responds with the indirect admission ("I was only focusing on"; as opposed to 'I only read one') that she has read only one of the two articles, as she succumbed to the pressures of the academic task ("I burst into tears," line 20; "finding it really difficult," line 22). This is an intruiging point in the interaction; Regina not only justifies her lack of progress through this emotion category (Edwards, 1999), but she also works to neutralise her wrongdoings by emphasising the nonattendance (i.e., a potential loafing behaviour) of another group member ("I mean you weren't here last time," line 19).

Despite Regina's proffers, her peers are unreceptive to her excuses (Nadia's minimal responses: "heh heh," line 21; "mhmm," line 25). In light of this, whilst she admits that she found even the "easiest" (line 23) task to be "really £difficult" (line 22), as in Extract 2, Regina is cautious not to position herself as being wholly incompetent in doing academia, as this would be truly catastrophic for her group membership. By showing an understanding of at least the core knowledge ("got the main gist," line 26), she salvages her membership to some degree and enables the task to proceed (Stokoe et al., 2013). Therefore, regardless of their private gossiping beforehand, the students recognise the expectations of the institutional environment (Brown & Levinson, 1978), in which even social loafers must be allowed to participate in the educational business at hand (i.e., to do PBL). However, as shown here, the boundaries between professional and personal are also made explicit, and the group are intolerant of Regina's excuses, as well as her discursive rights to be involved in the social "luxuries" of group humour.

We now examine the case of Callum, a student from Group A, who has similarly displayed recurring loafing behaviours. Like Regina, Callum uses metatalk to distract from the PBL work to be tackled and instead dwells on process issues that have supposedly inhibited his participation:

Extract 5: PBL Group A

1	**Callum:**	I dunno I found it quite: difficult to actually find
2		information on this-found the main suppliers (0.2) you know
3		obviously you've already written about it *((points to*
4		*Sharon))* you've written about it *((points to Craig))*
5	**Sharon:**	E:MM a bit of crossover's not bad
6	**Callum:**	yeah
7	**Sharon:**	like (.) as long as you're not doing the same thing twice
8	**Annie:**	yeah BUT there will be-you'll be able to rea:d (.) the stuff
9		on the forum
10	**Callum:**	yea:h
11	**Sharon:**	mhmm
12	**Annie:**	should be able to read theirs ove::r a:nd (.)
13	**Callum:**	I know (.)
14	**Craig:**	Linzi's up next

Callum's opening lines illuminate the standard excuse format, in which he first details the struggles he encountered in his individual research ("found it quite: difficult to actually find information," lines 1–2) but does not put his capacity to do education in jeopardy (Stokoe et al., 2013), noting that he has "found the main suppliers" (line 2) (i.e., the bare minimum). He attempts to neutralise his failure to obtain the relevant information by characterising it not as a result of his lack of effort but as an avoidance of repeating work already achieved by the group ("obviously you've already written about it," line 3). Callum formulates hearer-specific appeals accompanied by physical gestures to establish solidarity with Craig and Sharon, as though his actions are justified; there is no point in wasting time and effort when the problem has already been solved. Similar to Regina in the previous extract (and throughout the overall data corpus), Callum steps out from the content of the PBL tasks and instead reports on group processes in orienting to an underlying issue that has prevented his equal participation.

In line 5, Sharon is the first to oppose Callum's rationale ("bit of crossover's not bad"), followed by Annie's explicit alignment with Sharon's stance, which makes relevant the availability of academic support networks ("you'll be able to rea:d (.) the stuff on the forum," lines 8–9). That is, Callum has no excuse for failing to communicate his concerns with the team; thus his excuse is treated as inauthentic. Annie's reference to the group forum is particularly significant, as our analysis highlighted a deliberate shift made by students from their own private social media spaces (e.g., Facebook and WhatsApp) to the institutional discussion forum. In this way, the group documented Callum's worsening behaviours through a digital paper trail, available for the class leader to monitor. They tracked their unsuccessful efforts to encourage Callum's involvement without directly informing the tutor, and this may function as an alternative strategy for powering through the self-managed PBL.

A pivotal point in the extract comes in the final line; after a very brief pause (line 14), Callum loses his discursive space, as Craig positions a new agenda ("Linzi's up next"). Having experienced several PBL sessions with this recurring behaviour, the group do not dwell on Callum's inadequate contributions and swiftly continue their focus on the remaining academic business at hand. Furthermore, if we reconsider Callum's responding turns throughout, despite being granted the opportunity to defend his position, once confronted by Sharon's and Annie's oppositions, Callum seems to quickly back down from his justification (which might suggest that he

himself knows his position to be indefensible). However, similar to the previous case of Regina, whilst they coconstructively shut down Callum's excuse, the group first ensure he is given the space to offer his account of matters, essentially a diplomatic dismissal (Brown & Levinson, 1978).

Callum's loafing is further examined in the final extract, in which Craig orients to the group's reliance on each member if they are to proceed in the tasks; that is, Callum's lack of participation is damaging to the productivity of the whole group:

Extract 6: PBL Group A

1	**Craig:**	see my section is nowhere near completed (.) because: (.) see
2		for me to find numbers I'd have to research your whole section
3		(.) so like: I made a lot of changes to it (.) BUT like see
4		your section for the distillation column?
5		*((gazing at Callum))*
6	**Callum:**	yeah
7	**Craig:**	you'd <u>have</u> to find the numbers yourself
8	**Callum:**	do you want them?
9	**Craig:**	yea:h
10	**Callum:**	'cos I-didn't know-I was gonna talk to you about that-
11	**Craig:**	yeah it's like a JUDGEMENT CALL (.) but see for ME: 'cos
12		to-I'd have to like redo your whole research again
13	**Annie:**	YE:AH *((whilst nodding))*
14	**Craig:**	like: (.) Annie read it as well (.)
15	**Callum:**	I didn't even think you wanted to like (numbers in) (.) and
16		then everybody would be like "what are you doing?"
17	**Craig:**	AWW like: definitely

In the previous week's PBL meeting, Craig had volunteered to prepare the upcoming group report on behalf of his peers. Once again, however, Callum's minimal participation has amplified the complexity of what should have been a relatively simple task. In the opening lines, Craig states that his own progress has suffered ("my section is nowhere near completed," line 1) as a result of Callum's failure to perform fundamental calculations ("for me to find numbers," line 2) and being left with little option but to rectify these flaws on his behalf ("I made a lot of changes to it," line 3). Alongside these utterances, Craig makes his target explicit

through his persistent eye gaze towards Callum (line 5) and his emphasis on what Callum should hold individual ownership for ("your section," line 4). Here, it is Craig who discursively steps outside of the PBL content and instead discusses group processes as a means of holding Callum to account for his lack of contribution.

In line 7, Craig continues his forthright approach, positioning Callum's duties as non-negotiable ("you'd have to"). This is also apparent in his response to Callum's query ("do you want them?," line 8), which places significant stress on this assertion ("yea:h," line 9), as though this is an obvious expectation. In turn, Callum's struggles are shown through repeated reformulations ("'cos I-didn't know-I," line 10), in which he appeals to Craig through an unknowing stance, as though he intended to seek his opinion at this current meeting ("was gonna talk to you," line 10) (Heritage, 2012). Given the imminence of the PBL report deadline, Craig underscores the importance of making one's own "JUDGEMENT CALL" (line 11), which orients to the necessity of members functioning with some level of independence, as opposed to consulting one another every step of the way.

As we approach line 11, Craig raises the personal burden ("see for ME:") he faces in being left to complete the work of another team member. Here he accentuates the immensity of these pressures ("I'd have to like redo your whole research again," line 12), and Annie's loud assessment ("YE:AH," line 13), accompanied by her supportive nodding gesture, affirms Craig's stance: that Callum's levels of participation are unacceptable. Note also how Craig uses Annie's reciprocation to overpower Callum's excuses, so he is not the singular member confronting Callum's lack of ownership (Benwell & Stokoe, 2002). Consequently, Callum continues his unknowing stance ("didn't even think," line 15), as though he does not wish to appear foolish in front of his peers ("everybody would be like 'what are you doing?'," line 16) (Heritage, 2012). Craig once more firmly establishes the inclusion of these calculations as being essential ("AWW like: definitely," line 17), and Callum's case is closed.

DISCUSSION

The current analysis details how accountability for social loafing in floating facilitator PBL (Duch et al., 2001) is self-managed by students. In

early PBL sessions (e.g., weeks 1–2), loafing behaviours were positioned as relatively minor transgressions; the complexity of the academic tasks was constructed as being at fault rather than the ill-prepared students in question (Benwell & Stokoe, 2002). This leniency granted by the groups seems to be reflective of the final group assessment being far from sight. Similarly, the enactment of punishments (e.g., verbal/written warnings) was raised during teasing behaviours, and in this way the implications of social loafing were minimised as a means of sustaining group cohesion (Hendry et al., 2016). However, from consideration of the wider data corpus, these orientations to academic authority—albeit in a relaxed manner—also held connotations of the seriousness of social loafing and hinted at the need for discipline, should any member violate the group boundaries (i.e., going beyond a one-off event). In addition, crucial aspects of these formulations were the relevant individuals' open admissions of guilt: the notion that despite their failing to prepare for the PBL session, allegiance to the team could be restored through displays of "honesty" (Edwards & Fasulo, 2006). Being constructed as disingenuous—as shown in the second section of the analysis—was extremely problematic for one's PBL membership.

In contrast, recurring instances of social loafing involved intensified interactional work, in which students applied a series of intricate discursive strategies in self-governing their troubles in tutorless PBL. For instance, the offenders consistently formulated overly convoluted excuses with displays of vulnerability (e.g., Regina's illness/emotional state) (Edwards, 1999) and adopted "unknowing stances" (e.g., Callum's continuous prompts for clarification) (Heritage, 2012) in their "struggles" to complete their PBL duties. Rather than discussing the content of the PBL problems, Callum and Regina presented a series of process issues that distracted from the academic business and therefore forced their recipients to acknowledge these wider problems. In turn, both groups faced the dilemma of policing these acts of social loafing alongside the institutional norms for politeness (Brown & Levinson, 1978). That is, the students did not position themselves as "expert" enough to make tutor-like moves (Benwell & Stokoe, 2002), nor did they wish to be perceived as overly authoritative; another problematic move for group cohesion (Kindler et al., 2009).

Despite this resistance to institutional hierarchy, however, the students also oriented to the necessity of doing education and the need for regulation of participation in PBL. Subsequently, they opted for very subtle

displays of authority and indirectly hedged around failures to commit to team duties (e.g., transitioning communications from Facebook to the institutional discussion board, where the tutor had direct access to individual contributions, as with Callum). Considering the case of Regina, for instance, note how her peers engaged in cohesion-building gossip talk in her absence, perhaps their means of withstanding the ongoing social difficulties. However, upon her arrival at the group, in the spirit of institutional democracy, Regina was granted the discursive space to contribute to the PBL tasks. Once her excuses for slacking were established as inauthentic, the group members targeted social "luxuries" by avoiding uptake of these justifications, disbanding their engagement in humour/off-topic chats, and making no displays of empathy. This process of othering was also shown in their swift moves towards new educational business, in which they oriented to the burden being imposed on them and then very promptly pushed on with other PBL tasks (i.e., the loafer was being discursively dismissed).

CONCLUSIONS

These analytical findings are some of the first to illuminate the resilience of the PBL learner identity, in that the students adapted to the complications of social loafing behaviours and self-managed these occurrences without engaging in explicit team conflicts. Rather than avoiding the inevitable challenges that come with group work—detrimental to meaningful learning in itself (Kindler et al., 2009)—students autonomously applied their own interactional strategies to mitigate the issues raised as a result of social loafing. Learner identities are often viewed as static or insignificant, but this extensive video corpus sheds light on the dynamic student identity that comes into play in student-driven PBL (Sharma, 2013). The social dimensions of PBL hold significant influence over group productivity (de Grave et al., 2001), yet the current study shows how students self-monitored some of the principal complaints of tutorless PBL (Woods, Duncan-Hewitt, Hall, Eyles, & Hrymak, 1996).

In summary, the social processes of PBL must not be overlooked if we are to meaningfully inform educational practices by way of tutor and student training (Imafuku & Bridges, 2016; Teng & Luo, 2015; Skinner et al., 2012). Given the scarcity of research centring on how effective PBL collaborations can best be sustained (Hmelo-Silver & Eberbach, 2012; Jin,

2012), future studies should continue to adopt qualitative analyses to explicate interactions that foster positive PBL experiences. Furthermore, the present study was limited to a Scottish educational context with English as the native language, and this raises implications for the generalisability of our analytical findings. Similarly, it would be insightful to examine the management of social loafing in PBL across different years of education (e.g., undergraduate versus postgraduate) and to consider factors such as how long students have worked together as a group. How one deals with the complexities of social loafing is likely to vary considerably across different linguistic and cultural contexts, and therefore it is important to address these issues in PBL settings in other institutional contexts.

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APPENDIX: TRANSCRIPTION CONVENTION (Adapted from Jefferson 1984)

(.)	A dot in a bracket indicates a pause of less than two-tenths of a second.
(0.2)	Numbers in brackets refer to pauses in tenths of a second.
CAPITALS	Indicates a sound that is louder than the surrounding speech.
°quieter°	Degree signs indicate talk that is noticeably quieter than the surrounding talk.
Underline	Indicates emphasis on speech.
↑↓	Pointed arrows indicate a marked rising or falling in speech intonation. Placed *before* the change in intonation.
£	A pound sign indicates talk that is suppressing laughter or leading into a "laugh."
[ ]	Square brackets indicate the beginning/end of overlapping speech.
Cut-	A dash following a word indicates a cut-off sound in the speech (usually as another speaker interjects).
=	Equal signs indicate continuous talk between speakers.
(())	Words in double brackets and italicised reference non-verbal aspects of the interaction. In the present analysis, reference to physical gestures and objects are also labelled here.
><	"More than" signs enclose speech which is noticeably faster than the surrounding speech; "less than" (<>) signs label slower speech.
.h	A dot before "h" indicates an in-breath. More "h's" = longer in-breath.
h	"h's" *without* a dot before them indicate an out-breath.
::	Colons indicate an extension of the preceding (vowel) sound. More colons = greater the stretching.
(estimation)	Words in brackets label unclear speech, where estimations have been made by the analyst.

CHAPTER 10

How Can Screen Sharing Support Knowledge Coconstruction in Technology-Enhanced Problem-Based Learning?

Henrietta Y. Y. Lai, Anita M. Y. Wong, and Susan M. Bridges*
The University of Hong Kong

INTRODUCTION

In the late 1990s, three undergraduate health-care professional programmes (medicine, dentistry, and speech and hearing sciences) at the University of Hong Kong implemented problem-based learning (PBL) as their teaching philosophy, curriculum design, and pedagogy. While the three programmes varied in design and approaches in their implementation, they all employed the core principles of PBL to provide students with opportunities to work collaboratively in a small group and to apply practical and theoretical knowledge to problems designed to simulate real-life scenarios in clinical settings (Barrows, 1996). As a constructivist approach more recently grounded in the learning sciences, the PBL process of understanding the complex dimensions of ill-structured problems and working towards solving them supports students in becoming professionals and lifelong creators of collaborative knowledge at their workplaces (Lu, Bridges, & Hmelo-Silver, 2014). With teachers no longer acting as the primary source of information but as facilitators who support student learning through knowledge construction, new forms of learning software and educational technologies have been adopted as tools for supporting the facilitation process (Jin & Bridges, 2014; Savin-Baden, Poulton, Beaumont, & Conradi, 2016; Lajoie et al., chapter 12 in this volume). One of the more recent

* Corresponding author.

educational technologies in use is ClickShare™, a wireless presentation system wherein users connect via the ClickShare™ app and share their ideas from their own laptops or mobile devices to the large, central screen (Barco, 2016). The aim of this ethnographic study is to explore how students and their facilitator use ClickShare™ to support knowledge coconstruction within PBL tutorials and to analyse the social and academic consequences of the use of this technological affordance. Before we describe the study's data collection procedures, analysis, and discussion, the next section outlines the background of PBL with specific reference to facilitation goals and educational technologies.

BACKGROUND

PBL and Facilitation Goals

PBL is a constructivist educational approach in which the facilitator acts as a cognitive coach who guides students working in groups to "develop flexible knowledge, effective problem-solving skills, self-directed learning skills, effective collaboration skills, and intrinsic motivation" as they go through the PBL processes (Hmelo-Silver, 2004, p. 240). The PBL facilitator's interventions diminish over time as students develop these skills (Hmelo-Silver, 2004; Hmelo-Silver & Barrows, 2006). The processes include identifying the key facts, formulating and analysing the problem, generating hypotheses, identifying knowledge gaps (learning issues), gathering data during self-directed learning (SDL) time, and synthesising and applying the newly acquired knowledge to the problem at hand (Hmelo-Silver, 2004). Following Barrows' model (1988), a traditional problem cycle in the study's programme consisted of an initial tutorial (T1), followed by SDL, then one or two more tutorials to close the PBL cycle. In the local model of implementation, lectures, seminars, workshops, and clinical placements may occur with the problem cycle between PBL tutorials to support SDL or as separate curriculum "blocks" in the overarching structure.

Advocates argue that the learning environment of PBL tutorials is authentic and learner centred, and hence students' learning interest can be easily stimulated. For example, Koh, Khoo, Wong, and Koh's (2008) systematic review found PBL enhances the learning experience and equips students with a wide range of skills, such as interpersonal, communication, and teamwork. However, critics have indicated that some students may

find PBL problems difficult to navigate in a PBL tutorial, and they may not be able to engage in the learning activities once they lose track of the discussion, due to a lack of either prior knowledge or concentration (Kirschner, Sweller, & Clark, 2010). The counterargument is that facilitators can and should play a critical role as scaffolds in the PBL process to address the issue of cognitive load (Hmelo-Silver, Duncan, & Chinn, 2007). According to Hmelo-Silver and Barrows (2006), the main performance goals for PBL facilitators are to

1) keep all students active in the learning process,
2) keep the learning process on track,
3) make the students' thoughts and their depth of understanding apparent, and
4) encourage students to become self-reliant for direction and information. (p. 27)

To support these goals in more recent, technology-infused learning environments, PBL facilitators are now taking advantage of educational technologies as an additional scaffold to support student learning throughout the PBL process.

Educational Technologies for PBL

Through the use of new software and applications, computer-supported collaborative learning (CSCL) helps students learn together and provides creative opportunities for intellectual exploration and social interaction, with the goal of creating a learning environment that enhances the practice of group meaning making (Stahl, Koschmann, & Suthers, 2006). In CSCL environments, students can use their computers to search for information on the internet and to gather, present, and discuss the new information collaboratively (Stahl, Koschmann, & Suthers, 2006). Jin and Bridges' (2014) systematic review of the literature from 1996 to 2014 identified three types of educational technologies used in PBL: learning software and digital learning objects; interactive whiteboards (IWBs) and large, central screens; and learning management systems (LMSs). The review of study findings indicated positive learning outcomes for undergraduate students, including

- facilitating understanding of information and complex phenomena;

- having a positive impact on active learning and critical thinking;
- providing a rich, authentic learning environment;
- supporting student development of medical expertise through the accessing and structuring of expert knowledge and skills;
- making disciplinary thinking and strategies explicit;
- providing a platform to elicit articulation, collaboration, and reflection; and
- reducing perceived cognitive load. (p. 4)

In response to the cognitive load debate, Hmelo-Silver et al. (2007) argued for the efficacy of educational technologies in enabling students to learn in complex domains. Supporting this stance, Bridges, Corbet, and Chan's (2015) ethnographic study illustrated how undergraduate dental students in a PBL group used IWBs to support learning within and across all phases of a problem cycle by extracting and sharing in-house and open access digital texts and materials. The integration of learning software into a PBL curriculum can depend upon factors such as ease of use, accessibility, and user support (Jin & Bridges, 2014). For example, concept mapping software (CMapTools™) has supported blended approaches in undergraduate health professions education and fully online faculty development (Bridges, Dyson, & Corbet, 2009; Bridges et al., 2015; Mok, Whitehill, & Dodd, 2009, 2013). In these cases, concept maps helped to consolidate students' learning within and across the problem cycle. These initiatives found that through incorporation of concept mapping software, students improved their ability to identify concepts and build relationships and to retain learned knowledge. These studies also illustrated that when combined with a central large screen, concept mapping software can draw students' collective attention to the group task and help them present their complex ideas more systematically.

While Jin & Bridges (2014) concluded that educational technologies could play an important role in supporting the PBL learning process, they also identified the need for further research "to fully realize their potentials in enhancing inquiry-based approaches in health sciences education" (p. 10). The study reported here takes up this challenge by examining the application of one novel screen-sharing technology (ClickShare™) as a technological tool adopted to support face-to-face PBL group learning processes.

ClickShare™, a wireless screen-sharing presentation system, was piloted in a PBL course on adult speech and language disorders in the Bachelor of Science programme in Speech and Hearing Sciences, BSc (SPEECH). Barco (2016) proposed that by connecting to the ClickShare™ application, students could share their own work or digital reference materials from their own laptops or mobile devices via the central plasma screen for others in the group to see. The shared learning objects can help students focus their attention on the ongoing topic of discussion and raise new topics for investigation. In PBL, the shared learning objects may also help facilitators to scaffold student learning and the effective coconstruction of knowledge. This ethnographic study examined the use of ClickShare™ in a PBL course by addressing the following research question: *How do students and their facilitator use a wireless screen-sharing presentation system to support knowledge coconstruction within PBL tutorials?*

APPROACH

Interactional Ethnography

Participants provided written informed consent for video and audio recordings and access to ethnographic data relevant to the study (HRECNCF Ref.: EA360314). The study adopted interactional ethnography (IE) as a qualitative research approach to explore how learning is socially and culturally coconstructed in the classroom of a professional undergraduate programme for the preparation of speech-language therapists (Green & Bridges, 2018). The overarching IE goal is to examine what is learned through social interactions and to understand how the practice of a professional community is shaped by what students learn in and across time (Putney, Green, Dixon, Duran, & Yeager, 2000). Specifically, the interdisciplinary research team (education and clinical specialists) sought, through in-depth analysis of the video archive, to identify both the *ways* in which students learn and *what* students learn. IE provided a framework for us to explore when and where, under what conditions, for what purposes, and with what consequences and outcomes ClickShare™ use enabled, or did not enable, learning events (Green & Ana Inés, 2008). The ensuing analysis drew on one notion of Vygotskian sociocultural theory, scaffolding, and one key theoretical construct, zone of proximal development (ZPD) (Vygotsky, 1978). These were used to examine how group members

negotiated the use of ClickShare™ and for what purposes and to trace how members' interactions with the technology during discussion became consequential to their learning over time.

Participants

Nine Year 4 students from the same PBL tutorial group and their PBL facilitator (n =10) from a five-year, full-time BSc (SPEECH) were recruited via email for this study. They participated on a voluntary basis and received no incentives. Following an initial ClickShare™ induction by the facilitator, the technology was made available to the tutorial group in six tutorials (T) across three PBL cycles from October 19, 2015, to November 5, 2015 (see Figure 10.1). The three recorded PBL cycles included cases and inquiry-based materials on

- dysarthria on a patient with head injury (Problem 5 [P5]) (final tutorial for the prior cycle);
- dysphagia on a patient who had a stroke (Problem 6 [P6]) (full cycle);
- dysarthria on a patient with Parkinson's disease (Problem 7 [P7]) (full cycle); and
- management of a patient after a total laryngectomy (Problem 8 [P8]) (full cycle).

At the time of recording, the curriculum was organised so that each PBL cycle ran over three 3-hour tutorials (T1, T2, and T3). A new problem (P) began in the last hour of the third and final session of the cycle (e.g., P6/T3 and P7/T1), continued into the next full 3-hour session (e.g., P7/T2), and was completed in the first two hours of the third session (e.g., P7/T3 and P8/T1). The ethnographic archive consisted of video and audio recordings for three full PBL cycles (P6, P7, and P8) and for the final tutorial of Problem 5 (P5/T3) (see Figure 10.1).

In a typical PBL session, students engage in the collaborative construction of group notes, information search, and sharing of self-directed research, and the facilitator scaffolds the discussion with open-ended, nondirective questions (Barrows, 1988). In the BSc (SPEECH) model at the time of recording, there were skills laboratories between PBL tutorials to support self-directed learning and one master lecture during the course (Whitehill, Bridges, & Chan, 2013). Particular to local practice,

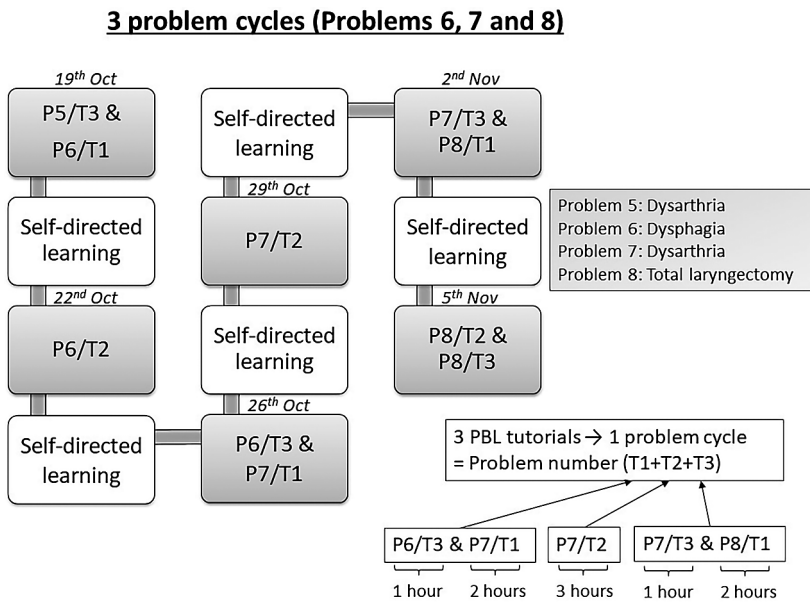


Figure 10.1 Six PBL tutorials with the integration of ClickShare™.

students also received a list of core readings and supplementary readings and completed a preparatory "reading form" as a summary, including critique, reflection, and arising questions. This was submitted prior to the PBL session to help students prepare for discussion in the tutorial. In each PBL tutorial, a student became the clerk who took group notes for the discussion on a shared Google Docs™. Other group members were able to view and edit the group notes by logging in to the same Google Docs™. In the next tutorial, another student would become the new clerk for taking group notes.

Data Collection

PBL sessions took place in a custom-designed tutorial room with an IWB (see Figure 10.2). Following ethnographic principles, the researchers video- and audio-recorded learning as it naturally occurred in the classroom (Baker, Green, & Skukauskaite, 2008; Derry et al., 2010). Three sets of cameras (cameras A, B, and C) on mounted tripods captured the PBL group interactions and IWB from different angles (Figure 10.2). Additional audio recordings (voice recorders 1 and 2 on the central table) captured the naturally occurring PBL tutorial discussions. All students (S1–S9) sat

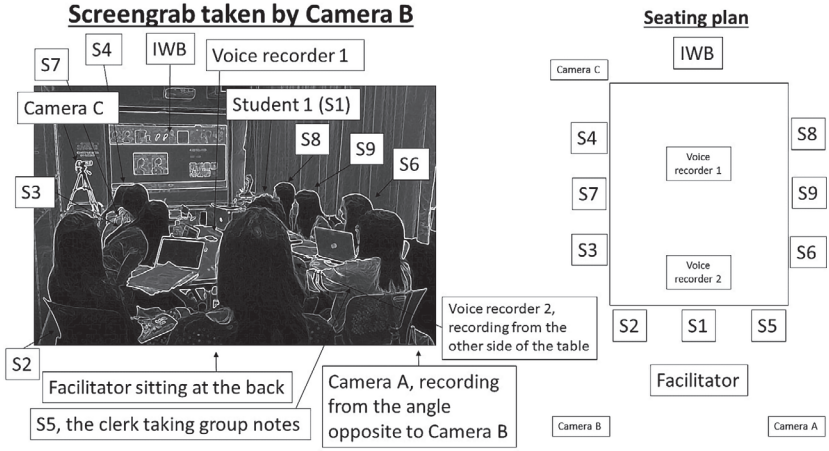


Figure 10.2 PBL tutorial room with an IWB, ClickShare™, and recording equipment.

around the table to discuss the problem/case at hand, while the facilitator sat towards the back of the tutorial room.

The final ethnographic archive consisted of recordings, curriculum documents, problem statements, whiteboard images from tutorial discussions, group notes in the form of Google Docs™, and concept maps. Trained research assistants transcribed the video- and audio-recorded PBL sessions. The research team verified the transcripts and engaged in joint video analysis as both internal and external ethnographers, as well as disciplinary, cultural guides (Green, Chian, Stewart, & Couch, 2018).

Data Analysis and Interpretation

An interactional ethnographer explores what is constructed in and through the moment-by-moment interactions among group members, how they interact in order to negotiate events, and how knowledge and texts generated in one key event influence and become a resource for members' actions in subsequent events (Castanheira, Crawford, Dixon, & Green, 2001; Green & Bridges, 2018). Following the IE approach, analysis of the transcripts focused on who talked about what, for what purposes, and with what intended outcomes, all analysed during "rich points" or key events, identified in this study as being when students employed ClickShare™. Using a telling case method (see Mitchell 1984 in Green & Bridges, 2018), the analysis examined how actions and interactions of the facilitator and her students were shaped by what was constructed in previous events and

the social and academic consequences of the associated discourse and actions for students in the group. An event map (see Figure 10.3) traced key learning events that were prompted by ClickShare™ across the problem cycles. Microanalysis of related discourse and artefacts examined how these events contributed to student learning.

Analysis drew upon the work of Vygotsky (1978) to provide explanations for how a technology-rich approach to scaffolding could support, or did not support, student learning in a PBL environment. Scaffolding is the assistance or guidance provided by a more capable or competent person (usually the teacher or peer), which will eventually be removed from the process as the learner gradually develops the skills and abilities necessary for completing certain tasks autonomously (Vygotsky, 1978). The concept of the zone of proximal development (ZPD) identifies the difference between what one can do without help and what one can do with help (Vygotsky, 1978). In the learning process with a knowledgeable other, the expectation is that the ZPD would be minimised through scaffolding. It has been argued that scaffolding helps students to bridge from current knowledge to practices (Reiser & Tabak, 2014). In PBL, when students have identified their group's learning issues (objectives), they will undertake independent research during SDL to collect resources and learn new knowledge to support the problem-solving process. Although students have gained new knowledge, their research and independent learning skill set may still be incomplete (Reiser & Tabak, 2014). This mismatch may create difficulties for them in applying what they have learned during SDL. Therefore, students need guidance from their teachers, who deconstruct the complex skills and tasks into small components. Their teachers may also perform the actions for learners (modelling) repeatedly until the students are able to associate the modelled actions with the learning goals (Reiser & Tabak, 2014). Based on these premises, when students have learned how to complete the task and have also understood the idea of how to complete a similar task independently, they are able to take responsibility for their own learning, and teachers can then remove the scaffolding (Vygotsky, 1978). As the students are developing the skills to identify the relationships between learning objectives and the problem-solving procedures, the need for explicit facilitator guidance is gradually minimised. Scaffolding has become a critical concept in learning and assisting learners in developing their full potential through teacher guidance, collaboration with more capable peers, and various tools (Hoadley, 2018). In the next section, the

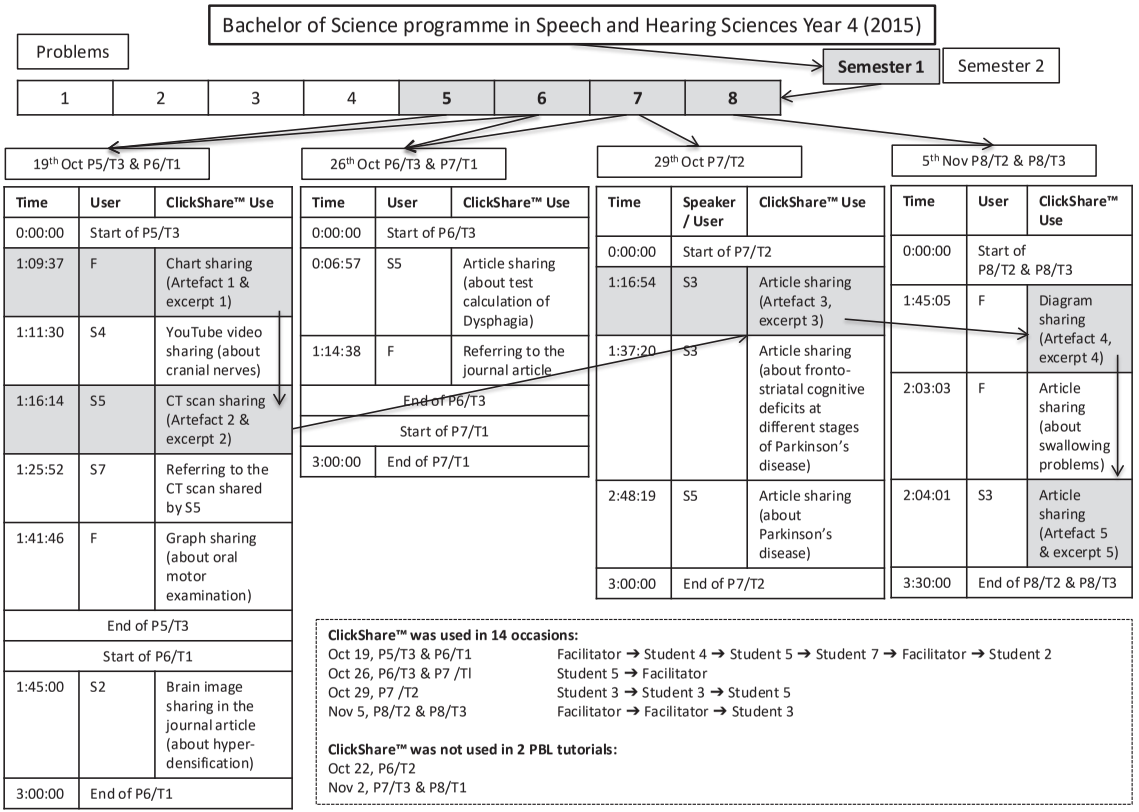


Figure 10.3 Event map of Clickshare™ key events.

application of ClickShare™ as a technological tool for scaffolding student learning and collaboration is examined.

ANALYSIS

Across the six tutorials in which ClickShare™ was available, the facilitator and students employed it on 14 occasions in four PBL tutorials (P5/T3 & P6/T1, P6/3 & P7/T1, P7/T2, and P8/T2 & P8/T3). The group did not adopt ClickShare™ in two PBL tutorials (P6/T2 and P7/T3 & P8/T1). The shaded segments of the event map (see Figure 10.3, above) indicate the key learning events in which discussion of the resources shared by ClickShare™ became consequential to group learning through the collective decision to include these in the group notes drafted by the clerk in the shared Google Docs™. In the following subsection, analysis of the discourse and actions of participants across five key events (see Figure 10.3) explores how the students and their facilitator employed ClickShare™ as a technology for collaboration and scaffolding.

Collaboration and Scaffolding in PBL

Student and facilitator use of ClickShare™ ranged from nine occasions (student-initiated) to five occasions (facilitator-initiated) in 4/6 PBL tutorials recorded across three PBL problem cycles (see Figure 10.3). Shaded segments on the event map indicate the key events across the problem cycles in which students or the facilitator employed the ClickShare™ functions to share journal articles, group notes, and brain images while explaining concepts or ideas in real time. The iterative and recursive ethnographic tracing of the historical and consequential nature of these sharings and discussions is indicated in the event map (Putney et al., 2000). Central to identifying these "rich points" (or key events) was the group decision to include the shared digital objects in the "collaborative group notes," a local term for the record of the case discussion and synthesis of new knowledge.

Key Event 1

The first key event occurred in the combined session (P5/T3 & P6/T1) when the facilitator joined in the ongoing discussion by asking the group: "Do you guys know of any device that helps remember the functions or just the names of the cranial nerves?" (Excerpt 1, 1:09:37). Student 4

(S4) responded to the question: "There is a video from YouTube that our classmate shared" (Excerpt 1, 1:09:50). Then S4 and S3 tried to search for that video. Meanwhile, the facilitator used ClickShare™ to share a chart (Excerpt 1, 1:09:54) to stimulate quick recall of the functions and names of cranial nerves. She then recommended that the group use this chart as a framework to develop their own chart. After that, she also shared an image using ClickShare™ and recommended the group draw all ideas into an image. The clerk, Student 2 (S2), asked the facilitator to share with the group after class (Excerpt 1, 1:11:26). It was not clear whether S2 found the image or the chart useful and wanted to include either in the group notes. Later, the first author found that only the framework was applied in the group notes for Problem 5, as the names and functions of the cranial nerves appeared in the first two columns (see Artefact 1, Figure 10.7). However, the image shared by the facilitator was not included in the group notes. Therefore, the sharing of the chart by the facilitator was the first key event that contributed to student learning and note generation.

Excerpt 1: Synthesizing Information for Problem 5

Time	Speaker	Discourse
1:09:37	Facilitator	Do you guys know of any device that helps remember the functions or just the names of the cranial nerves?
1:09:50	S4	There is a video from YouTube that our classmate shared.
1:09:54	Facilitator	Okay, could you include that in your notes maybe? ((S4 unplugs the dongle [the ClickShare™ USB for screen sharing] from S5's laptop and plugs in S3's laptop; S3 shares screen to IWB and searches for the video on YouTube))
		I'll. . . . I will show you this too meanwhile. ((trying to use ClickShare™ to split screen and make her chart full screen on the IWB but unsuccessful))

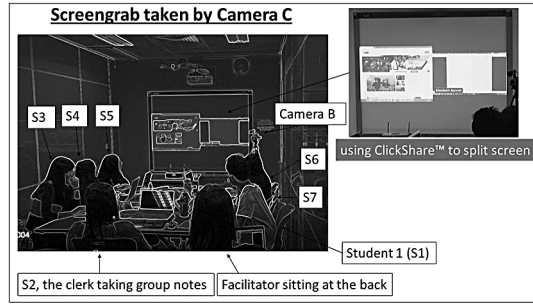


Figure 10.4

How do we make it big? ((asking the technician next to her))
Oh, so we can . . . oh, to make it a full screen, okay.
((making her chart on the right-hand side full screen using ClickShare™))
Okay, um, can you see this? ((showing her chart on IWB; all students are paying attention to the IWB))

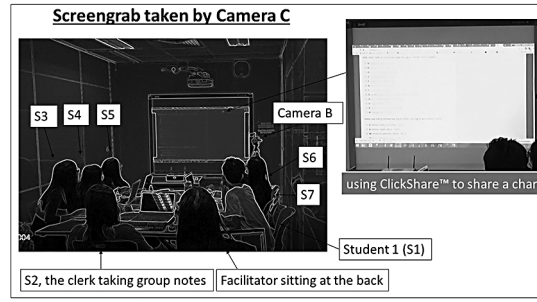


Figure 10.5

so um, pretty easy way to remember . . . and then the functions. . . . Alright, so um those are two little ways you could help remember ((S6 nods her head)).
And then another is. . . . I found I found this, this photo ((switching to an image; all students are still paying attention to the IWB))

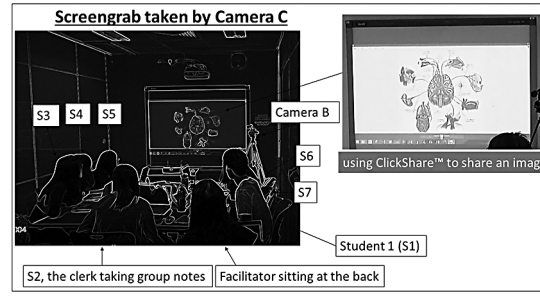


Figure 10.6

which I think it is a good visual, right? So you guys did a great job . . . put all of the . . . you know the whole chapter into a very organized chart, but sometimes for people who are more visual I think this is kind of um a nice way to ((S6 and S7 nod their heads)) . . . you know, okay?

1:11:26	S2 (the clerk)	How do we include this (the chart or the image) in our notes?
1:11:28	Facilitator	Oh you want me to um upload it on the er? Form, that's it. Okay

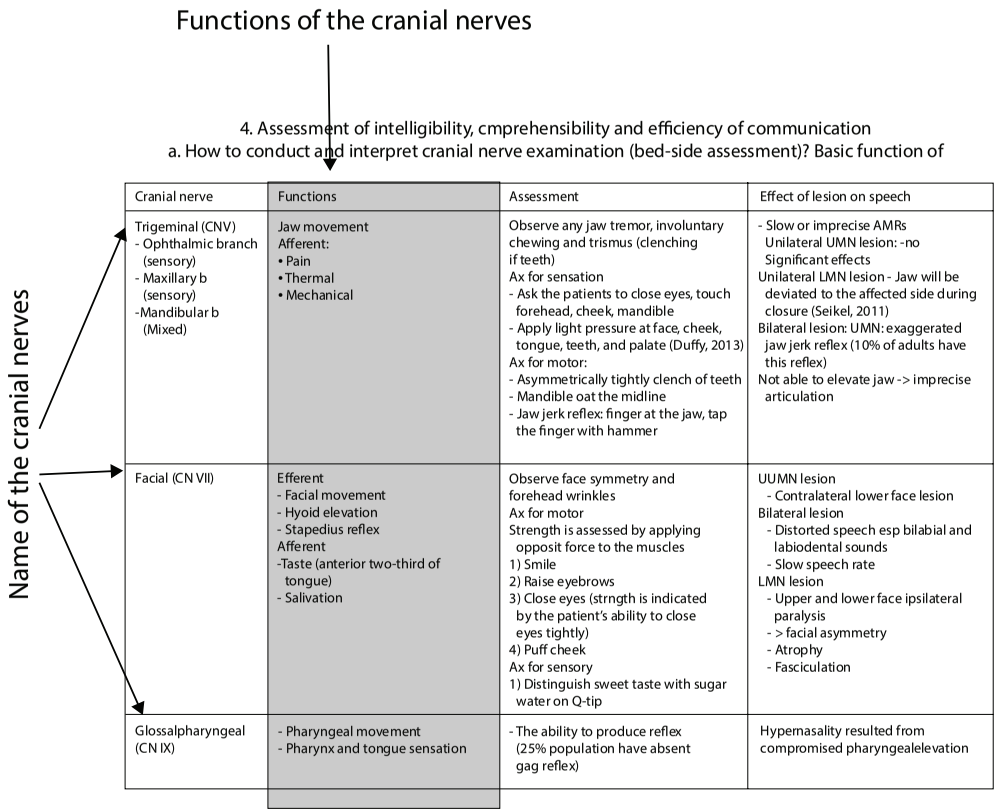


Figure 10.7 Artefact 1, p. 13 of the group notes for Problem 5 (researcher annotations added).

The facilitator's use of ClickShare™ to share a chart as a framework and the PBL group clerk's later application of this framework to the annotated student group notes (Artefact 1) illustrates two of the PBL facilitation goals listed above goal 2, "keep the learning process on track," and goal 3, "make the students' thoughts and their depth of understanding apparent." The facilitator kept the learning process on track by providing an exemplar as a scaffold to guide students on note generation. In sharing with ClickShare™, she not only made it visible to the collective but also provided a framework to enable joint coconstruction by the whole group (Hmelo-Silver & Barrows, 2006). In this key event, the required action for the students was to create a framework to summarize ideas (modelling), but the students had not learned about the framework previously. This was one of the learning tasks they should have undertaken independently. Therefore, the facilitator performed this action once as a scaffold to model for students how to learn the relationship between the learning objective and the learning task (Reiser & Tabak, 2014). It shows ClickShare™ playing an important role in scaffolding, as it allowed the facilitator to make public the chart (framework) as an exemplar and resource for enhancing group interaction.

Key Event 2

The second key event took place in the same PBL tutorial (P5/T3 & P6/T1) when S4 and S7 built on S5's presentation on hypodense areas (Excerpt 2, 1:16:14) and the basal ganglia (Excerpt 2, 1:24:44) and added their viewpoints in the discussion. S4 responded to S5's presentation on hypodense areas (Excerpt 2, 1:19:25) by giving her view: "And we can also say this stage is sub-acute, sub-acute when it is isoted (when there is an isodense lesion) and hypodense will be chronic." When S5 was trying to identify the site of the lesion from the CT scan in the journal article that she shared via ClickShare™, S7 explained the brain image and provided the answer (Excerpt 2, 1:25:52). Evident from the student-generated synthesis of final group notes (see Artefact 2 in Figures 10.10 and 10.11) was that S4, S5, and S7's discussion contributed to a collective understanding about the consequence of a hypodense area and the location of the basal ganglia. The shared CT scan in the article helped the whole group to focus on the ongoing discussion and visualize S5's interpretations on the results of the CT scan. It would have been very difficult for S5 to explain her interpretation verbally without using a shared visualisation. Therefore, ClickShare™ not only helped S5 to present her ideas but also helped the whole group

to understand S5's ideas and respond accordingly. From an interactional perspective, the interaction among S5, S4, and S7 increased at 1:16:14 when S5 employed ClickShare™. Consequentially for their learning, this led to the coconstruction of the group notes (Artefact 2) by these three students. As students were active in the learning process and were able to make their thoughts and depth of understanding apparent (Hmelo-Silver & Barrows, 2006), the facilitator did not intervene in the discussion and let the students take the responsibility for their own learning.

Excerpt 2: Synthesizing Information for Problem 5

Time	Speaker	Discourse
1:16:14	S5	It shows that there are some sagittal views ((all students are paying attention to the IWB; S5 uses ClickShare™ to split screen and share the CT scan found in an article on the right-hand side of the IWB; the clerk takes notes on the left-hand side of the IWB))

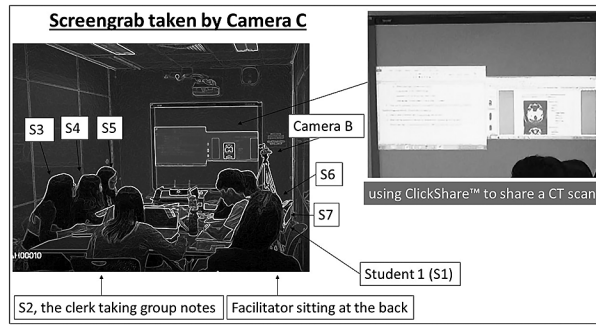


Figure 10.8

In fact, from CT scan we have different views ((all students are paying attention to the IWB)). And the view we had, on the, from the case history is high-mid brain level . . . yea . . . and for hypodense er hyperdense area, so er for acute haemorrhage, it will be hyperdense so it will (be) right red, and after 4 days to 2 weeks, it will be isodense, so that the basal will be similar to the colour of the brain. And it will finally be darker than the brain after 2 to 3 weeks.
((the clerk jotting down the notes))
Hypodense. Maybe haemorrhage stage ((suggesting the note taking)) I don't know.
((the clerk is jotting down the notes))
Post-haemorrhage after 2 to 3 weeks ((suggesting the note taking; S3, S4, and S5 are paying attention to the IWB; the clerk is jotting down the notes; S6, S7, and S1 are discussing on their side))
In fact, there will be isodense. There will be isodense period. It will be 4 days to 2 weeks after the haemorrhage.

1:19:25	S4	And we can also say this stage is subacute, er subacute when it is isoted . . . and hypodense will be chronic ((the clerk is jotting down the notes; other students are focusing on their mobile devices))
1:19:58	S5	Because other (parts in this journal article) are quite . . . quite difficult ((laughing)), but I think this . . . the best thing I think is that we can identify ((pointing to the IWB)) the structure from the CT scan more easily because they have pointed this quite well ((all students are paying attention to the IWB)), so I better share this to you. ((S3 nods her head))
1:24:44	S5	I am wondering the view is up . . . higher than that of er basal ganglia. Because um ya ((using the split screen function to show the CT scan in an article; all students are paying attention to the IWB))

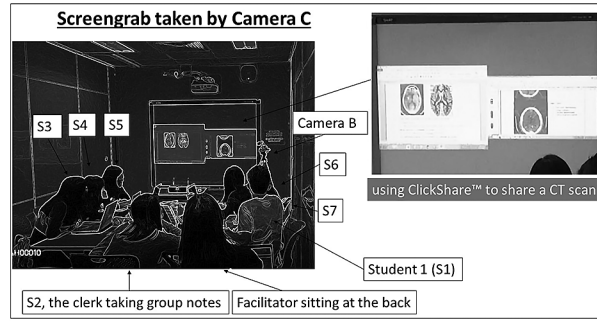


Figure 10.9

		Um we have, um CT scan has different um can scan different segments and for A is a basal ganglia region. So it is quite different from the upper cortex, is it. . . . It seems to me that the scan would be more like an upper cortex instruction. Can I make it brighter? Is it useful? Not useful? Isn't it? ((asking the group whether the screen becomes brighter))
1:25:52	S7	Can you move up to the basal ganglia? ((asking S5 to scroll up)) Because it has the internal capsule container and also contact ((pointing to the CT scan on the IWB; all students are paying attention to the IWB)), which is also signal to adaptation beside the CT scan, so I would suggest this is basal ganglia.
1:26:08	S5	Okay.

Key Event 3

The third key event occurred at 1:16:54 in P7/T2 when S3 shared a journal article on the prognostic factors for the progression of Parkinson's disease and provided information on the HY scale (Excerpt 3, 1:18:45; Artefact 3 in Figure 10.14). S3's contribution to coconstruction of knowledge was evident in the group notes (Artefact 3). By using ClickShare™, S3 was able

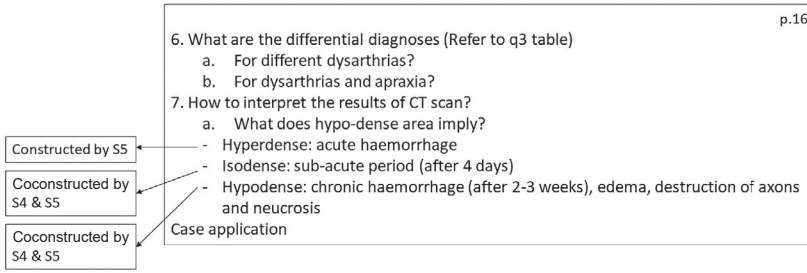


Figure 10.10 Artefact 2, part of p. 16 of the PBL group notes for Problem 5 (researcher annotations added).

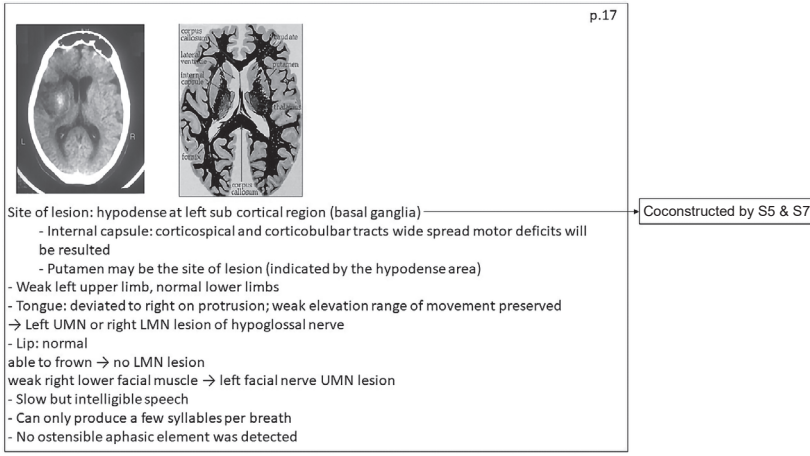


Figure 10.11 Artefact 2, part of p. 17 of the PBL group notes for Problem 5 (researcher annotations added).

to present what she found during SDL to support collaborative knowledge building, as evident in the consequential uptake in the group notes. Given that the facilitator did not intervene in S3's presentation, the learning process made visible S3's acting with autonomy.

Excerpt 3. Synthesizing Information for Problem 7

Time	Speaker	Discourse
1:16:54	S3	I have a journal (article) talking about the prognostic factors ((grabbing the dongle [the ClickShare™ USB for screen sharing]))

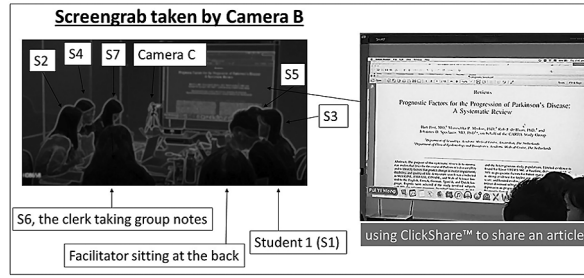
1:16:59	Facilitator	Say again? Prognostic?
1:17:02	S3	I have a journal (article) ((S5 helps plug in the dongle to S2's laptop)) talking about the prognostic factors for the progression of Parkinson's disease by . . . ((waiting for ClickShare™'s screen sharing response to the IWB))
1:17:30	S3	

Figure 10.12

((S3 talks about the first prognostic factor, which is not included in the group notes))
And then another report it says the age of onset is another prognostic factor . . . like older age will er indicate like faster progression ((using ClickShare™ to share a journal paper; all students are focusing on the IWB; the clerk jots down on p. 5 of the group notes for problem 7))

What to do now? ((S3 uses lip language to ask S6))
((S3 keeps scrolling down the article))

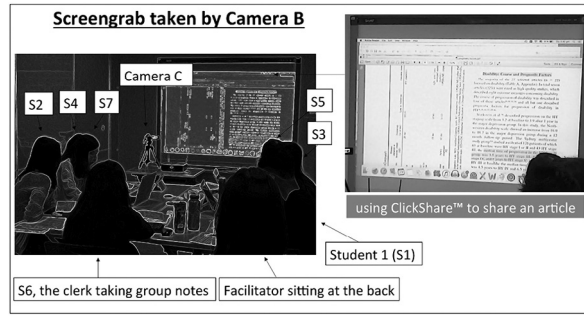
1:18:45	S3	

Figure 10.13

Here it shows er another . . . .another type of progression. This is using the scale we mentioned before the HY scale.
((S3 continues to share the same journal and talks about HY scale; the clerk jots down on p. 6 of the group notes for problem 7))

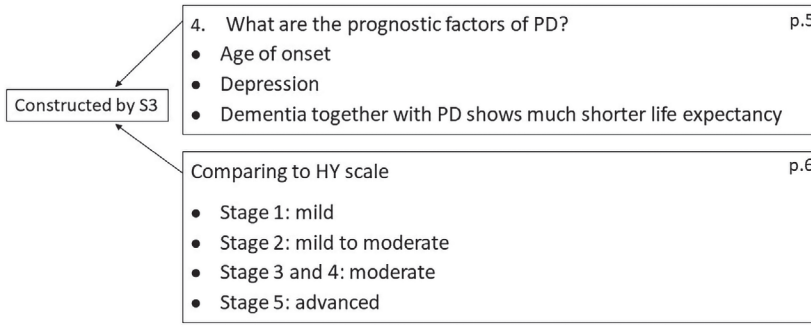


Figure 10.14 Artefact 3, p. 5 and p. 6 of the group notes for Problem 7 (researcher annotations added).

Key Event 4

The next key event occurred at 1:45:05 in the last tutorial of Problem 8 (see Figure 10.3), when the facilitator used ClickShare™ to display a diagram and encouraged her students to adopt this for both sharing accessed images and visualizing their own ideas (Excerpt 4). The students did not know a diagram was available online. The facilitator saw this learning need and shared a diagram via ClickShare™ to visualize her idea. The clerk then searched for the diagram on Google in real time and included it in the group notes (Excerpt 4 and Artefact 4 in Figure 10.16). This facilitator activity illustrates PBL performance goal 4, encouraging learner autonomy (Hmelo-Silver & Barrows, 2006). Key to learner autonomy is that students have control and agency in deciding when they should share visual representations. In addition, by sharing the diagram for collaborative knowledge building via ClickShare™, the students had learned a new step, visualizing ideas with a diagram, to add to the known sequence (Reiser & Tabak, 2014). They had therefore acquired more complex learning behaviours from simpler learned behaviours. The goal of scaffolding here was to help them develop their full potential in learning independently.

Excerpt 4. Synthesizing Information for Problem 8

Time	Speaker	Discourse
1:45:05	Facilitator	And then recently um I don't know if you guys can see it ((using the split screen function to show a diagram)) I think a nice diagram here ((making the diagram a full screen))

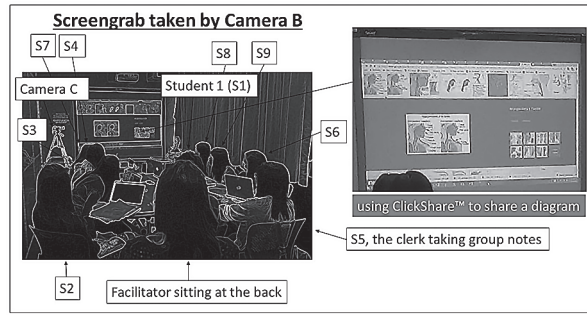


Figure 10.15

This is a nice diagram that shows okay, pre-operative, post-operative. And you can see okay air, food and the system. I think something like this graphic or you guys have another one from the skills lab, it's a really good way to kind of make this a little more useful ((the facilitator stops sharing the diagram on the IWB and returns to the group notes)). I think this is good but I don't think you know when you guys do the revision, it is that useful. So you might want to include (the diagram in the group notes), you could even draw one or make one, I just think a visual is a little easier to draw these ideas kind of together. ((the clerk searches for the diagram on Google right away and then includes it in the group notes of Problem 8))

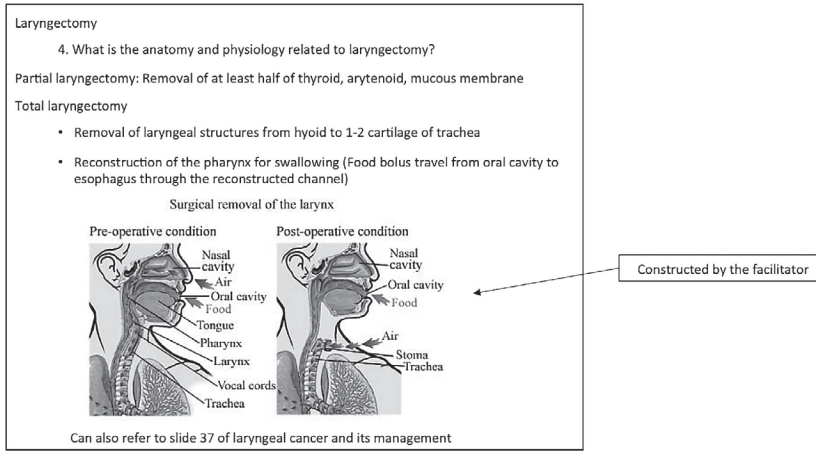
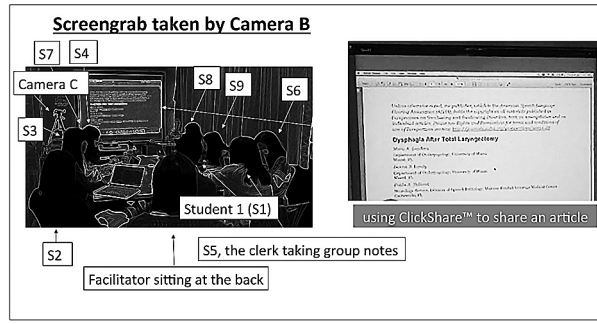


Figure 10.16 Artefact 4, part of p. 5 of the group notes for Problem 8.

Key Event 5

The final key event indicated in the event map (see Figure 10.3) occurred at 2:04:01 during the atypically combined tutorials in this final problem of the module (P8/T2 & P8/T3). At this instance, Student 3 (S3) shared a journal article using ClickShare™ (Excerpt 5, 2:04:01). The article title was then included in the collaborative group notes (Artefact 5 in Figure 10.18). S3's presentation on the result of radiotherapy (Excerpt 5, 2:06:12) was also included in the group notes. S7 also added her idea on dry mouth (Excerpt 5, 2:04:50) after S3's sharing of the article, and it is included in the group notes. ClickShare™ helped S3 make her thoughts and the depth of her understanding apparent. The facilitator did not need to intervene in the discussion at this moment, as ClickShare™ became the technology that supported student learning. The learning process was on track.

Excerpt 5. Synthesizing Information for Problem 8

Time	Speaker	Discourse
2:04:01	S3	I have a journal (article) about dysphasia after total laryngectomy ((all students are paying attention to the IWB)). And it says that um if there is no complications, then the patient usually can be normal swallow about 5-7 days after surgery, but it also mentions some complications such as . . .
		
		Figure 10.17
2:04:50	S7:	. . . Because the surgical procedures (are) always in combination with radiotherapy, and therefore they may also have some dry mouth, and dry mouth, it may affect the lubrication of bolus and make it more difficult to manage.
2:06:12	S3:	I think the loss of sense of smell and taste can also be a result of radiotherapy. ((the clerk jots down the notes))

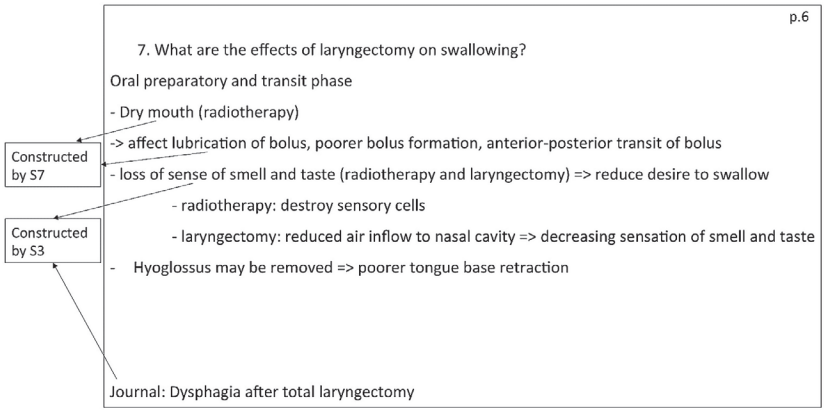


Figure 10.18 Artefact 5, p. 6 of the group notes for Problem 8.

DISCUSSION

In PBL, the facilitator does not act as the source of information but rather guides and supports student learning when needed. Analysis presented in this IE indicates that the facilitator only provided scaffolding with the use of ClickShare™ when the students could not complete the tasks without her guidance. By sharing new knowledge with the students via ClickShare™, the whole group could make the move, in the Vygotskian sense, from "what they cannot do" without incorporating new knowledge to "what they can do" with incorporating new knowledge. The repeated interactions over the course of the five key events supported their movement towards closer approximation of the modeled actions and their association of these actions with the learning objective and the learning task (Reiser & Tabak, 2014). The facilitator provided scaffolding via ClickShare™ based on the learning needs of the whole group. After the first ClickShare™ trial (P5/T3 and P6/T1), the facilitator reflected in the group debriefing on her experience with using ClickShare™. The group debriefing was a part of the formal stage of the PBL cycle in which members (students and their facilitator) reflected on or evaluated their own and peers' performance:

> I think I did well using my ClickShare™ a couple of times, however I think I could have done better by not jumping in onto discussion

> a lot of times and I am giving you more space to do that and prompting you and then join you.

In P5/T3 and P6/T1, the facilitator employed ClickShare™ twice (see Figure 10.3, 1:09:37 and 1:41:46) to share a chart as a framework and a graph to prompt students to generate some hypotheses. These sharings supported performance goals 2, "keep the learning process on track" and 3, "make the students' thoughts and their depth of understanding apparent" (Hmelo-Silver & Barrows, 2006). In both key events 1 and 2, when the facilitator and S5 shared the results of their online searches with the group using ClickShare™, the whole group's shared attention was on the IWB. This collective engagement then prompted a clear and focussed discussion. To sum up, S4 responded to the facilitator's sharing of a chart by requesting the facilitator to share it with the group (Artefact 1), while S4 and S7 also joined in the discussion by adding their ideas to S5's, which helped the construction of the group notes (Artefact 2). Therefore, this ethnographic tracing of the role of ClickShare™ during this single PBL tutorial (P5/T3 and P6/T1) indicated how application of this technology contributed to students' learning processes in sharing their ideas and in stimulating the whole group to making active contributions to the discussion. In these instances, the technology not only served as a scaffold for the acquisition and coconstruction of knowledge but also acted as a prompt to enhance within-group interactions (see Hmelo-Silver, Bridges, & McKeown, 2018).

In ensuing PBL tutorials, the facilitator and students continued to incorporate ClickShare™ as a technological tool for scaffolding and collaboration. In P7/T2 (see Figure 10.3, 1:37:20), after S3 used ClickShare™ to share a journal article found during SDL research on the topic of frontostriatal cognitive deficits at different stages of Parkinson's disease, the facilitator used a technique called "reflective toss" to scaffold the group's thinking processes (Hmelo-Silver & Barrows, 2006). The reflective toss takes place when a teacher takes the meaning of a student's ideas and asks the student to elaborate. This act lets the student take responsibility for his or her own learning. The facilitator prompted the students to make their thinking visible and apply what they had learned by asking an open-ended question:

> Given your [S3's] understanding about impaired working memory in Parkinson, impaired short term memory span or working

> memory, how much can you [S3 and other students] integrate that to practice in a team?

ClickShare™ in this example provided an opportunity for S3 to share her ideas with the group. It also led to improved facilitator understanding of what S3 and her peers already knew, which was consequential to her subsequent prompting of the students to construct knowledge collaboratively.

In P8/T2 and P8/T3 (see Figure 10.3, 1:45:05), when the students were discussing the total laryngectomy and the clerk was jotting down the ideas in bullet points in the group notes, the facilitator simultaneously showed them a diagram using ClickShare™ and commented that it was

> a nice diagram that shows okay, pre-operative, post-operative [laryngectomy]. . . . I think something like this graphic or you guys have another one from the skills lab. It's a really good way to kind of make this a little more useful. . . . I just think a visual is a little easier to draw these ideas kind of together.

Students agreed that the shared diagram was useful. To further encourage the use of diagrams, the facilitator suggested that they summarize the ideas in a diagram of their own. The shared diagram was then inserted into the group notes (see Artefact 4). This sharing of a useful diagram again helped the facilitator to attain facilitation goal 2 of keeping the learning process on track. The discussion around the shared diagram then helped students to improve their understanding of the pre-operative and post-operative conditions of a total laryngectomy (see Hmelo-Silver et al., 2018).

Students took the initiative to employ ClickShare™ on nine occasions to share new information with the group in order to support collaborative learning. ClickShare™ stimulated the whole group to actively contribute to the discussion, with the ethnographic tracing indicating consequential progression, in which some ideas were adopted and included in the collaborative group notes (see Artefacts 1–5). The social interactions within the group were enhanced as students made use of ClickShare™'s screen-sharing function and others built on what was shared and discussed. When students were able to share ideas using ClickShare™, the whole group could move from "what they cannot do" without sharing new knowledge to

"what they can do" with sharing new knowledge. Given that the ZPD was the gap between "what students cannot do" without scaffolding and "what students can do" with scaffolding, our analysis has indicated that a central role of ClickShare™ was to help students narrow the ZPD and gain control of both disciplinary subject matter and collective learning processes. This analysis has indicated that ClickShare™ was important for supporting students' gradual development of the skills and knowledge necessary for becoming clinical professionals.

Limitations

The adoption of an ethnographic telling case approach may have limited the generalisability of the findings; however, this allowed an in-depth exploration of the "how" of PBL learning processes with the use of educational technologies. Recording ClickShare™ activities on an IWB was challenging, despite using three cameras. In the future, supplementary recordings using screen capture software on students' or the facilitator's laptops could enhance the quality of the ethnographic archive. Finally, the group did not employ ClickShare™ in two PBL tutorials. Additional interviews with the group members could have provided further understanding of why the technology was not taken up on these occasions.

CONCLUSION

As a novel tool, ClickShare™ played a role in the presentation of learning objectives, the collaborative construction of knowledge, and the scaffolding of learning in the PBL tutorials. Analysis of the video recordings indicated that both students and the facilitator used ClickShare™ to present their ideas, share images or journal articles, coconstruct the group notes, understand and react to others' ideas, and share useful resources on the IWB. ClickShare™ not only helped the facilitator to scaffold students' active construction of knowledge but also helped students to coconstruct knowledge in PBL tutorials through the process of social interactions (Sawyer, 2006a, 2006b). The results of this study could inform future directions in the design and development of educational technologies for PBL as well as inform understanding of new technology-engaged PBL facilitation strategies.

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SECTION II

NEW THEORETICAL DIRECTIONS AND LEARNING DESIGNS FOR PROBLEM-BASED LEARNING

The two chapters in this section address important challenges to problem-based learning (PBL) as we move into the second decade of the 21st century. By addressing these challenges at both the theoretical and learning design levels, the authors also illustrate PBL's evolution, relevance, and currency half a century after its inception. Savin-Baden synthesizes a body of qualitative research on student engagement in higher education to expand the theoretical foundations of PBL, proposing a set of generic "transdisciplinary threshold concepts." She also challenges us to regain lost ground in defining higher education in a world of change and argues that this new conceptual framing can support students and facilitators in recognizing and managing key interactional moments, or "portals," which offer transformational opportunities but are also the key moments at which students become "stuck" in the PBL process. This new conceptual framing, founded on an interactional evidence base, affords new insights into learning in PBL that move from purely epistemological framings to wider sociological considerations of learner identity. In an age when we are making great efforts to bound and constrain curricula, her argument for this reframing has the laudable goal that curricula "should be spaces for meddling with" (*this volume*, p. 356). Taking up the "meddling" metaphor, Lajoie and colleagues offer new directions for technology-enabled PBL with their development of a learning dashboard called HOWARD

that aims to sustain and promote group interactions at distance and on a larger scale.

Both chapters not only expand the field but also indicate the significant impact on theory building and innovative practices that can occur through the nuanced understandings posed by in-depth, interactional studies into the PBL process.

CHAPTER 11

The Impact of Transdisciplinary Threshold Concepts on Student Engagement in Problem-Based Learning

A Conceptual Synthesis

Maggi Savin-Baden
University of Worcester

INTRODUCTION

There is extensive international research, literature, and much discussion about student engagement in higher education, but few studies have explored it in-depth in relation to PBL. Furthermore, the growing number of constellations of PBL (Savin-Baden, 2014) illustrates the variety of options available for its use worldwide. There is relatively little understanding of the impact of these different PBL constellations on student engagement. Drawing from a qualitative research synthesis on student engagement (Wimpenny & Savin-Baden, 2013), research on tutors' and students' experiences of PBL (Savin-Baden, 2000), research on threshold concepts and PBL (Savin-Baden, 2006; Silén, 2000; Doody, 2009; Barrett, 2010; Fredholm, Savin-Baden, Henningsohn, & Silén, 2015; Chen, 2015; Major & Major, 2013), and recent literature in this area using PBL in immersive worlds (Savin-Baden et al., 2011; Beaumont, Savin-Baden, Conradi, & Poulton, 2012), this chapter argues that student engagement in PBL is troublesome as both a concept and a practice. In particular, I suggest that four distinct transdisciplinary threshold concepts have an impact on student engagement with PBL: liminality, scaffolding, pedagogical content knowledge, and pedagogical stance. I also suggest that by acknowledging these and working with them, facilitators will be able to enhance student learning in PBL across disciplines, contexts, and diverse forms of PBL. In particular, this chapter argues the following points:

1. Students who are learning through PBL are often initially unaware of it as a learning approach, the process of getting stuck in learning, or the notion of transdisciplinary threshold concepts.
2. Recognizing common transdisciplinary threshold concepts could improve student engagement in PBL.
3. Facilitators who are aware of the impact of transdisciplinary threshold concepts in PBL are more likely to be able to enhance and support student engagement.

Since their inception, threshold concepts have been defined as follows:

> A threshold concept can be considered as akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress. (Meyer & Land, 2006, p. 3)

While this early definition does not specifically locate threshold concepts in disciplines, in fact, all the arguments and examples were based in the disciplines. Examples include "opportunity cost" in economics, "pain" in physiotherapy, and "deconstruction for text analysis" in English literature. Threshold concepts are seen as transformed ways of understanding, without which learners cannot progress, and have a number of key characteristics (Meyer & Land, 2003, 2005), summarized here:

- Transformative: Once understood, a threshold concept changes the way in which the student views the discipline.
- Troublesome: Threshold concepts are likely to be troublesome for the student, for example, when knowledge is seen to be counterintuitive, alien, or seemingly incoherent.
- Irreversible: Given their transformative potential, threshold concepts are also likely to be irreversible; that is, they are difficult to unlearn.
- Integrative: Threshold concepts, once learned, are likely to bring together different aspects of the subject that previously did not appear, to the student, to be related.
- Bounded: A threshold concept will probably delineate a particular conceptual space, serving a specific and limited purpose.

In this chapter I argue that while the idea of threshold concepts being located within disciplines is useful to a degree, they need to be broadened. Instead, particularly in the context of PBL, transdisciplinary threshold concepts are more helpful. *Transdisciplinary threshold concepts* are defined here as concepts that transcend disciplines and subject boundaries and are challenging and complex to understand, but once they are understood, the student experiences a transformed way of understanding, without which he or she would struggle to progress through the curriculum.

Other concepts used in this chapter are defined here. *Student engagement* is defined as student connection with the learning context, discipline, peers, and tutors that enable transition and voicefulness in learning. It also includes students' "will to learn": the degree of interest and attention they show when they are learning. *Discipline* is defined as a field of study, a branch of knowledge that is taught and researched as part of higher education, which has a particular object of research and tends to use specific terminology.

This chapter suggests that in PBL students struggle to understand both what it is they are expected to learn and how they are required to learn it. Thus I argue that the transdisciplinary threshold concepts of liminality, scaffolding, pedagogical content knowledge, and pedagogical stance can help tutors to improve, support, and enhance student engagement in PBL. The relationship between transdisciplinary threshold concepts and student engagement is illustrated in Figure 11.1, which illustrates that these four concepts are often barriers to students' engagement in PBL.

LITERATURE REVIEW

New models and theories of learning that have emerged over the last decade have informed the concept of curriculum spaces. For example, the work of Trigwell, Prosser, and Waterhouse (1999) on teachers' conceptions of learning offers useful insights into the impact such conceptions have on student learning, along with Barnett's exploration of conditions of flexibility (2014). This body of work, along with shifts away from the certainty of learning styles toward more holistic conceptions of learner approaches, is important in developing the debate away from generalizations and cognitive foci toward understanding of learner and teacher identities and student engagement (Buckingham, Burn, Parry, & Powell, 2014; Carvalho

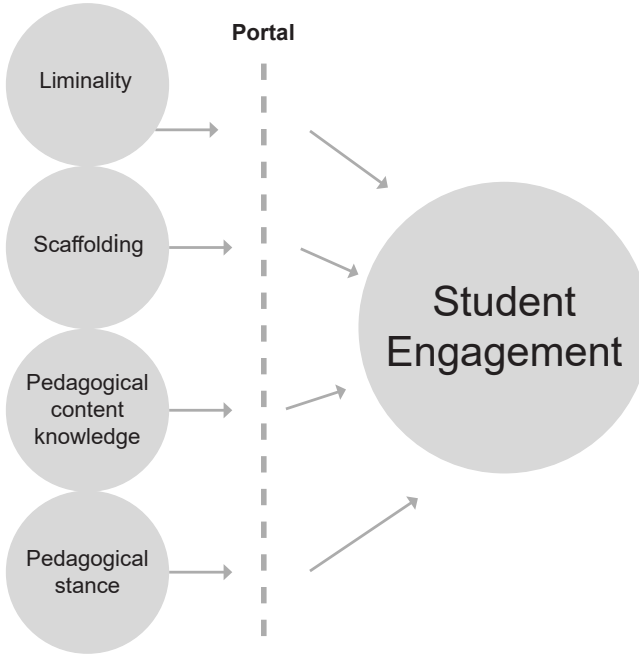

Figure 11.1 Transdisciplinary threshold concepts as barriers to student engagement in PBL.

& Goodyear, 2014; Savin-Baden, 2015). Over the last 15 years there has also been increasing interest in student engagement in higher education.

Student Engagement

Studies on student engagement range from those focusing on institutional achievement to those that focus on learning (e.g., Porter, 2006; Hockings, Cooke, Yamashita, McGinty, & Bowl, 2008). Many current definitions of student engagement promote an institutional focus centered predominantly on outcomes such as retention and success rates (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2007). However, the findings of a literature review on student engagement conducted by Trowler (2010) argued that student engagement has received extensive attention internationally. This review presented definitions of student engagement that include the extent to which students are engaging in activities that contribute to desired (high-quality) learning outcomes. Zepke and Leach (2010) also examined

"high quality learning" but broadened their accepted definition to include a focus on the student's cognitive investment, active participation, and emotional commitment to their learning. Boughey (2008) took a different stance toward the notion of student engagement. She questioned the extent to which engagement is an autonomous skill, since the rules of engagement are formulated by academic expectations and traditions that students need to learn in order to participate in academic dialogues, processes, and practices. Students often misunderstand the idea that an academic text comprises multiple voices, those voices used by the author to substantiate his or her position as well as the solo voice of the author. While academics are able to recognize and locate different voices, students are not always able to distinguish voices and often see books and articles as flat textual pieces.

A recent study on student engagement (Wimpenny & Savin-Baden, 2013) recognized the diversity and complexity of the research and literature and undertook a qualitative research synthesis. Qualitative research synthesis (Major & Savin-Baden, 2010) is a research approach that was developed to synthesize qualitative data from the same research tradition in order to provide a sound synthesis of evidence. Such an approach was adopted to make sense of concepts, categories, or themes that recurred across the student engagement literature in order to develop a comprehensive picture of the findings. The study by Wimpenny and Savin-Baden (2013) found student engagement could be classified as follows:

- *Engagement as connection and disjunction:* There was a variety of student experience, ranging from those who had a more troublesome, questioning approach to those who had experienced a strong sense of disjunction.
- *Interrelational engagement:* Student engagement was characterized and experienced through connection to a wide set of relationships, including student to tutor, student to student, student to family, and student to career.
- *Engagement as autonomy:* This was related to how students shifted from unfamiliarity and self-consciousness to self-sufficiency in learning.
- *Emotional engagement:* This was illustrated by intrapersonal capacity, in terms of student resilience and persistence.

The themes of the synthesis suggest that there are particular issues related to student engagement in the literature that to date have largely been overlooked by those designing learning and making policy in higher education (HE). Findings from the synthesis have revealed that when students are engaged in meaningful learning that they value, the potential for learning something new increases. The study also indicated that engagement with learning is a deeply personal experience and that tutor support of student learning needs as well as acknowledgment of students' struggles, insecurities, pleasures, and pains needed to be evident. In this chapter *student engagement* is therefore defined as student connection with the learning context, discipline, peers, and tutors that enables transition and voicefulness in learning.

Student Engagement and Problem-Based Learning

There has been little exploration of the relationship between forms of learning (such as PBL) and student engagement. Although there is a considerable body of literature on facilitation and PBL (Wilkie, 2004; Silén, 2000; 2004; Barrett, 2008; Savin-Baden, Poulton, Beaumont, & Conradi, 2016), few studies have been found to be central to enhancing learning and promoting student engagement in PBL, although Jacobsen (1997), Silén (2000, 2004), Wilkie (2004), and Barrett (2008) are notable exceptions. An early study by Jacobsen (1997) found that discussion about problems and issues beyond the PBL team were vital to enable learning to take place. Jacobsen termed these discussions "frame factors," issues students raised that do not directly relate to the problem scenario but are important to them. Examples of frame factors include transport between campuses, the arrival of student uniforms, the previous night's television programs, and students' personal problems. Silén (2000) used ethnography to understand student-centered learning from the students' perspectives. She found that students' conceptions of responsibility and independence resulted in their seeing themselves on a continuum of frustration and stimulation. Students' views of their positions along the continuum appeared to affect their willingness to engage with self-direction. However, what is particularly interesting about Silén's work is the way in which students managed the interrelationship between their own personal learning needs and those of the curriculum. Students' ability to be independent learners, as opposed to dependent ones, was affected by their abilities to both engage with the dialectic between the prerequisites of the educational program

and use these prerequisites to support and enhance their own learning needs. Wilkie (2004) examined the strategies adopted by new facilitators in a PBL program and followed their progress for a two-year period. The study was undertaken in a school of nursing in which the preregistration program utilized PBL as a major teaching strategy. Although all the nursing lecturers possessed a formal teaching qualification, none had experience with PBL. Participants represented a range of teaching experience, nursing practice backgrounds, and teaching styles. Wilkie's findings indicated not only the adoption of four different modes of facilitation over time and the impact of six elements on these modes, but also that several of the issues regarding facilitation related to the professional identities of the lecturers involved. Barrett (2008) used a critical discourse analysis approach as an effective methodology for analyzing the dialogue of PBL tutorials. She argued that by experiencing and understanding the PBL process as a means of finding and being in flow, students were more readily able to transfer their use of PBL and the sense of being in flow to a range of other contexts and situations.

What much of the literature on engagement seems to point to is the need for academics to understand that student engagement is strongly related to learner identity and students' pedagogical stances. While this is still an area that needs further development in higher education, in general this link is increasingly being made in the PBL literature (e.g., Sadlo & Richardson, 2003; Fredholm et al., 2015).

As mentioned previously, early studies on PBL facilitation tended to examine how it was undertaken and ways in which it could be improved to support students' learning. Yet more recent work has indicated that student engagement in PBL remains a complex and contested concept (e.g., Yew & Yong, 2014) that requires further consideration in PBL and in higher education in general.

Defining Threshold Concepts

The literature on threshold concepts to some extent builds on the theories from cognitive tradition (Meyer & Land, 2006) and concentrates on the identification of discipline-specific concepts, which are in a sense essential in the acquisition of the thinking, learning, and communication of understanding within specific subject learning, for example, to think logically like a mathematician, or to think, learn, and express oneself like an economist. It is argued that developing understanding and use of these

concepts is crucial for student learning and knowledge construction. The thresholds literature is both fascinating and helpful, but Davies (2006) and Meyer and Land (2006) argue that threshold concepts are generalizable discipline-based concepts that can necessarily be embedded in a curriculum structure. Yet to argue for such a position immediately implies that threshold concepts are dislocated from learner identities.

The link between PBL and threshold concepts is important because PBL is a process, practice, and pedagogy in which students experience disjunction: the sense of students getting stuck in learning. Yet the threshold concepts seen in PBL curricula are transdisciplinary in nature, since they tend to be experienced as more general occurrences, not related directly to a given discipline. For example, many students have described becoming generally stuck in PBL and describe this disjunction as a little like hitting a brick wall; there is an overwhelming sense of "stuckness," and they have then used various strategies to deal with it.

Transdisciplinary Threshold Concepts and Problem-Based Learning

The early literature on PBL and threshold concepts focused on discipline-based threshold concepts; however, more recent work has expanded, and increasingly threshold concepts are used in a more generalizable way. For example, an early study by Doody (2009) explored the idea of a threshold concept in computing. He undertook a study to examine the impact of using a hybrid PBL approach to teach an introductory software development module. A randomized controlled experimental design was used to measure changes in attainment, programming self-efficacy, motivation, approaches to study, and preferences for types of teaching. Questionnaires, data mining of learner activity, and attendance logs were used to provide additional information about learner behavior, and further analysis was undertaken using qualitative techniques, such as classroom observations and interviews. The findings indicate that PBL was effective in helping students master threshold concepts in computing and that the use of PBL to teach novice learners may also help to improve student retention.

However, there has been a trend toward what is referred to in this chapter as transdisciplinary threshold concepts. In the field of education, Barrett (2010) argued that the concept of learning in PBL as "hard fun" is a threshold concept. She suggested that this understanding is irreversible, since it affects the ways in which tutors consider and implement PBL, while

the concept of hard fun incorporates the challenges of learning through demanding activity and the subsequent transformation that ensues. More recently, Chen and Rattray (2017) undertook a study that explored the extent to which PBL contributed to the attainment of critical thinking as a threshold concept, using action research. They found that the development of critical thinking through PBL was not linear but oscillatory. Chen and Rattray (2017) argued that critical thinking, the idea of a threshold concept, goes beyond the level of a concept to the level of a theory resulting in capabilities, which ultimately challenges the teacher to reconsider quality of teaching and learning. However, today the links between these studies, as well as the broader literature on thresholds, PBL, and student engagement, remain inchoate. This chapter remedies this situation by bringing together research and literature that synthesizes the transdisciplinary threshold concepts that appear to affect student engagement in PBL.

METHODOLOGY: A CONCEPTUAL SYNTHESIS

This section presents a conceptual synthesis of threshold concepts in student engagement in PBL. There have been many attempts to classify different types of literature reviews, ranging from simply reporting and describing existing research to a more direct analysis of the literature. In practice, this synthesis was undertaken by seeing the synthesis not as a direct, in-depth, interpretive, qualitative research synthesis, but rather as Form 5 research, as "part of a whole," as demonstrated in Figure 11.2, and described here as a conceptual synthesis.

Research as Part of Whole: A Conceptual Synthesis

This kind of synthesis requires collating information into a unified whole in a way that offers a bigger picture of what the collated findings indicate. This approach, research as "part of a whole," involves locating and analyzing literature so that individual components can be viewed collectively to aggregate previous research. The synthesis began by defining inclusion and excision criteria, as demonstrated in Table 11.1.

While more than 25 articles dealt with threshold concepts and PBL, those listed in Table 11.2 were selected as meeting the inclusion criteria.

Once the papers were selected according to these criteria, analysis was undertaken as described in the following section.

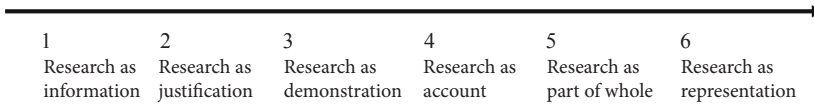

Figure 11.2 Forms of literature use, along a continuum. *Source:* Major & Savin-Baden (2010, p. 24).

TABLE 11.1 *Inclusion and Exclusion Criteria*

Criteria	Included studies	Excluded studies
Topic	Sources and publications related to PBL, threshold concepts, and conceptual thresholds	Sources with narrow discipline-based descriptions of threshold concepts
Context	HE	FE, School sector
Date	2000–2015	Prior to 2000
Research design	Primary empirical qualitative studies (including case study research, narrative inquiry, ethnography, phenomenology, participatory action research, and grounded theory)	Quantitative studies, literature reviews, and research syntheses
Location	International literature	Sources not in the English language

TABLE 11.2 *Papers Included in the Synthesis*

Paper	Summary	Link to transdisciplinary threshold concepts
Trafford, 2008	Trafford explores how doctoral candidates use conceptual frameworks in their research and theses and argues that conceptual frameworks engage with liminality as they attempt to understand them.	Liminality
Barrett, 2008	Barrett explores PBL students' discussion about PBL in the PBL tutorials for an education development module. In chapter five she discusses how the concept of the problem as a provoker of a liminal space, a threshold, betwixt and between spaces, was derived from the data. It explores the three dimensions of this liminal space between old and new ways of knowing, old and new ways of being, and habitual and new forms of professional action.	Liminality

Paper	Summary	Link to transdisciplinary threshold concepts
Silén, 2004	This chapter describes a meta level of discernment that comes to the fore in the students' narratives about being learners in a PBL context. The source of the students' actions and conceptions is their experience of facing the challenge to be responsible and independent in their learning processes. The metaphor for this is described as the dialectic relationship between chaos and cosmos.	Liminality
Major & Major, 2013	In this article, the authors present information gathered from a marketing course designed for second-year students that centered on a problem-based project at a two-year institution. Using "learning context" as a theoretical frame for this classroom-based research, they explore student perceptions of the method and outline strengths and weaknesses of the approach. The authors make suggestions for research and practice based on their findings.	Scaffolding
Savin-Baden, 2000	This book explores staff and students' experiences across three professions and argues that scaffolding within subjects affects the kind of PBL offered. It is based on a 4-year study and discloses ways in which learners and teachers manage complex and diverse learning in the context of their lives in a fragile and often incoherent world.	Scaffolding
Jacobsen, 2004	This chapter gives some examples from a study that found that despite an institution advocating and expressing a self-directed PBL ideology, students often engaged in cue seeking and also focused on the surface structure of the proffered case descriptions. The case descriptions were often read as didactic texts rather than as representations of real-life phenomena. This meant that the problems at hand were rarely discussed or indeed solved. Rather, they triggered discussions about what issues it might be strategic to raise.	Scaffolding
Savin-Baden, 2003	This book explores a broad range of issues about facilitation, in particular understandings of facilitation that have emerged from the author's recent research and ways of equipping and supporting staff. It also questions how students are assessed and suggests ways of designing problem-based curricula that enhance learning.	Scaffolding

(*continued*)

TABLE 11.2 (*Continued*)

Paper	Summary	Link to transdisciplinary threshold concepts
Chen, 2015	This study defines critical thinking as a threshold concept and establishes the epistemological threshold framework with conceptual and practical levels to investigate how PBL contributes to the development of critical thinking in the news media literacy class through students' learning experiences, academic performance, and perceptions of their development.	Pedagogical content knowledge
Fredholm, Savin-Baden, Henningsohn, & Silén, 2015	This study investigates the relationship between autonomy in learning and narratives of personal challenge and development in the context of student PBL experiences in clinical education. The findings suggest that in order to create autonomy in learning in medical education, it is important to move away from the image of an independent learner who is learning from the patient to a learner who learns together with the patient in a reciprocal relationship.	Pedagogical content knowledge
Beaumont, Savin-Baden, Conradi, & Poulton, 2012	This article reports on the findings of a demonstrator project to evaluate how effectively immersive virtual worlds (IVWs) could support PBL. The project designed, created, and evaluated eight scenarios within Second Life (SL) for undergraduate courses in health-care management and paramedic training. Evaluation was primarily qualitative, using illuminative evaluation, which provided multiple perspectives through interviews, focus groups, and questionnaires with designers, facilitators, learning technologists, and students. Results show that staff views about scenario design and pedagogical content knowledge affected facilitation and student engagement.	Pedagogical content knowledge
Savin-Baden, 2000	This book presents the findings of a longitudinal study that used collaborative inquiry to explore tutors' expectations and experiences of being PBL facilitators. The findings indicate that tutors' pedagogical stances influence not only the PBL teams but also the student learning experience. These findings are underpinned by earlier work in this field that explored both tutors' and students' experiences of PBL in four professions.	Pedagogical stance

Paper	Summary	Link to transdisciplinary threshold concepts
Wilkie, 2004	Wilkie examines the shifts made in the pedagogical beliefs of nursing lecturers implementing a problem-based diploma in a nursing program. The lecturers expressed beliefs about teaching and student learning that reflected a PBL philosophy, but their actions within seminars were similar to actions used previously in subject-based teaching. The findings raise issues related to the imposition of PBL curricula and facilitator selection.	Pedagogical stance
Good, Howland, & Thackray, 2008	This paper presents a case study in which university students were tasked with building an interactive learning experience using Second Life as a platform. The use of a virtual environment, combined with PBL and constructionism, subtly changed the nature of the instructor–student relationship, allowed students to explore "problematic problems" in a motivating and relevant manner, provided students with greater ownership over their work, and allowed problems to be set that were flexible, but at the same time allowed for ease of assessment.	Pedagogical stance

ANALYSIS

Each paper was read and reread several times, and a summary was created to enable the studies and concepts to be compared. The purpose of analysis was to move beyond comparison and explore the possibilities for locating transdisciplinary threshold concepts that might relate to student engagement with PBL. In practice, this involved

- combining ideas across studies,
- expanding or refuting possible transdisciplinary thresholds concepts,
- rereading data, and
- developing a matrix to locate issues as transdisciplinary threshold concepts (Tables 11.4–11.7).

Findings

This section draws on the included articles to suggest that there are four distinct transdisciplinary threshold concepts that can be seen in relation to student engagement with PBL: liminality, scaffolding, pedagogical content knowledge, and pedagogical stance. These transdisciplinary threshold concepts are neither sequential nor hierarchical but do appear to have an impact on one another, but further research in this area needs to be undertaken to understand these concepts in detail and depth. This section outlines each of the concepts, explains why they are transdisciplinary threshold concepts, and begins with a summary of the threshold characteristics (see Table 11.3).

Liminality

Liminality tends to be characterized by a stripping away of old identities and an oscillation between states; it is a betwixt and between state, and there is a sense of being in a period of transition, as well as an oscillation between states and personal transformation. The idea of a liminal state is taken from ethnographic studies on rituals, for example, rites of passage such as the initiation of adolescent boys into manhood. Turner (1969) adopted the term "liminality" (from Latin *limen*, "boundary or threshold") to characterize the transitional space/time within which the rites were conducted.

> These ethnographical examples relate primarily to liminality in life cycles. . . . The concept of the "betwixt and between" liminal state then becomes easy to recognise in contemporary western culture—think, for instance, of the wedding ceremony where the "threshold" ceremony is followed by a "liminal" honeymoon. Think, too, of funerary ceremonies where the period from death to inhumation (or cremation) is equally "liminal." (Trubshaw, 2003, n.p.)

Liminality is a transdisciplinary threshold concept in student engagement in PBL because it is a complex, often covert learning space. It is invariably a place of incoherence and confusion for students and is a threshold concept because students (and often tutors) do not realize or accept that liminality, and the processes involved in managing it, can enable students to adopt deep approaches to learning and emotional engagement

TABLE 11.3 *Summary of Threshold Concepts in Student Engagement with PBL*

	Irreversible	Bounded	Transformative	Troublesome	Integrative
Liminality	The very nature of liminality means that it is irreversible after transition.	Usually bounded by the issue that has resulted in the liminality.	It is transformative since the liminality itself helps students to see the world anew.	Liminal spaces are complex and uncomfortable by their very nature.	Understanding the concept and value of liminality for learning is integrative.
Scaffolding	The realization that the availability of different forms of scaffolding means students and tutors are unlikely to go back.	This is bounded by the type of scaffolding adopted by the tutor.	This is transformative because high-level, flexible scaffolding prompts the valuing of scaffolding differently.	Reviewing scaffolding results in questioning what has been required by the adoption of it.	Recognizing that some forms of scaffolding are valuable is integrative.
Pedagogical content knowledge	The recognition of new forms of knowledge means there is little likelihood of returning to older views.	This is bounded by the type of knowledge presented.	New views of knowledge result in shifts in critical thinking.	Dealing with different forms of pedagogical content knowledge challenges views about what counts as knowledge.	Realizing the existence and impact of pedagogical content knowledge is integrative.
Pedagogical stance	Tutors and students are unlikely to return to a previous state once they have gained a new learning perspective.	This is bounded by students' and tutors' perception of their stances.	Changes in pedagogical stance enable new perspectives about knowledge values.	Shifts in pedagogical stance prompt troublesome challenges to learner identity.	Acknowledging the impact of pedagogical stance in learner identity is integrative.

with the knowledge put before them. There has been increasing interest in recent years in the concepts of liminality within the threshold concepts literature. For example, Land (2014) suggested that the liminal state can be seen as a "progressive function," which enables learners to realize the current shortcomings of their existing view, while Ross argues that

> transformation has to be understood as a matter of shifting subjectivity, not as deep changes to an essential selfhood. Subjectivity is best understood as always in process, and so shifts are commonplace, part of the negotiations that take place as a result of the discursive nature of subjectivity. (2011, p. 226)

The difficulty here is the assumption that transformation is seen as rather more cognitive than connected to shifts in learner identity, which would indeed result in deep changes—certainly in stories from students' journeys in PBL, the PhD here being seen as the ultimate form of PBL; Trafford (2008) explored threshold concepts in PhD supervision and offered some fascinating insights into threshold encounters. What is poignant is the consistent sense of a conceptual state of being lost that students experience, as if they were slipping in and out of liminal variation and across diverse forms of liminality. For example, one student said:

> Each new concept looked interesting and provided insights on my data. I felt like using it to analyse my data, but a week later a different theory seemed just as promising. I was conceptually lost. (Trafford, 2008, p. 281)

Another said:

> I did ask for help. I sat with my colleagues and asked them about their conceptual frameworks. Everybody was talking about "IT," but most of them were looking at an illusion. They thought they knew what IT was but gradually I doubted it. I then felt at peace when I realised that most of them were still looking for their conceptual framework. (Trafford, 2008, p. 282)

This sense of being lost and looking for something seems to be a shift away from liminal variation. This is a response to both preliminal variation,

in terms of encountering the portal, and liminal variation, in terms of how the liminal space is entered and negotiated. Yet it would seem that here students speak of the realization of being lost and needing to look for something that is there or having an expectation that this sense of lostness will disappear.

Transitions and transformation resulting from disjunction and subsequent liminality appeared to prompt students to interrogate the achievements and experiences of the past in relation to what was then occurring for them. Students who engage with disjunction tend to speak not of constructing a voice but of "gaining a voice" (Savin-Baden, 2000), as a way to depict an intellectual and ethical process whereby the development of a sense of voice, mind, and self is interlinked. This then would seem to be a developmental transformation, which is increasingly being seen in other studies. For example, Chandler (2015) suggested that there are five thresholds evident in theological reflection and that these are both cognitive and developmental. Further, Land (2014) and Rattray (2014) seemed, at points, to suggest that engagement with threshold concepts requires both cognitive shifts as well as ontological and emotional shifts that result in more than a cognitive transition. In terms of PBL, students struggle to know how to learn independently and to take up a pedagogical stance. The result is a shift into liminality that both students and tutors struggle to understand or accept. The impact for both tutors and students can be liminal experiences, as delineated in Table 11.4.

For some tutors the reaction to students' experiences of liminality in PBL can result in their feeling a need to provide more structure and more scaffolding. This can be helpful, depending on the type of scaffolding, but it can also bring with it a greater sense of disjunction and liminality. Tutors and students may also struggle with liminality because of their beliefs about the value of scaffolding.

Scaffolding

There is a strong focus in higher education, and particularly in professional education, on the notion of scaffolding learning. Emerging from Vygotsky's zone of proximal development (Vygotsky, 1978), this is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. The concept of scaffolding refers to the context

TABLE 11.4 *Forms of Liminality*

Form of liminality	Description	Evidence drawn on
A moment of aporia	A moment of aporia* is when a misconception becomes apparent and the student needs to explore and examine the assumption underlying his or her views or beliefs about an issue.	Burbules, 1997
A moment of conceptual puzzlement	A moment of conceptual puzzlement is when feeling stuck results in a sense of feeling paralyzed or fragmented.	Savin-Baden, 2008a
Recurring liminality	This is where someone may understand that he or she needs to move away from a particular position of stuck space but does not know how or where to move results in a constant cycle of liminality, where there is a perpetual return to the same stuck space.	Savin-Baden, 2008b
Reflexive metaxis	This is a reflexive position in which the liminality and stuckness is recognized but also, amidst the moving on, there is recognition of transition, a sense of continual oscillation between threshold crossing and liminal states, resulting in an ongoing sense of metaxis.	Savin-Baden & Falconer, 2016

* Aporia (Greek: Απορια: impasse; lack of resources; puzzlement; embarrassment, from Aporia, the spirit of difficulty) is a puzzle or an impasse, but it can also denote the state of being perplexed, or at a loss, at such a puzzle or impasse.

provided by knowledgeable people to help students develop their cognitive skills. For example, Orsini-Jones (2008) presented a process of scaffolding for learning grammar but found a mismatch between students' perceptions of what was difficult and what they found to be difficult, in relation to the categorization of particular grammatical categories. While scaffolding can be helpful, it can also lead to a sense of preliminal variation in terms of how students perceive or encounter the portal. What Orsini-Jones's study appears to indicate is that difficulty occurs that leads to a consequential increase in stuckness, either when the students do not understand the lecturer's map for learning; there is disjunction between the lecturer's map and the student's map; or, perhaps in more cases than we would wish to acknowledge, the student's map is better than that of the lecturer. Thus it would seem that tutors' need to scaffold learning is troublesome and results in student disenchantment. Even those innovative suggestions for

scaffolding provided by Hmelo-Silver, Duncan, and Chinn (2007) and Belland, Kim, and Hannafin (2013) essentially position the tutor as being the orchestrator of the learning process over the student.

Hmelo-Silver and colleagues (2007) argued against Kirschner, Sweller, and Clark (2006), who suggested that PBL and inquiry learning are minimally scaffolded and therefore influence effective student engagement. Hmelo-Silver and colleagues (2007) argues that PBL is scaffolded, but in particular ways. However, their argument is somewhat simplistic in that it did not take account of diversity in learning, pedagogical content knowledge, or learner identity, since they believed

> scaffolded inquiry and problem-based environments present learners with opportunities to engage in complex tasks that would otherwise be beyond their current abilities. Scaffolding makes the 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). (Hmelo-Silver et al., 2007, p. 100)

Belland and colleagues (2013) suggested that many tutors using PBL believe providing students with authentic problems will necessarily result in student engagement. They argued that this is not the case and provided clear guidance and a rationale for designing scaffolds that enhance cognitive outcomes and student motivation. While this is laudable, it tends to take little notice of learner differences, diversity, or levels of student criticality, as well as learner identities and pedagogical stances.

Scaffolding is a transdisciplinary threshold concept, as students *believe* they need it and tutors *believe* they must provide it, since both consider it vital for students to learn the "correct" information. In practice, tutors who over-scaffold can inhibit student learning and prevent both disjunction and resultant movement over any threshold. Furthermore, scaffolding is a transdisciplinary threshold concept because most tutors do not understand that it can be unhelpful to the learning process, since they do not recognize the value of stuckness. Thus removing or minimizing scaffolding can enable tutors to improve student engagement in PBL, since it will assist students to move more effectively through the multiple learning portals available in the PBL process. Removing scaffolding is likely to increase the possibility of disjunction in a range of learning areas and thus augment threshold crossing:

> For example, Sally's belief that her learning was someone else's responsibility stemmed from her uncompromising experiences in life: brought up in a religious family, Sally believed that there were clear guidelines and right answers. Her low self-esteem—she described herself as being "not particularly intelligent," had emerged from her position in the family as one of the few who had not achieved high grades at Advanced ("A") level whilst at school. This meant that she not only wanted to be told what to learn but also needed to be affirmed in the choices she had made: "You need to know, are you doing the right thing? Are you doing the wrong thing? You don't know if you've never come across it before what is right and what is wrong, do you? What is the right way to go about something and what is the wrong way? And you might be doing it all wrong but because nobody's said any different to you, you go through with the feeling you're doing it right." . . . Sally expected not only that the tutors would provide her with the knowledge and skills that she needed to become a nurse, but that they would also show her how to make connections between herself and what she was learning. (Savin-Baden, 2000, p. 69)

As the scaffolding was removed, Sally shifted away from the idea of right answers and tutors as purveyors of knowledge. In many ways this supports the arguments suggested by Rogers (1983) and hooks (1994) for freedom to learn and teaching to transgress. In the context of PBL, it is important to note that scaffolding is essentially a cognitive construct and relies on cognitive learning theory and students' cognitive capabilities. There is increasing focus in the 21st century on what and how students learn and on ways of creating learning environments to ensure that they learn effectively, invariably with a focus on scaffolding this learning—although much of this remains contested ground. During the learning process, many students fail to locate what Perkins (2006) referred to as the episteme, or underlying game (what it is that is required by the tutor). Tutors' attempts to communicate the underlying game have taken a number of forms. For example, Kinchin, Cabot, and Hay (2010) suggested that providing information in chains is unhelpful to students, and that such a strategy merely constitutes procedural sequences. They argued that teaching students within a linear lecture structure fails to help them link different knowledges together. Instead we should teach networks of

TABLE 11.5 *Forms of Scaffolding*

Form of scaffolding	Description	Evidence drawn on
Scaffolding tasks	Tutors provide and students expect tasks/ scenarios to be guided step by step through the PBL process.	Belland, Kim, & Hannafin, 2013 Hmelo-Silver, Duncan, & Chinn, 2007
Scaffolding group processes	Tutors guide students through the group process, the ways of managing a group and dealing with conflict, rather than this all being organized and dealt with by the group.	Hmelo-Silver, Duncan, & Chinn, 2007
Scaffolding problem-solving	Problem solving is seen as being guided through a set of procedures rather than being open, flexible, and innovative in the process of problem management.	Hmelo-Silver, 2004
Scaffolding autonomy	The form and degree of autonomy allowed are guided by the tutor, such as the pedagogical content requiring engagement or the group process that is permitted.	Belland, Kim, & Hannafin, 2013

understanding, illustrating how knowledges and practices are connected so that knowledge is integrated and holistic. Chains and networks are one helpful exemplar, but a particularly popular one is that of scaffolding. The forms of scaffolding shown in Table 11.5 are seen within PBL.

Scaffolding for most tutors currently is seen as a "good thing," yet to see scaffolding as problematic is in fact a threshold concept and will help students engage with PBL. Movement over the threshold for both tutors and students relies on *not* over-scaffolding, instead allowing for disjunction and threshold exploration to occur in the context of scaffolding that is pedagogically informed. Scaffolding may reduce the possibilities for imaginative curriculum making for students as well as a tutor. Thus, it might be that tutors, through scaffolding, lead students around disjunction and into liminality, thereby guiding students only into transitional states rather than transformative opportunities. Yet scaffolding can also occur through misplaced notions of pedagogical content knowledge.

Pedagogical Content Knowledge

Pedagogical content knowledge is seen as central to the idea of thinking like an engineer, physiotherapist, or teacher. While subject knowledge

TABLE 11.6 *Forms of Pedagogical Content Knowledge*

Form of pedagogical content knowledge	Description	Evidence drawn on
Content knowledge	Knowledge (facts, concepts, theories, and principles) that is seen as central to content, that is seen as needed to be "covered" within a discipline.	Zepke, 2013
Subject knowledge	Knowing the content knowledge of a discipline well enough to teach it as a subject within a classroom This requires not only knowing about the subject, but also knowing how the knowledge belongs to the discipline and how it should be taught in the context of the discipline.	Zepke, 2013
Epistemic knowledge	Knowledge used by the discipline to create systems of meaning to serve the discipline, such as the creation of models or theories that are discipline specific	Trowler, 2012
Pedagogical knowledge	Knowledge about how and why a discipline teaches what it teaches in ways that are acceptable to the discipline.	Jenkins & Zetter, 2007 Bernstein, 1972

and pedagogical knowledge are perhaps self-evident, pedagogical content knowledge draws upon knowledge that is specific to teaching particular subject matter. These different types of knowledge are explained in Table 11.6. Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring to their learning of those most frequently taught topics and lessons (Shulman, 1986, pp. 9–10). In the United Kingdom there has been increasing discussion about discipline-based pedagogy (which is parallel to pedagogical content knowledge), particularly in debates about the relationship between research and teaching. Jenkins and Zetter (2007) argued that disciplines shape the nature of pedagogy, and such pedagogies reflect the practices and culture of the discipline. Shulman (1986) described pedagogical content knowledge as the ways of representing and formulating the subject that make it comprehensible to others. Pedagogical content knowledge may draw on other forms of knowledge as well as knowledge

from other disciplines. For example, students may have studied psychology in high school, but the use and portrayal of psychology in a medical or theology degree is reformulated to reflect the pedagogical content knowledge. The result is that knowledge of a particular discipline is taught and fashioned within it and for it, and thus it is for many students a threshold concept. Few students realize that in order to think like, for example, an engineer, they have to see knowledge through the lens of the discipline. However, perhaps more pertinently, there is also an assumption by tutors that knowledge has to be gained in a particular way related to the pedagogy of the discipline. Tutors see their role as inducting (or forming) students into the discipline and rarely recognize their assumptions about pedagogical content knowledge or its impact on learning. Pedagogical content knowledge is a threshold concept because it is bounded; once tutors appreciate this they realize that knowledge and the teaching of it have to be seen afresh. For example, a facilitator explained his position thus:

> "I try not to be directive although at times I say to the group, I think I'm taking my problem-based learning hat off for a few minutes is that okay, so they know the difference, now I'm putting on my nursing lecturers hat and I will throw something out to them which is possibly a gaping hole in their argument and they should have identified it, so I will give it to them. Now go back and play with that ball, and I'll put that problem-based learning hat back on again. I think I'm that kind of facilitator, not directive, give them a long lead, do a lot of listening, try to play the game they want to play as long as they look at the objectives of the problem-based learning, and they are heading in that direction. I'm quite happy to believe that there are many different routes to achieve the learning outcomes, you don't have to go down a specific road, as long as at the end of the problem-based learning they have achieved them, for the students and for the patients."

His perception of himself as not being directive does not square with "putting on my nursing lecturer's hat" so that he can supply students with the practical knowledge they need to be safe with patients and achieve the learning objectives. (Savin-Baden, 2003, p. 40)

This struggle for tutors in deciding how and whether to impart knowledge to students is also evident in more recent work (Conradi et al., 2009).

Here tutors involved in PBL in virtual worlds tended to take on one of two specific roles: a technical role, assisting students by offering guidance on how to use the environment, or a clinical subject matter expert. Pedagogical content knowledge is a transdisciplinary threshold concept in PBL because once tutors realize that it can disable students' learning in PBL, they change their approach to facilitation to reflect this, as Wilkie's study (2004) demonstrated. Thus as tutors shift to seeing pedagogical content knowledge as troublesome, since they recognize the need for greater flexibility about what counts as knowledge, this in turn results in increased autonomous engagement for the students as they shift toward owning knowledge for themselves.

The following quotation from Beaumont and colleagues illustrates a focus on both scaffolding and the need for pedagogical content knowledge:

> In the paramedic scenarios, one tutor confirmed that the scenarios assumed students had a level of knowledge that they could apply and the scenario focussed on developing clinical reasoning and decision making in simulated real-life situations. However, his original intention for the pedagogic model required that prerequisite knowledge (background) would be incorporated within the Second Life scenario and that the scenario could therefore be used to promote learning of theory in addition to application to practice. He envisaged an active facilitator approach; which would vary as students repeatedly visited a scenario and would "*direct them how to learn and where to find information . . . and follow them until I make sure they are heading the correct way*." (Beaumont et al., 2014, p. 135)

In terms of student engagement, this quotation illustrates the hidden "texts" in tutors' expectations for students' learning. For example, Boughey (2008) argued that students believe their work should reproduce regarded texts and hence feel discouraged when they are criticized for reproducing facts and tutor perspectives. Thus the uses of language are deeply related to issues of engagement—both for students and academics—and are not just social, cultural, or political skills.

This illustration also exemplifies the impact of pedagogical stance on student engagement in PBL.

Pedagogical Stance

Pedagogical stance depicts the way in which students see themselves as learners in particular educational environments, as illustrated in Table 11.7. The choices students make within a learning situation and the particular learner history that they bring to a learning environment both influence students' pedagogical stance. Pedagogical stance is a transdisciplinary threshold concept because tutors and students rarely recognize that they have a pedagogical stance or the impact it has on facilitation and student engagement.

TABLE 11.7 *Types of Pedagogical Stance*

Type of pedagogical stance	Description	Evidence drawn on
Reproductive pedagogy	Students may revert to methods of learning that they have always used, despite the considerable difference they may have encountered between methods of learning experienced at school and those at university. Learning, for these students, is expected to be safe and predictable, requiring neither personal initiative nor critical thought.	Savin-Baden, 2000
Strategic pedagogy	Students in this domain may use several different learning strategies, but these are all within the remit of what is acceptable to both the authorities (institution, tutor, profession) and the student. Adapting their learning will ensure that they are equipped with the necessary skills and knowledge for the workplace.	
Pedagogical autonomy	Students adopt a position of learning that they perceive will offer them the greatest degree of autonomy. Students opt to learn in a way that suits them and that will offer them, as far as they are concerned, the most effective means of learning, meeting their own personally defined needs as learners, yet also ensuring that they will pass the course.	
Reflective pedagogy	Students see learning and knowledge as flexible entities; they evaluate personal knowledge and propositional knowledge on their own terms, and thus the student both engages with knowledge and questions it.	

These types of pedagogical stance can be seen as transdisciplinary threshold concepts, in that they are stages through which students pass on the way to high-level, deep engagement in learning. Thus they journey across multiple thresholds on their way toward reflective pedagogy. However, many students in PBL appear to become stuck because of tutors' views of knowledge and the way in which they scaffold PBL. For example, a student in an engineering program explained that

> he found that even by buying into the academics' notion of problem-based learning he was not always enabled to develop himself and explore areas which he valued. Application and understanding were issues which he felt were key to being able to apply his knowledge. They were skills which had enabled him to learn to resolve or manage problem situations effectively by using his knowledge in a way in which he had been unable to do upon the mechanical engineering course in the first year. However, now, in the fourth year, he felt angry when some tutors imposed their own strategies upon students. He believed he had not been offered the opportunities to develop his problem-solving capacity fully. He objected to these artificial discipline boundaries, and the ways in which he had been prevented from exploring various aspects of the given problem due to the inculcation of a step-by-step approach to problem-solving by some of the staff. (Savin-Baden, 2000 p. 82)

Students' stories of PBL could not be separated from the ways in which they talked about themselves and their pedagogical stances. However, although pedagogical stance has been presented here as reflecting students' journeys through liminal states and over thresholds, tutors too hold pedagogical stances that affect student engagement with PBL. Issues of power and control in PBL were spoken of many times by tutors (Savin-Baden, 2003, ch. 3). There was a sense that these staff were dislocated not just because PBL did not fit with their pedagogical stances but also because they felt unable to let go. Letting go was partly about control, but it was also about feeling safe enough with this method of learning and feeling that students could be trusted. Many facilitators later remarked on how part of the transition they had made was learning to trust the students to learn for themselves.

DISCUSSION

What the PBL literature and the literature on student engagement appear to indicate is that although transdisciplinary threshold concepts may share certain characteristics, the experience of them differs between people and invariably relates to identity transitions and transformations. Thus it would seem that transdisciplinary threshold concepts are affected both by the spaces in which they occur and through the pace of change in learner experience and learner identity. Although in the thresholds literature the term "concepts" might be seen as both cognitively and ontologically positioned, there still needs to be a greater emphasis on the relationship between learner identities and threshold concepts than there is in some of the current research and literature. For example, the difficulty with the notion of locating ideas of troublesomeness around "knowledge," "concepts," or "theories of difficulty" seems to somewhat dislocate the concerns from the identities and biographies of learners and teachers. However, the overemphasis on cognitive dimensions to threshold concepts, as delineated by Entwistle (2006), is where this difficulty seems to be most apparent. For example, Entwistle argued that engaging with threshold concepts is connected to *conceptual* change and related his argument to Perry's (1970) conceptions of knowledge and Säljö's (1979) conception of learning. Thus, there would seem to be too much emphasis on epistemology and not enough on identity; for example, work carried out with postgraduate students in terms of their development of conceptual-level thinking and engagement with the research question and the interdisciplinary disciplines—the disciplinary mix in their writing of the thesis—has identified moments of "learning leaps" (Wisker, Kiley, & Aiston, 2006; Wisker & Riley, 2008; Wisker, Robinson, & Kiley, 2008). Learning leaps occur when students cross conceptual thresholds to raise the level of their critical thinking and expression. Conceptual threshold crossings are moments when students make the learning leaps and start to work at a higher and more conceptual, critical, and creative level. Transdisciplinary threshold concepts enable student engagement, although they need to be linked to personal learning and experiences of individual disjunction rather than overly generalizable, simplistic threshold concepts.

Barnett (2000) has described the modern world as super complex. From his perspective, the role of the university is to prepare students for a world in constant change, being exposed to several and sometimes

conflicting frameworks for understanding. By seeing these four concepts as transdisciplinary threshold concepts, tutors can help to improve student engagement in PBL, as mapped in Table 11.8.

By acknowledging these transdisciplinary threshold concepts and working with them, facilitators will be able to enhance student learning in PBL across disciplines, contexts, and diverse forms of PBL. The result will be that instead of curricula being over-planned, over-organized, and over-prepared spaces, they will be spaces for meddling with. McWilliam has argued that

> the nature and purposes of *what counts as preparation must change*. From fixed and immutable, curriculum needs to be conceptualised as *content for meddling with*. And this means a significant shift in what many teachers prioritise in their teaching. (McWilliam, 2005, p. 13; emphasis in original)

Despite moves, at least in the United Kingdom, toward flexible pedagogies, considerable resistance seems to remain. The focus seems to be on shoring up the disciplines and using outcomes, benchmarking, and standards to pin down knowledge and quality, rather than opening them up.

If the role of the university is to prepare students for a world in constant change and exposure to several and sometimes conflicting frameworks for understanding, then it is vital to recognize that transdisciplinary threshold concepts do have an impact on student engagement and need to be explained to students and engaged with by tutors. Tutors need to support students in recognizing the ways in which aspects of their lives impact engagement in pedagogic spaces. However, it is important to note that while these are generally seen as transdisciplinary threshold concepts that affect students, they may also affect tutors. For example, tutors who believe in the value of high-level scaffolding or fail to recognize liminality may become stuck or troubled in the process of facilitating PBL. Further, it would seem from this conceptual synthesis that unless tutors encounter and work through their own transdisciplinary threshold concepts when designing PBL curricula, students may struggle to experience engagement with PBL. A student-centered pedagogy must be viewed as a lens of students' exploration and discovery. Such a critically transformative pedagogy (Zyngier, 2007) will support an improved communal and social connection among students and tutors and encourage autonomy and agency as well as

TABLE 11.8 *Constellation of PBL, Threshold Engagement, and Facilitation*

	Constellation 1	Constellation 2	Constellation 3	Constellation 4	Constellation 5	Constellation 6	Constellation 7	Constellation 8	Constellation 9
	PBL for knowledge management	PBL through activity	Project-led PBL	PBL for practical capabilities	PBL for design-based learning	PBL for critical understanding	PBL for multimodal reasoning	Collaborative distributed PBL	PBL for transformation and social reform
Level of scaffolding	High Promoting competence in knowing and managing knowledge	High Learning through guided activity	High Project-led, step by step	Medium Guided toward practical resolutions	Medium Guided toward design-based solutions	Low Supported in gaining knowledge with action	Low Supported in managing dilemmas	Low or none Defined by team	Low or none Prompted to see alternatives
Form of facilitation	Directive	Directive	Directive	Guide to practice	Guide to practice	Coordinator of knowledge and skills	Orchestrator of learning opportunities	Enabler of group reflection	Decoder of cultures
Level of threshold engagement	Interrelational engagement	Interrelational engagement	Interrelational engagement	Interrelational engagement	Engagement as autonomy	Engagement as autonomy	Emotional engagement	Engagement as connection and disjunction	Engagement as connection and disjunction

reduce students' conceptions of isolation and alienation. Furthermore, as Bernstein (1992) has argued, it is through their experiences as students that individuals within HE form their identities. He has suggested that identity formation may be seen as the construction of pedagogic identities, which will change according to the different relationships that occur between society, HE, and knowledge.

University education should engage students by bringing problems and questions to them, not merely pass on scaffolded knowledge. Students need to be free to discriminate; make judgments; and develop the capacity to improvise, inquire, and take intellectual risks. If we are to see curricula as content for meddling with, then we also need to see PBL differently. Yet few authors offer strategies for dealing with negative performative practices, upheld by constructive alignment and narrowly defined learning outcomes. Perhaps what is needed is more "deliberative pedagogy," in which deliberation rather than outcomes is seen as the organizing principle of the PBL curriculum. This would mean that consensus decision making, consciousness raising, and knowledge creation are the responsibilities of both learners and teachers, and deliberation is the hallmark of facilitation.

IMPLICATIONS AND FUTURES

The challenge for higher education is to prepare for unpredictability and uncertainty. Today's challenges in higher education are highly complex, and solutions may be found only by crossing disciplinary borders and by defining new and emergent ontologies. It is clear then that research is needed on how curricula are designed and which underpinning pedagogical frameworks are adopted, as well as more detailed questions, such as the following:

- What kinds of activities prompt engagement with transdisciplinary threshold concepts in PBL?
- To what extent do particular activities improve student engagement in PBL?
- Why are particular models of PBL located in particular disciplines, and in what ways do they prevent or enhance students' engagement?

- What forms of scenarios prompt engagement with transdisciplinary threshold concepts in PBL?
- How can understanding transdisciplinary threshold concepts help to promote effective facilitation in PBL?

CONCLUSION

Building on theories of threshold concepts developed in undergraduate disciplines, as well as research into conceptual threshold crossing in doctoral learning journeys, may help to improve and understand different levels of student engagement with PBL. It would be easy to dismiss the notion of transdisciplinary threshold concepts for engagement with PBL as being too difficult, too troublesome, to take on. The risk of not engaging, of over-scaffolding, and of not living with the liminal will result in a poverty of PBL experiences, performative pedagogies, and curricula in search of criticality.

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CHAPTER 12

Toward Quality Online Problem-Based Learning

Susanne P. Lajoie*
McGill University
Stephen Bodnar
McGill University
Cindy E. Hmelo-Silver and Yuxin Chen
Indiana University
Juan Zheng, Lingyun Huang, and Maedeh Kazemitabar
McGill University

INTRODUCTION

Although problem-based learning (PBL) has its roots in small group facilitation in medical education, it has been used successfully in a number of domains (Walker, Leary, & Lefler, 2015). Facilitating PBL is a demanding practice that requires a repertoire of strategies to guide the learning process and traditionally consists of face-to-face interactions and tutoring. Our recent research demonstrated that technology can be used to support international groups of medical students and tutors in a synchronous PBL to coconstruct an understanding of how to communicate bad news to patients (Lajoie et al., 2014; Lee, Lajoie, Poitras, Nkangu, & Doleck, 2017). In particular, web conferencing software and shared applications were designed with video exemplars to support synchronous interactions with mixed groups of students from Canada and Hong Kong who worked with medical facilitators from each country (Hmelo-Silver et al., 2016). The PBL groups worked together to determine how to best provide patients with bad news by using video examples from their respective countries of physicians giving such news. The PBL was facilitated by tutors, who monitored the thread of discussion in the chat window, and a wizard-of-oz facilitator,

* Corresponding author.

who prompted tutors to use discourse moves that would lead to productive interactions with their students. Our analysis of the discourse determined that this online PBL supported successful cultural exchanges in which learners and instructors shared multiple viewpoints on common problems that led to better understanding. Interestingly, the culture of medicine emerged as the predominant culture rather than particular cultures of origin.

The value of synchronous online PBL is not in dispute. However, this chapter presents our work on the design of an asynchronous PBL environment, which was motivated by several factors. Our initial technology-based PBL platform reduced the physical distance of international participants and provided tools that supported learning; however, the technology did not address the challenge posed by a 12-hour time difference, so the first reason for developing an asynchronous environment was so that working in different time zones would no longer be an issue. A second reason was that asynchronous PBL allowed tutor expertise to be scaled up to multiple small groups with the proper support tools. Small-group PBL tutoring is costly in terms of human capital in the form of tutors. Normally, a tutor works with one PBL group at a time. Our goal was to create technology tools that would allow tutors to monitor and scaffold multiple PBL groups. This chapter speaks to the design of technology tools for facilitating asynchronous group learning and tutoring.

This chapter describes the design and redesign of HOWARD (Helping Others with Argumentation and Reasoning Dashboard). To our knowledge, this is the first asynchronous online platform specifically designed from the outset to support both students and facilitators in PBL. Therefore features for supporting tutors needed to be created, piloted, and redesigned to ensure that the tools would serve their intended purpose. Accordingly, this chapter provides a description of one approach to developing sound technology tools designed to help PBL facilitators promote high-quality interactions rather than an empirical study on the effectiveness of HOWARD. In particular, we limit the discussion in this chapter to the tools created to support the monitoring and scaffolding of multiple asynchronous PBL groups so that facilitators can recognize when group interactions go awry and make appropriate discourse moves to help guide the groups toward more productive interactions. Such usability studies are a precursor to full-scale evaluations of this type of asynchronous PBL. We discuss the affordances of modern computer-mediated communication, web, and learning analytics technologies and how they can be leveraged

to promote high-quality online discourse. We start with a short synopsis of the PBL approach and how it was used in our work to support medical student learning about how to communicate bad news.

PROBLEM-BASED LEARNING

PBL is an instructional framework that is used to support collaborative knowledge construction and in the process helps learners develop skills of critical analysis, problem solving, and content knowledge (Hmelo-Silver, 2004). Learning begins when learners are given a problem to solve on which they work together to identify the problem; identify the facts, including the knowns and unknowns; establish learning objectives; identify learning issues that need to be researched; research the unknowns; analyze and list possible solutions; synthesize results; and discuss, integrate, and summarize solutions (Hmelo-Silver, Kapur, & Hamstra, 2018). Small groups of learners work collaboratively on these cases, and a tutor facilitates the group by guiding the learning process in a manner that helps them at each phase of problem solving. The demands on tutors are high because they must intervene at appropriate times to move the discussions forward (Hmelo-Silver & Barrows, 2006, 2008). Tutors need to be able to adapt their facilitation strategies to help scaffold the group dynamics and encourage students to engage deeply with disciplinary content.

Interaction is at the core of PBL, and the quality of the interaction is revealed in the group discourse. Interaction occurs between learners as well as between learners and tutors. The success of the PBL depends on whether such interactions result in learners achieving their learning goals. Many lenses can be selected to examine such interactions. One is to focus on the learners and how their interactions demonstrate effective collective knowledge building. Another is to focus on the tutors and how their facilitation leads to knowledge changes. In either case, theoretical stances can guide the analyses of such group discourse. For example, using a coregulation stance (Hadwin & Oshige, 2011), we have analyzed PBL discourse to investigate whether group members share the metacognitive demands of monitoring, evaluating, and regulating the task processes and how such sharing leads to cognitive changes, as well as whether the types of questions asked by facilitators and students lead to better understanding (Lajoie et al., 2015; Lee et al., 2017).

The quality and type of the learners' discourse in the group matters, and tutors use such interactions to provide contingent scaffolding—providing the right support based on what is happening in the group at the moment (van de Pol, Volman, Oort, & Beishuizen, 2014). Technology can assist tutors in finding interactional patterns by using data mining techniques to reveal the nature of the group interactions. We describe how these techniques have been used in our project below. We first present the PBL context, followed by the iterative design process used to improve the instructional model. We discuss two phases of the design process. The first phase summarizes our findings from a synchronous online PBL. The second and most recent design phase is centered on an asynchronous online PBL that addresses issues of convenience and scalability associated with online long-distance PBL.

THE PBL CONTEXT: LEARNING HOW TO COMMUNICATE BAD NEWS TO PATIENTS

Research has suggested that effective patient-doctor communication influences patients' health outcomes (Stewart, 1995). Unfortunately, even experienced physicians struggle in their basic communication skills if they have not had specific training in this area (Aspegren & Lonberg-Madsen, 2005) and lack confidence in their ability to communicate bad news effectively (Sise, Sise, Sack, & Goerhing, 2006). The manner in which a health professional communicates bad news can alter a patient's course of decisions and actions, potentially affecting his or her relations with the health system, treatment (emotional and mental health), and, importantly, his or her immediate social context (family, workplace, friends) (Pendleton, House, & Parker, 1987). For example, if a physician ineffectively communicates bad news to a patient, that patient may not understand the danger of noncompliance with treatment, which could lead to adverse personal or public health consequences. Given the importance of these communication skills, we created an online PBL to help medical students learn the best ways to deliver bad news. We anticipated that this topic would create lively discourse.

Phase 1: An Online Synchronous PBL

A natural starting point for creating online PBL was communication platforms that allow real-time, face-to-face communication. In the first phase of

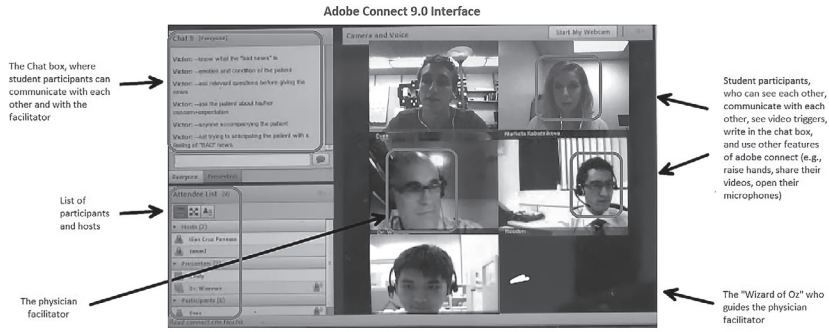

Figure 12.1 Online synchronous PBL.

our research, we situated an online PBL intervention within a synchronous, video-based communication platform that included a shared whiteboard, with the rationale that this mode of interaction would be familiar to participants and allow them to transfer their face-to-face PBL interactions to a computerized environment. This online PBL provided opportunities for an international exchange of perspectives on how to provide bad news to patients without having to travel across the globe (see Figure 12.1).* In particular, the PBL provided an international cultural exchange of perspectives between medical students and tutors in North America and China on the topic of communicating bad news to patients (Lajoie et al., 2014, 2015; Lee et al., 2017). Students and tutors met synchronously in an online environment created with Adobe Connect. The environment supported individual students in giving bad news to standardized patients using videoconferencing before and after participating in a targeted, small-group PBL on how to communicate bad news effectively. In this way, students were able to practice their skills as well as engage in the required multiple perspective taking that the PBL provided. Tutors interacted with students by listening and watching the "hand-raising" tablet provided in Adobe Connect. However, there were times that the tutor had difficulty listening and observing the technology indicators simultaneously and consequently, a "meta-tutor" or "Wizard-of-Oz" expert facilitator observed and listened

* Full ethical approval to record the tutorials and use sections of the anonymized data (transcripts and still images) in publications was provided by participants and the local authority.

to the PBL interaction in the background and interacted directly with the tutor when needed. The wizard communicated with the tutor through a private chat window, helping the tutor monitor the group exchange and encourage learning strategies that the tutor might not have considered in the heat of the activity. The technology thus supported real-time tutor professional development in a seamless manner that might not have been available in face-to-face settings.

The PBL context involved two video-based medical scenarios (one situated in Canada and another in China) of a physician delivering bad news to a patient. These videos served to trigger discussions about communicating bad news. Videos provided the context for collaborative engagement, in which students took responsibility for generating, supporting, and building understanding about these issues using an online whiteboard to externalize their discussion space. The role of the expert facilitator was to guide the discussion toward achieving the goal of the collaborative session. SPIKES (Baile et al., 2000) is a North American medical consensus-based protocol that establishes six steps a physician should take in giving a patient bad news. We used the SPIKES model to facilitate discussion around the appropriate content after viewing the videos. SPIKES stands for establishing the appropriate *setting*, assessing the patient's *perception* of the problem, *inviting* the patient to ask questions, providing *knowledge* to the patient, expressing *empathy* for the patient, and providing a *summary* or *strategies* for follow-up when communicating bad news. The PBL group consisted of seven volunteers: four medical students with a mean of 2.5 years' experience, two from Canada (one male, one female) and two from Hong Kong (two males); two experienced male physician educators (one from each country), and a female expert in PBL facilitation from the United States.

Several analyses were conducted of the online PBL discourse, which revealed rich in-depth discussions similar to what one would find in a face-to-face context (see Lajoie et al. 2014, 2015; Lee et al., 2017). The discourse was coded using the community of inquiry framework developed by Garrison, Anderson, and Archer (2000) to establish the relationship between the facilitators and student interactions and student-student interactions. This framework codes interactions based on evidence of cognitive, social, and teaching presence to determine the nature of the dialogue. Facilitators were found to use appropriate levels of direct instruction and avoided dominating the group dialogue. The students' discourse revealed

high levels of social cohesion and cognitive presence, revealing high levels of meaning making and multiple perspective taking over a two-hour PBL. They also demonstrated that such conversations could bring discussions of culture to the fore, an important consideration in this medical communication context (Hmelo-Silver et al., 2016). These findings demonstrated that online synchronous PBLs could be effective and revealed multiple episodes of shared understanding and positive group interaction, suggesting that for small-scale instruction, a synchronous video-based platform is an effective medium for delivering online PBL (Lajoie et al., 2015, 2014).

At the same time, the study also made clear that synchronous online PBL has two important limitations. First, connecting instructors and students in distant time zones can be impractical and limits the potential for cross-cultural discussion. Second, synchronous video-based discussion requires a low student-teacher ratio, limiting its scalability to large class sizes. For this reason we redesigned our environment to provide opportunities for scalability.

Phase 2: Asynchronous Online PBL, HOWARD

To address the limitations of synchronous online PBL, the second step in our design process was to create an asynchronous online PBL platform. Asynchronous instruction, by definition, does not require simultaneous participation (Johnson, 2006) and can allow users in different time zones to interact at times that suit their schedules. Distance educators report a number of advantages of using asynchronous communication, including "encouraging in-depth, more thoughtful discussion; communicating with temporally diverse students; holding ongoing discussions where archiving is required; and allowing all students to respond to a topic" (Branon & Essex, 2001, p. 36).

To explore the potential of asynchronous PBL, we developed a collaborative learning platform called HOWARD for online, multiday PBL workshops targeting medical students' knowledge and skills related to delivering bad news (Hogaboam et al., 2016; Kazemitabar et al., 2016). The PBL groups generally convene over two or more days and are facilitated by one or more PBL experts. A workshop has start and end dates with intermediate milestones, but the individual activities each group member performs can be completed asynchronously. Students work in small groups and log into the system at their convenience to complete coursework collaboratively.

HOWARD provides a platform on which multiple PBL groups can work concurrently and be tutored at a distance. Once again our instruction was situated around realistic case videos depicting physicians delivering bad news to patients. These cases helped to illustrate the complexity of the problem and to stimulate group discussion. HOWARD provides a student interface that supports small-group discussion with a text-based chat space and summarization and synthesis with an integrated collaborative virtual whiteboard, and also includes separate interface for PBL facilitators.

The Student Interface. The student interface (see Figure 12.2) is composed of four components: (1) a navigation bar, (2) videos that are reviewed and annotated by students, (3) a discussion board on which students work together to discuss the PBL, and (4) an interactive whiteboard on which students report on the PBL. The navigation bar allows students to access the platform's different functions (i.e., guide, today's tasks, reflections. etc.). Students are first directed to the Guide, which introduces them to the goals of the workshop and frequently asked questions about how to interact in the workshop. Subsequently, students are directed to the Today's Tasks page, where they review their to-do lists for each day of the workshop. Students then navigate through their tasks by working on their assignments, be they reviewing the video, interacting with others in the discussion space, or posting comments on the whiteboard. Once they complete their tasks for the day, students are prompted to mark the items they have completed on their task sheets before logging out of the system.

As in phase 1, the videos served as the context for the PBL; students reviewed, reflected on, and discussed video vignettes with their group. Unlike phase 1, students could play the videos and annotate them with comments and reflections about how the physician was communicating bad news to patients. These annotations could then be shared with the group. In an effort to support asynchronous dialogue within the groups, the discussion board provided an area for sharing thoughts and perspectives and negotiating and resolving conflicts when they appeared, and it could be used by the instructor as an assessment tool for choosing if, how, and when to intervene in the group discussion. Students would be notified when new messages were available as well as when emerging edits appeared in the whiteboard.

The collaborative whiteboard was located to the right of the discussion area and could be used to document the problem, summarize, and record

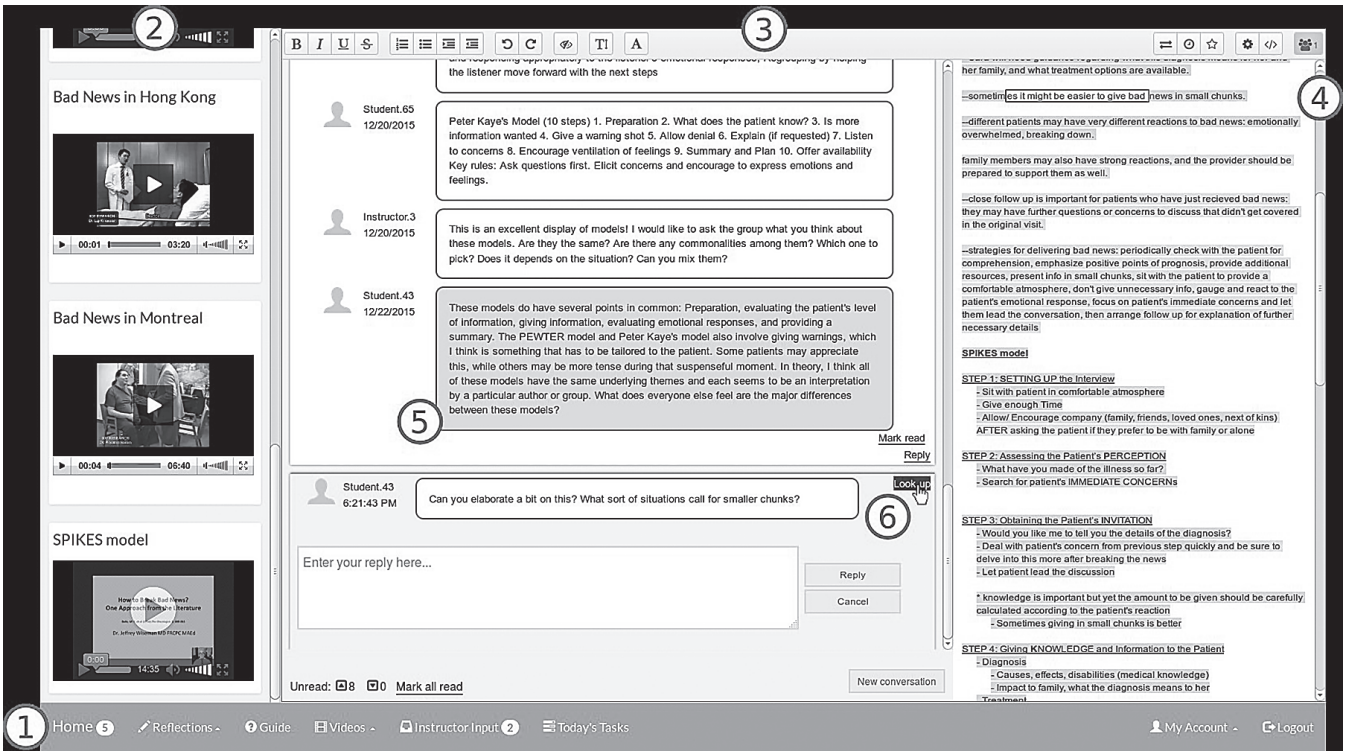

Figure 12.2 Components in the student user interface: (1) navigation bar, (2) videos, (3) discussion space, and (4) collaborative whiteboard. New messages appear in blue (5); discussion space posts can reference text in the whiteboard, which students can locate via a "Look up" link (6).

important points from the discussions. Background color was used to attribute regions of text to their authors, with each learner having a unique color within a group. For ease of navigation learners could link their posts in the discussion area to a whiteboard entry. For other students reading these linked posts, locating the target text was accomplished by clicking a look-up button on the top-right corner of the post. The discussion space appeared as a threaded chat, in which each student's entry appeared. Since students entered the discussion space at different times, the system updated their discussion space by illustrating the old messages in white and new ones in blue.

Finally, students completed two private reflective writing activities on whiteboards shared only with their instructor. The system notified learners when their assignment had been reviewed; feedback on the assignments, as well as other general messages from instructors, could be accessed via the "Instructor Input" menu item. Thus, the system provided for individual accountability and feedback as well as group accountability, consistent with best practices for collaborative learning (Blumenfeld, Marx, Soloway, & Krajcik, 1996).

The instructor interface for HOWARD was created to assist the tutors in their observation and decision making regarding the effectiveness of small-group interactions. Tools were created that would provide the instructor with indicators of how each group was functioning in terms of amount and quality of interaction, frequency of interaction by individual students in the group, and group cohesion. Tutors need such interaction indicators to make decisions about when and how to intervene in the asynchronous PBL—thus providing contingent scaffolding. In an effort to support the instructors in their tutoring decisions, we created a learning analytics dashboard.

Learning Analytics Dashboards for Online PBL. To address challenges with employing PBL on a large scale, we have drawn on developments in the emerging field of learning analytics (LA). LA has emerged from the broader area of educational data mining (EDM). EDM analyses are data driven, aimed at extracting value from big datasets (Ferguson, 2012), namely mining online class data to investigate the relationship between students' participation and learning outcomes. LA also analyzes educational data, but does so for "purposes of understanding and optimising learning and the environments in which it occurs" (Ferguson, 2012, p. 305). Where EDM is passive, observing patterns in educational data,

LA is active, putting this information to use to transform instruction and learning processes (Long & Siemens, 2011).

Dashboards are tools that have materialized out of LA research with the potential to transform learning processes. A dashboard can generally be defined as "a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance" (Few, 2006, p. 34). It is a set of visualizations that provide a multifaceted, synthesized look at the status and activities of a system. Historically, dashboards have their roots in business analytics, which are concerned with leveraging corporate data and presenting them in visualizations to enable business decisions (Few, 2006). In an educational context, however, logs of learner and group activities drive dashboards "that provide graphical representations of the current and historical state of a learner or a course to enable flexible decision making. Most of these dashboards are deployed to support teachers to gain a better overview of course activity . . . , to reflect on their teaching practice . . . , and to find students at risk or isolated students" (Verbert, Duval, Klerkx, Govaerts, & Santos, 2013, p. 3).

By synthesizing detailed log files and showing the data to instructors or students in condensed form, dashboards have strong potential to help instructors monitor learning-related interactions, particularly those in which intervention may be required. This functionality seems especially applicable to asynchronous instruction, in which many discussions and activities may have taken place since the last time a teacher logged in, and an efficient method is needed for bringing the teacher up to speed on the activities of the groups and for triaging the groups to focus the teacher's attention on those that need it most.

We have applied LA techniques to the design of the learning analytics dashboard (see Figures 12.3 and 12.4) in HOWARD. The dashboard was created to meet the needs of PBL facilitators and help them manage multiple groups. LA is used to extract value from the datasets produced in online collaborative PBL activity. In our case these datasets are the group dialogues and individual activities that are mined to present visualizations for the instructor to make decisions. The visualizations were designed to help instructors understand the type, frequency, and quality of students' participation; the type of interaction with fellow members; and generally whether or not the group was on track in engaging in productive collaborative activity. The LA dashboard presents a graphical arrangement of

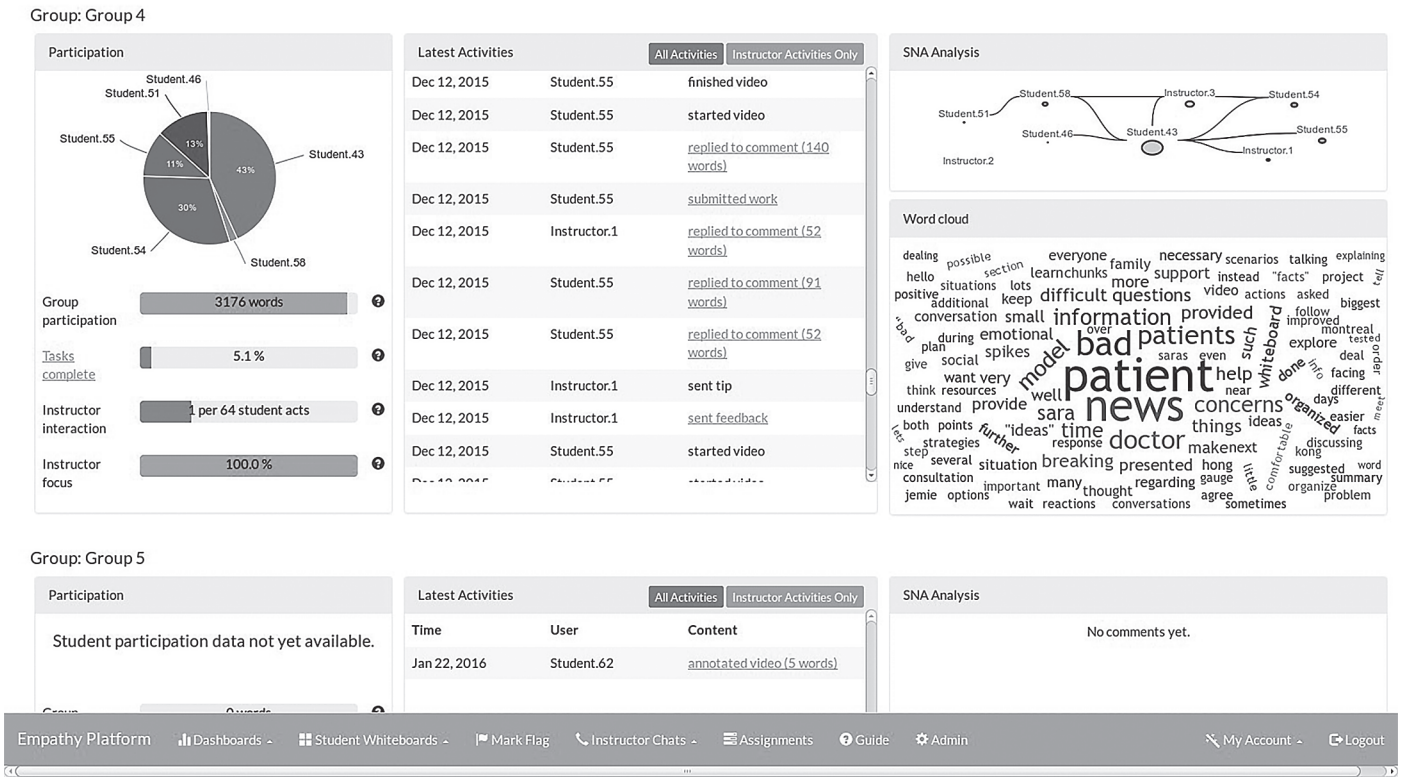

Figure 12.3 The initial HOWARD learning analytics dashboard.

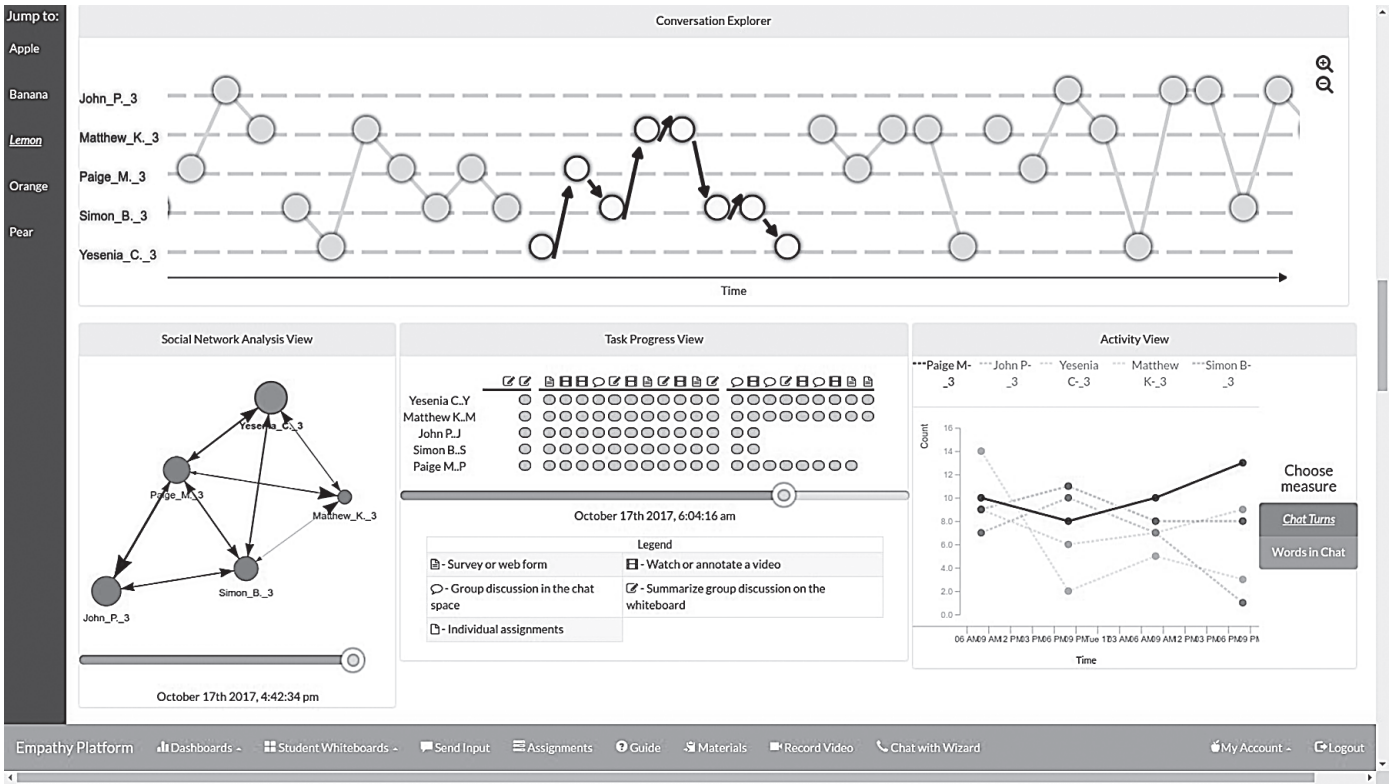

Figure 12.4 The redesigned HOWARD learning analytics dashboard.

a set of data visualizations that allow instructors to more quickly grasp group dynamics, help identify difficulties, and signal when intervention is needed. Trace data obtained from logs of student and facilitator interactions during a HOWARD workshop feed into an analysis module that processes the data and drives the visualizations.

Our initial dashboard design (shown in Figure 12.3; see also Kazemitabar et al., 2016) included four information displays: (1) participation in group discussion and progress on workshop tasks by means of pie and bar charts, (2) student and instructor activities through a news feed display updated in real time, (3) group member interaction patterns via a social network analysis graph, and (4) frequently discussed topics shown with a word cloud. A pilot test of this initial design revealed that it effectively signaled student participation and interaction patterns but did not provide enough support for helping instructors to quickly understand the contents of students' discussions (Hogaboam et al., 2016). Consequently, we redesigned the dashboard (see Figure 12.4) to provide more nuanced LA tools that include more context for each interaction.

More specifically, the second iteration of the LA dashboard replaced the static pie and bar charts with dynamic versions, removed the activity news feed, enhanced the functionality of the social network analysis graph, and replaced the word cloud with an interactive conversation explorer. We elaborate on these changes below.

The conversation explorer presents the overall participation level of individual students in terms of when and where they contributed text outputs in their discussions. More specifically, it presents an interactive diagram that visualizes each conversation from the threaded discussion space as a graph: nodes in a graph represent group members' posts, and links between the nodes indicate the boundaries of a conversation as well as turn taking. At a glance, instructors can examine how many people are talking and look for interactional patterns. Importantly, they can click on the nodes to (a) read the contents of conversation threads that were occurring at any point in time and (b) access a Key-Word-In-Context search tool (Luhn, 1960), which provides a list of frequently occurring words together with their sentential contexts. In this manner, the visualization provides a deeper way for the instructor to see the conversational context and content of the PBL.

The social network analysis (SNA) reveals different types of data about the group dynamic. In Figure 12.4 the SNA is illustrated in the lower left

of the dashboard. The display is realized as a set of nodes and linking lines, in which one color-coded node represents one student user. The larger the node is, the more output the student has produced. In the example shown in Figure 12.4, Matthew is the least interactive. Each line connecting two nodes represents the interaction between two users. A thicker line indicates more communication, compared with a thinner connecting line. Information about communication flow is depicted with arrowheads at the end of each line and can be useful for identifying unbalanced interaction patterns, such as that between Paige and John. By examining the SNA visualization, the instructor can make quick observations about the group dynamic in terms of equal or unequal participation or problematic groups that are not functioning as a collaborative unit. The task progression view allows the instructor to see how each individual is progressing throughout the workshop on the assigned tasks. The activity view presents a temporal view of when and how each group member participated during the workshop. In other words, it presents a snapshot of word counts and chat turns at different points in the workshop.

EVALUATING TECHNOLOGICAL TOOLS FOR ONLINE ASYNCHRONOUS PBL: A SIMULATED-DATA APPROACH

Our goal in creating the LA dashboard was to provide instructors with a quick and observable way to examine group dynamics and make decisions about when and where to intervene. The data analyzed in our earlier pilot (Hogaboam et al., 2016) provided methodological insights regarding the challenge of evaluating the effectiveness of the dashboard design for tutors at the same time as evaluating the effectiveness of the platform for students. In essence, it was difficult to evaluate the true effectiveness of the LA tools without large numbers of students to populate the visualization dashboards, and we were not prepared to run large samples without ensuring that these tools were usable by instructors to facilitate large numbers of students. Consequently, our approach was to select an alternate strategy to test the usability of the new dashboard for tutors to increase the speed of the design-test feedback cycles. Our strategy was to use a simulated data approach to evaluate HOWARD by creating a mock dataset of simulated learners to maximize the power of the learning analytics tools to provide visualizations for tutors. Our research question was a simple one:

Can instructors differentiate between specific group dynamics using the HOWARD visualizations?

Methods

Participants

The LA dashboard was tested with 10 PBL instructors who individually participated in a two-hour online data collection simulating a two-day workshop.

Materials

In this study the materials consisted of creating PBL groups of simulated students: These materials were created by consulting PBL experts and surveying the literature to identify specific group dynamics frequently observed in PBL sessions. Based on this review, we created a dataset of fictional groups with well-defined dynamics described in the PBL literature (e.g., Hendry, 2009). More specifically, we created five types of groups (well functioning, dominant group member, dysfunctional, social loafing, and parallel play) that would require different types of tutoring intervention (see Table 12.1 below for descriptions). We created a scripted scenario for each of the five groups that would allow us to examine the types of observations instructors would make given these different group dynamics.

In creating each simulated group, the research team took a collaborative approach to scriptwriting that approximated the interactional behavior expected from real students in the workshops. We started by constructing a well-functioning group script, with the rationale that once we had created this script, it could be used as a starting point for developing scripts for the less functional groups. This script assumed that the well-functioning group would reflect equal involvement of all participants in discussion and negotiation, leading to successful collaboration (Hendry, Ryan, & Harris, 2003; Skinner, Braunack-Mayer, & Winning, 2016).

The procedure we took to create the script involved participating in the workshop in a way similar to how real students would participate. The scriptwriters watched a video and then composed the script in Google Docs collaboratively, in real time. Each group member wrote an initial and overall reaction to the video. For example, some commented on the style of physician communication, the method of communication, and the importance of specific things that were said. Members then posed

questions concerning the initial posts, such as "I wonder if the physician did X because of Y?" or "What might happen as a result of this method of bad news delivery?" Following question creation, members responded to posts of others as they saw fit. For each post that was created through this process, a general discussion ensued as to whether the responses reflected the intended target group dynamics. Scripts for the dysfunctional groups were created by modifying the healthy group script. For example, to create the dominant-member group, posts from one of the well-functioning group members were modified to disproportionately increase the participation of this member and create instances in which the dominant member exhibited signs of confidence and controlling others. We also increasingly shortened or removed responses from other members as the workshop progressed to create the effect of participation withdrawal as a result of the dominant personality. Table 12.1 provides additional information on the key features of the other scripts for all groups. Finally, to simulate a two-day workshop and study how instructors observed group activities over time, we divided the scripts into two sections and developed a software tool that could upload these scripts to populate the HOWARD database incrementally, mimicking the asynchronous nature of the online PBL.

Procedure

Instructors participated in the two-day workshop and were asked to think aloud and verbalize their thoughts as they examined different visualizations on the dashboard and made observations about the group dynamics relating to the quality of the group work. Screen capture technology was used to record videos of the instructors' actions while using HOWARD, along with the audio of their think-alouds.

Results

For the purposes of this chapter we report preliminary findings on only four instructors in depth: two advanced PBL instructors (with 10 or more years' experience) and two novice instructors (zero to five years' experience) because we are in still in the process of a full analysis (Chen et al., n.d.). Preliminary analysis of the protocol data revealed that all instructors were able to use the LA dashboard to identify three types of groups, the well-functioning group, the dominant group, and the social loafing group. This finding is reassuring because identifying these patterns is a first step to identifying successful interventions when needed.

TABLE 12.1 *Group Dynamics Selected for Implementation as Mock Script Data*

Group	Description	Key features
Well functioning	A high-functioning yet realistic group serves as a reference for a "healthy" PBL group.	Conversations with high involvement and reciprocity, reflection on the problem, consideration of the connections between the current and previous problems, self-evaluation of performance and of peers, reflection on effectiveness of collaborative learning
Dominant member	The dominant member "talks a lot, tries to control the direction of discussion, and prevents others from contributing." (Hendry, 2009, p. 611)	Dominant personality that exhibits little open-ended thinking; is controlling and self-confident; and argues against the ideas of group members, shuts them down, and orders fellow members; dominant personality that becomes increasingly the main and only voice;, and the source of most of the ideas; increasingly fewer exchanges between members
Social loafing	"Social loafing occurs when there is a reduction of individual contributions . . . and this can result in individuals' free loading off the group. This can be either because they do not think their contributions are valued or, more commonly, because they know that they will still benefit from the group's efforts regardless of their own input." (Seymour, 2010, p. 73)	Members slow to react or become engaged; high dropout rate; limited responses of shorter length; lack of members taking the initiative; reliance on others; lack of building on each other's contributions; similar amounts of text output from members; reports of more effort than actually expended
Parallel play*	Members complete their work in a shared space, but do so independently, moving "through the activity on parallel paths without meaningfully interacting with one another." (Hmelo-Silver, 2004, p. 197)	Longer and fewer comments and replies; lack of acknowledgment of others' contributions, ideas, etc.; unanswered questions; inactive group leader and summarizer
Off-topic	Members frequently engage in discussions that wander away from the main subject or dwell on minor points (Gilkinson, 2003), such as fixating on diagnosis or on the technicalities of treatment.	Active participation, alternating between on- and off-topic discussions (a completely off-topic group would be unlikely)

*The term originates from Parten's (1932) study of social participation patterns in preschool children's group play.

Furthermore, the think-alouds revealed effective use of specific visualizations to determine directionality and patterns of interactions. One instructor explicitly referred to comparing the size of nodes in the SNA to determine who was most dominant and described how the activity changed over time by checking the SNA. She also shared how she would respond as a tutor by intervening to "encourage others to increase their participation, so that they benefit from activity without being steamrolled." Another instructor referred to using the conversation explorer to examine group dynamics in more depth. For example, he verbalized: "Ok, so that sounds like it is building a very good um to prepare the groups, it sounds like a very good dynamics. Oops go back. . . . Now, here is a new member, his name is Trixie Tran and he, she is also, I think she is female, she is very excited to be on board. to meet everyone and she is a sophomore from Hong Kong." This example captured the instructor's thoughts as she used the tools to inform her decisions concerning group dynamics and participation. Another instructor who read a different set of posts determined "this group has a lot of work yet ahead of them . . . working a way towards possible and variable solutions."

CONCLUSION AND FUTURE DIRECTIONS

This chapter has demonstrated how technology can support PBL interactions in innovative ways that support both learners and tutors. In particular, we have presented new directions that might make it easier to sustain PBL interactions at a distance and on a larger scale. This chapter has documented our journey in exploring ways to use technology to create online PBL environments that would increase access to students and tutors. In particular, we discussed different online designs that we have created to support both learners and tutors in engaging in high-quality collaborative discourse.

Phase 1 of our work replicated the strengths of face-to face PBLs in an online synchronous PBL and extended the resources in a manner that could be used by students and tutors internationally. Results from this phase demonstrated strong group cohesion, productive discourse, and strong learning outcomes in terms of meaning making and learning how to communicate bad news to patients. Furthermore, we found that the "Wizard-of-Oz" approach to having an online expert facilitator tutor the other tutors in managing the PBL was a real strength of this approach. This

research demonstrated the value of sharing PBLs cross-culturally to encourage multiple perspective taking on these difficult constructs (Hmelo-Silver et al., 2016; Lajoie et al., 2014). However, the research also demonstrated that this approach did not address the practical issues of scalability of the PBL model, especially when working with individuals in different time zones.

In phase 2 we have been tackling the scalability issue more directly by creating an asynchronous online PBL platform, HOWARD. This platform allows students and instructors to participate on their own schedule but still have access to an evolving small-group discourse about the PBL content. A unique dashboard was created for the instructors, using LA techniques to mine group data and present visualizations that let the instructor see overall group interaction patterns, the depth of discussions, the frequency of discussions, who is and is not talking with whom, who is making progress on the task assignments, and so on. Preliminary data demonstrate that the dashboard is being used by instructors to make appropriate decisions about group dynamics that will ultimately lead to specific tutorial interventions. The detailed think-aloud data and screen recordings document the reasoning processes used by instructors as they interpret the visualizations, as well as help identify group dynamics of interest. This methodology of using think-alouds with simulated groups provides an important window into tutors' cognition as they attempt to understand different interactional data and use these for instructional decision making. These simulated group scripts may find further value for providing professional development for new PBL tutors to help them learn to support high-quality interactions in tutorial groups.

By combining simulated student data with real instructor data, we have been able to make decisions about the effectiveness of technology tools in a relatively short period of time. This design-and-test scenario will make testing these tools on a large scale more effective. The next step in our research will be to complete the analysis of the think-aloud data from phase 2 to examine the types of instructional decisions that are made based on identifying group dynamic differences. These data can help reveal the types of tutorial scripts that might help others in facilitating PBL and promoting more uniformly productive discourse related to emotionally charged topics in medical communication, such as breaking bad news. Engaging students in cross-cultural discourse is particularly important in the area of medical communications, where learning to have these

discussions will be important for future medical professionals. We will also further examine the expert/novice instructor data to find out if there are expertise-related differences in self-regulation that may be associated with tutoring strategies. Finally, we will examine these data to determine any other usability issues and then make design changes accordingly. Future research will involve testing the refined dashboard in a large-scale study with real students and instructors to learn how they use HOWARD and to better understand the prospects and challenges for using technology to support PBL on a large scale.

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CLOSING COMMENTARY

Observations from the Outside

Fledgling Researchers' Perspectives

Florian Verbeek and Monaliza Maximo Chian
The University of Hong Kong

INTRODUCTION

New insights tend to arise not necessarily by producing new knowledge, but often through reorganizing existing information in an alternative way. In this chapter we attempt to "reorganize" the information and work presented by this particular sample of the academic community to see if our perspective as early career scholars in education research can provide new insights. We are in a special position as outsiders, which we characterize in this case as not being the editors, not being chapter authors, and up to this point not specialized or established in the field of problem-based learning (PBL) or interactional research. Our view, therefore, is that of fledgling academics entering fields in which the scholars who have written the contributions in this book have been deeply immersed, communicating our thoughts as new readers. This is not meant to be a summary or synthesis; neither is it a book review or expert criticism, nor an instruction on how to read or interpret the chapters. In some way, this is a report of our struggle to understand and learn what this field is about, and therefore we have chosen to call our ideas *observations*. We are aware that what for us may be novel insights may be self-evident for the expert reader, but we also hope that our outsider perspective is helpful to readers in developing their own views and perspectives as well as to the authors, so we can contribute in our own way to moving the field forward.

What all the chapters have in common is some sense of ethnographic approaches (Green & Bridges, 2018; Castenheira, Crawford, Dixon, &

Green, 2000), an interest in social interaction in learning, and a common thread of PBL. We have followed this thread by approaching the chapters with ethnographic eyes, with a general inquisitive question: What is going on here? One great contribution that we found, and what all these chapters have helped us to understand, is that PBL is very much about learning to learn, working with people, and dealing with obstacles in completing a structured process of inquiry (Lu, Bridges, & Hmelo-Silver, 2014). The methodology on display provides in-depth examples and observations of how this learning-to-learn works and why it works. It does so in a way that outcome-based and pre- or postresearch designs would make difficult to measure, therefore inhibiting certain discussions and innovations. When taken together, the chapters help promote how process-based methodological approaches, studying student experience, and taking the student seriously as either an agent, individual, or interest group in one's own right can reveal these valuable perspectives.

In what follows we explore some reorganization and reinterpretation of the chapters, which we have linked to the key observations detailed below. The observations are explained and illustrated with reference to the chapters, basic familiarity with which is assumed. The observations themselves only make reference to chapters in this book.

Observation 1: The research method and outcome show that the very research approach itself is a clue to incorporating and applying the research results into pedagogic innovation.

Two illustrative points explain the dynamic we have observed when researchers explore educational practice in action. First, the researchers, by subjecting students to their research questions and data collection, force a reflective process and student-educator interaction that may otherwise not have occurred. Rather than viewing this as problematic and as what might appear to be a criticism on the validity of the research, we present this as a clue and supporting argument for a theme that recurs throughout the chapters: the necessity for students and tutors to prepare for and reflect on how they are learning. Second, there is a recurring tension in the balance between preparing the student for learning in a natural setting that anticipates moments of struggle, conflict, and negotiation and a temptation to avoid those events in the name of planned learning for achieving intended or planned learning outcomes (Bereiter & Scardamalia, 2008). This problem is familiar to inquiry-oriented educators: too much of one can mean

a devolution into prescriptive group work by overscaffolding or messy, competitive dysfunctionality due to lack of preparation and guidance. Both of these observations are elaborated on below.

Self-ethnographic potential, personal development, and social skills in PBL: ethnographic research or action research?

Learning in an inquiry-based environment and in PBL processes is synonymous with learning how to learn individually and collaboratively with others. A recurring conclusion in the book is that if students were more aware of social rules, group dynamics, behavioural patterns, and motives, it would lead to an enhanced PBL experience. This comes down to communicative competence (Cazden, 2017) and social skills, which cannot simply be transferred from a textbook. This idea also asks one to consider whether the PBL collaborative process is something that needs to be taught to the students first, independent from content.

Consider Almajed, Skinner, Peterson, and Winning's extensive review of collaborative student learning experiences (Chapter 5). The results provide an overview of suggestions for dealing with mixed groups, individual differences, and the function and meaning of knowledge conflicts. As part of the data collection, students were asked to reflect on their experiences and questioned about them in person and via email. One of the outcomes of the research is the advice that students should be encouraged to reflect more on their learning, as the researchers found that students often do not know enough about collaborative learning (CL) or are unaware of the potential of social learning processes. It is striking that in the end, reflection is both the method and the advice researchers give for better CL. In other words, the research itself ended up being a pedagogical intervention The research result was a genuine inquiry into learning and created an exchange of views between students and educator-researchers. This means that teaching students about CL could be done in nearly the same way as this research was conducted, like a type of action research. The intervention and interaction that were the result of the research enhanced the learning experience to such a degree that reflection on these produced valuable additional outcomes and implications. A possible next step would be analysing the research performed and developing a permanent integration not of the results, but of the ethnographic methods, into CL pedagogy itself. One way of understanding this is letting ethnographic research inform a student-centred understanding of learning.

One student discussed in this chapter really stood out to us and provides a good example of how to use direct engagement with student experiences in CL pedagogy and presentation. The student said that individual learning was slower but guaranteed, while group learning was a gamble with a high pay-off. This seems to be a very significant notion because it allows a reframing of CL pedagogy into thinking about how to make CL worth the risk to the students or give them confidence that it will pay off. Perhaps the potential for failure without affecting the final grade should be part of how CL is presented, and some room for individual learning should be guaranteed in the curriculum. Explaining this to the students in advance and designing the learning that way could be important in its success. Future research could therefore focus on examining how to engage with students' willingness to take risks in learning.

Another illustration of this observation is found in the study by Imafuku et al. (see Chapter 7), in which they report extensively on social interaction in learning and conflict management during collaborative interprofessional learning. We note there how the research can constitute an intervention in PBL learning. Researcher engagement with the students is likely to initiate reflection on learning that might otherwise be absent. The extensive treatment of conflict in a collaborative interprofessional setting, highlighted in such a detailed fashion thanks to the qualitative approach, provides new lessons for how group interactions function to promote and inhibit learning. In terms of implications for practice, it could essentially end up arguing for teaching students basic skills such as how to hold a meeting, divide tasks, manage conflicts, and social skills and psychology in general. These skills have little to do with the disciplinary content knowledge that the PBL process is applied to but are necessary not only for PBL to function, but also, arguably, for professional life and lifelong skills in general (Bereiter & Scardamalia, 2008).

If we as educators are going to promote a focus on social knowledge and efficacy and combine those factors with reflective self-ethnographic learning practices, then what we are talking about here is education formulated and enacted in a way to promote personal development, independent of disciplinary content. While keeping ethics and sensitivity in mind, imagine how personal and educational it could be to confront students with the detailed ethnographic data arising from this type of research, giving explicit examples of recognizable student behaviour and conflicts and reflecting on them together. When the line between the researcher, the educator, and

the student becomes hard to distinguish, we will have reached the highest standard of teaching, a complete engagement with learning on both the students' and educator's sides.

So if the pedagogical potential is in this research, to whom and when should this lesson be applied? Should students be educated about social and collaborative learning in a preparatory sense, or instead of preempting learning, should we educate the educators to scaffold and guide learning as it happens, making visible the learning process to those participating in it? In the following, we further expand on this question in light of the interplay among interactional research designs, findings, and pedagogy.

Structured and strongly scaffolded learning versus risky liminality with high pay-off potential.

Ideally, we would want students to make as many managed mistakes as possible while they learn in college, so that they can minimize the occurrences of inevitable errors when their performance really begins to matter in professional practice.

Svihla and Reeve (Chapter 4) discuss issues in the pedagogy of team-based learning in a project-based setting. Particular about this chapter is that it analyses the early stages of the project-based teaching process, namely the framing, when groups are introduced to their assignment, then follows them to see how it sets the stage for later events in the project. One of the most interesting findings is how an open-ended framing provided a large space for developing ownership with a consequent high level of engagement. As a result, the project moved away from educator control, raising the stakes, while creating high pay-off potential.

As high levels of engagement and ownership take place, they pose a novel educational situation in which a student gets too deeply engaged and the project becomes too personal for comfort. Terms such as "engagement" and "ownership" are often thrown around casually, but this chapter gives a particularly vivid sketch of how they can actually change learning and its outcomes. The chapter shows that when the student gains ownership, the learning process turns into something a lot more meaningful, which the student may not have been prepared for. At the same time, when the teachers achieve learning ownership in their students, they seem to start to worry about their own role; the teacher here lost some of the ownership to the student and therefore some of the control that teacher was used to having in the high school setting of the study.

This is a great example of the problem of teaching versus experiencing learning, as both students and teachers negotiate control, pulling and pushing. In extreme cases students may either seek to take control from the educator or lean on the educator to avoid responsibility for learning. In the fervour of the educational project of problem design and facilitation, it is easy to lose the liminality and uncertainty that PBL could and maybe should entail, as the tension in this chapter shows.

Another good example of this issue is McQuade et al.'s study (Chapter 9), which focuses on social loafers to illustrate key interactional and social aspects of PBL. Social loafers are traditionally considered to be a prototypical handicap to learning in the PBL method, as indicated by the authors. The chapter provides clues to how dealing with this phenomenon can enable a positive learning experience. If the risk of social loafing did not exist at all, the learning moment in dealing with it would also not be enabled, and an important educational opportunity would be lost for both the loafer and those dealing with the issue. Both for tutors and students, this chapter reemphasizes not just the importance of designing learning, but also the importance of the PBL experience as personal development opportunity and the high potential for students if they reflect on and analyse their own behaviour and interactions. Gaining insights into how students deal with social loafers and understanding the behaviour and social processes behind them could constitute a learning moment in managing teamwork and collaborative communication, which a facilitator could either let go and allow to play out or take the initiative and push for group reflection.

The theme of liminality in learning is discussed in depth by Savin-Baden (Chapter 11). Liminality is a broad concept but in these cases shows itself as the moment in which full team engagement with a task is at risk of breaking down or the moment when group members need to define their task/project without strict prescriptions, seeking to enable integration with their interests and motivations. Both these moments entail risk, as failure to deal with them can lead to severe problems, either immediately or later in the process. The qualitative methods and data used in the chapter illustrating this observation are perfect in showing us how liminality in learning occurs and should be appreciated, teaching us about the balance of structured and risky learning.

Observation 2: There may be potential in reframing or at least noting connections with the fields of social psychology, organisational

studies, science and technology studies (STS), educational philosophy, and education research

Given that problem-based, project-based, and interprofessional education generally tend to rely on team efforts, research into group dynamics and interactions is a logical direction to pursue. First, if a researcher is exploring how the tutorials proceed, how team members interact, and how their work and personal development are affected byresearch into group dynamics and interactions, then as researchers, we wonder how this work is to be distinguished from organizational studies and social psychology. Second, reading this volume moved us to peek into a black box as we consider technology and its use in educational research. Speaking of technology in education as a general topic or approach may be too simple and obscures important distinctions in the use and character of technology in daily life, social interaction, work, and education.

Learning about group dynamics and social psychology in education.

Like a PBL facilitator, would not the HR professional, supervisor, or consultant equally observe employees in their functioning and stimulate correct behaviour and professional development? The fact that PBL has been arguably most successfully employed in professional and interprofessional education in higher education to prepare students for the workplace, evidenced by the studies here, should reinforce this comparison. The major difference is one of emphasis: in the work situation the priority should be on the product or service rendered, and in the educational situation it should be on professional development. Reflecting on what is involved in PBL and innovative pedagogies, it should not be too far-fetched to envision a PBL specialist coming into a government or business context to facilitate professional development or conflict management activities. So in reverse, why shouldn't lessons from the study of those contexts and fields be applicable to the goals of PBL research? The consequence of this close association is twofold. On the one hand, it means literature from those additional fields could be relevant in building and enhancing the search for learning about and developing inquiry-based learning. On the other hand, it means the literature and methods in this book are highly applicable to those other fields, opening up opportunities for collaboration and broader exposure to academic communities and beyond, with implications for academic reach and impact.

A key illustration of this point is the wonderfully original focus that Skinner, Braunack-Mayer, and Winning (Chapter 2) provide in applying

qualitative analysis to illustrate the use of silence in social practice as an interactional phenomenon. They extend the implications of the study to leadership dynamics, role taking, and learning styles, all of which have extensive fields of their own in organizational and psychological schools of research. The explicit focus on silence itself, however, creates a situation in which PBL becomes more of a context for the research than a research target itself. The study of silence is more important to the results and the research than the PBL context. The point in this case is that there is no clear difference between the PBL context and any other meeting setting. Rather than being a limitation due to weak applicability, a more explicit distinction could be made between the contribution of this type of work to teaching PBL and the contribution it makes to the understanding of group dynamics and social psychology as a whole.

Another illustration of observation 2 is the Wiggins et al. chapter (Chapter 6), which focuses on analysing introductions and first contact in PBL group work and describes aspects of self-presentation, interprofessional interaction, group processes, and the group formation stage. This chapter, like the others, situates these in the PBL context, but it is striking that the outcomes and phenomena under study are clearly not unique to that context.

Likewise, Schettino (Chapter 3) presents a deep analysis of social interactional patterns and how they affect the positioning and experience of a learner. This is extended into arguments and opportunities for social justice and empowering marginalised groups. Leaving aside the discussion on what feminine values are and the role of feminism in this research, the data and results can stand on their own in endorsing a shift from teacher-centred to PBL pedagogies, helping to reconfigure power relations away from problematic traditional authoritative teaching dynamics. Although the approach is useful for all learning, those particularly vulnerable to authority for cultural or social reasons, such as women in the historically masculine mathematics pedagogy and disciplinary field, can benefit from it because of its implications for agency, relational support, and empowerment. This result could extend to racial and other types of marginalized groups in entirely different situations and supports a normative and emancipatory argument for the intercultural and international use of PBL and inquiry-based pedagogies as a whole.

These insights could be considered so profound that the interest in basic questions and details of "how" and "what" in PBL may seem to

fade into the background. The qualitative data allow for these insights to appear in a way that was only theoretical before, having consequences for the debates about and justification for educational systems and approaches in relation to, for example, larger questions in educational philosophy and cultural criticism. Schettino may have been too modest about this. We look forward to reading more research along this line of inquiry.

What these examples show is how the work performed in education researchal is strongly related to other fields and practices and the potential that the educational research in this book has to benefit those within and outside the field, not just in the classroom.

Technology as a monolithic concept.

By itself, the term "technology" conveys too little meaning, and we should ask deeper questions about what exactly we are referring to when using it. To illustrate this point, consider the studies presented by Hendry, Wiggins, and Anderson in Chapter 8, about phone usage; Lai, Wong, and Bridges in Chapter 10, on Clickshare™; and Lajoie et al. in Chapter 12, about online learning platforms, all on technology in education. Chapter 8 reveals verbal and nonverbal responses to phone usage in a PBL setting. The authors' analysis of microprocesses presents social interaction during the learning process, rather than social interaction in direct relation to it. Therefore, framing the work as a study of "technology" may be too broad. Thinking about what technology is and what it really does, it could possibly be understood otherwise as how technology enables access to, and engagement with, information or persons outside of the predefined meeting space of the group.

Technology is complicated and broad, and indeed a pen, laptop, whiteboard, and glasses are also "technologies." Perhaps the real issue is not technology itself, which is quite a monolithic term, but what unique services and resources the phone in this study enables and what that does for the group's functioning: information and communication outside the group space, which would otherwise have been limited to the physical space, now starts to have an effect, its agency enabled and conducted through the phone. This communication and information can either be found more interesting and important than the group and its task or be utilized to enhance the group functioning and its task. For a similar reason, reading a novel or writing a personal letter during a meeting can be problematic, but consulting a reference work or writing minutes is not.

In Chapter 10 on how screen-sharing software may facilitate knowledge coconstruction and collaborative processes in PBL, a similar issue emerges. The Clickshare™ appeal for PBL is clear: being able to share your computer screen with the group is convenient. But once again, what we understand as technology should not be a black box, an opaque tool partaking in our human interactions. Clickshare™ may be better understood not just as a technology, but as a tool that has specific relations to the work process, such as providing efficiency improvements or enabling an act not available before. This is complicated by what people choose to show in their meetings, which could also have been shared via other media such as PowerPoint presentations, by writing or drawing on the board, or by simply connecting laptops to the beamer. In other words, just like the problem of considering phones as a static and constant variable, Clickshare™ is not just a constant variable that alters educational processes like mixing sugar into tea, but instead creates and enables new connections, almost as an agent itself, which can be evaluated individually and compared to other technologies and actions that make similar connections.

The last illustration to support the idea of a deeper engagement with the use and understanding of technology is from Chapter 12, which offers a descriptive report of the developmental processes and pathways of technology-enabled PBL programs. The innovation presented in that chapter is the technology's allowing one tutor to administer multiple groups and hence also enabling a specific act or efficiency not available before. These examples show technology is deeply intertwined with human interactions and forms a complex field of potential actions, process modifications, and behavioural enablers that impact group performance and possible actions, ripe for deep reflection and qualitative inquiry, as exhibited in this book.

Observation 3: Chapters address the gaps in methodological approaches but still need more future interactional studies to realise PBL's aspirations.

The aforementioned unifying thread of this collection of research studies is an answer to the call to develop methodological approaches that enable a more in-depth exploration of the "inside" of PBL, raised by Jin and Bridges as a result of their systematic review of qualitative research in PBL (see Chapter 1). The methods in use for the studies presented in this volume are designed to provide close analysis of participant interactions in situated contexts in order to enhance readers' understanding of the

learning and teaching processes in inquiry-based learning (Heap, 1991). The detailed descriptions of the methodological approaches allow other researchers, not particularly in inquiry-based contexts but in education in general, to replicate these studies. Video recordings used in many of the studies are considered as artefacts, which captured observable interactions of particular actors bounded in a moment in time in a distinctive setting (e.g., Baker, Green & Skukauskaite, 2008; Green, Skukkauskaite, Dixon, & Cordova, 2007; Lemke, 2007). Interviews can be viewed as narratives providing insights from the points of view of the participants of the particular phenomenon under study, mediated by questions from the researchers (Fontana & Frey, 2000). Studies drawing on field notes, journals, and other artefacts all inscribe the lived experience as a historical phenomenon (Evertson & Green, 1986). These sets of records depict human activities situated in a particular social ecology (Erickson, 2006) and provide emic perspectives on common local knowledge and shared cultural practices (co) constructed and/or (re)negotiated through social and discursive interactions (Edwards & Mercer, 1987; Bridges, Botelho, Green & Chau, 2012; Bridges, Green, Botelho, & Tsang, 2015; Castenheira et al., 2000; Green, Skukauskaite, & Baker, 2012).

Given their predominant focus on student learning, a primary extension of some of the research studies in this chapter would be to analyse the PBL interactions from the perspective of the teachers, tutors, or facilitators. These multiple angles make it possible to triangulate perspectives, data, analyses, and interpretations (Green & Chian, 2018; Hammersley & Atkinson, 1991; Denzin, 1978). Another extension would be to explore how integrating PBL with the students' academic lives becomes consequential to their professional lives, in terms of professional and social skills and identities (Putney, Green, Dixon, Duran, & Yeager, 2000). This could be achieved by extending the exemplary methodological work done here in studying classroom interactions to professional settings, ideally in longitudinal or comparative studies.

However, despite the richness of these resources, the studies in this volume acknowledge the issue of generalizability and the limits to certainty of video-recorded moments and a "database" of collected artefacts as well as the responses to the interview questions (Baker & Green, 2007). Readers will wonder, as we did, about the meanings behind the actions, intertextual references, and contextual cues embedded within the dialogues as the research teams engaged with the texts (Bloome, 1992; Bloome & Bailey,

1992; Bloome, Carter, Christian, Otto, & Shuart-Faris, 2004; Gumperz, 1992). A challenge or suggestion to the authors for future work in extending their studies is to ask what had happened in the past that set the stage for the event under investigation and what the curriculum designer(s) (e.g., teachers, facilitators, tutors) would like to happen in the future. This frames the need to trace the development of phenomena (i.e., learning, teaching, agency, identities, etc.) over a period of time across contexts (Green & Bridges, 2018). We suggest capitalizing on the accessibility of archived data (video, audio, written artefacts) for multiple (re)viewings in order to extend and/or expand research work from multiple angles of viewing or perspectives (e.g., Green, Chian, Stewart, and Couch, 2018; Goldman, Erickson, Lemke, and Derry, 2007; Derry, 2007; Roschelle, 2000). If new data could be linked to previous data and also be made available and ready for future research over time, a corpus of PBL data could be built. This would not only enable convincing generalizations in the future but facilitate further extensions of the many valuable ideas and observations that the approach enables and that have been explored here.

More important, such efforts, in order to work, require a transdisciplinary and multifaceted approach that reflects the nature of project-based learning, PBL, and interprofessional education. To accomplish this, we recommend promoting high standards of collaborative learning and reflection as advocated by PBL. This transdisciplinary research team could dig deeper into these questions and perhaps see further development in designing integrated learning activities for learners, as suggested in the findings of the studies in this book, We realize that proposing a shared corpus of qualitative data and longitudinal studies may appear naïve and idealistic, but it would help address concerns that multiple authors have expressed about their limited datasets. A corpus would be in a much better position to make assertions than a literature review that collects a number of heavily contextualised claims that even the authors themselves regard as nongeneralizable. We hope researchers in the future can learn from the work done in this volume and dream up such collaborations and projects on a large scale.

CONCLUDING REMARKS

The idea that a process-based method of inquiry in research is complementary to a process-based pedagogy should not be surprising but could be an

important addition to the self-consciousness of the researcher. The lessons on methodology in this book could therefore be turned into lessons on pedagogy. The familiar problem of how much a student should struggle to learn, how much room for failure and difficulty should exist, also rears its head. In particular, we noted that ownership and engagement do not just enhance but can fundamentally change learning. Investment in learning means more risk, explaining the sense of high-stakes learning, and why it can appear daunting but also provide a high pay-off.

Some of the questions and findings presented in the book do not always seem to pertain to just education, and in some cases they even appear peripheral to it. We argue then that this is an indication of their interdisciplinary potential. PBL, ethnography, and interprofessional education are inherently interdisciplinary, so why should educational research itself not also look beyond its own community? The potential for expansion and collaborations left us feeling eager and excited. The work, we feel, is transferable, having potential for going further afield in its applicability, impact, and empirical value. The question of the philosophy of technology and its consequences for research framing and direction was also raised, showing that it may be valuable to consider how we define technology in our work, what we attribute to it, and whether we should look deeper and wider at what it represents rather than leaving the open question of a monolithic idea of technology unanswered.

The qualitative research methodologies presented in this volume have provided ways to explore the situated social dynamics and learning processes of learners in inquiry-based learning contexts (Heap, 1991) and could also be applied in different learning environments, such as the professional world. There is tension in the very feature that delivers strength to the studies; the detailed explanations of the particularities of the phenomenon also represent its limitations (Mitchell, 1984, Baker & Green, 2007). Questions remain: How do we then extend the time scales of the "bit of life" under study? How do we make its historicity and development consequential to future events? These questions lead us to look forward to future research studies from this community of scholars.

Finally, the process we undertook to answer our question—What is going on here?—through an ethnographic lens, and finding ways to (re)organize the information presented in this volume, enabled us to experience parallel activities that were under investigation in some of the chapters. To collaboratively work on a common task required us to

negotiate meanings as we (co)constructed our presented observations. Through our discussions of the shared and (re)negotiated differences in interpretations, influenced by our previous experiences and backgrounds, we expanded our understanding of the learning processes, (inter)cultural aspects, and group dynamics in an inquiry-based approach and in turn enriched our knowledge of teaching and learning, in general. Through this process, we not only learned the content but also learned from each other and about ourselves, as learners, entering as academics. Our experience through this process has resonance in our presented observations, a carillon of academic growth enabled by leading academic muses.

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About the Editors and Contributors

EDITORS

Susan M. Bridges is an associate professor and assistant dean (learning and teaching) at The University of Hong Kong, Faculty of Education/ Centre for the Enhancement of Teaching and Learning, whose research areas include PBL in health and professional education, technology in education, interactional ethnography, and integrated curriculum designs.

Rintaro Imafuku is an assistant professor at Gifu University, Medical Education Development Center, whose research areas include PBL in medical education, communication skills, research-based teaching, and student learning.

CONTRIBUTORS

Abdulaziz Almajed is an orthodontist and teaching supervisor at Prince Sultan Military Medical City & Prince Abdulrahman Advanced Dental Institute whose research areas include dental and medical education and clinical orthodontics.

Anthony Anderson is a senior teaching fellow at the University of Strathclyde whose research areas include student learning and quantitative and qualitative analysis of dialogue.

Stephen Bodnar is a postdoctoral researcher at McGill University whose research areas include language technologies and artificial intelligence tools in second-language practice materials.

Annette Braunack-Mayer is a professor and head of the School of Health and Society at University of Wollongong whose research areas include public health, community outreach, and health ethics.

Yuxin Chen is a doctoral candidate and research assistant at Indiana University whose research areas include PBL, computer-supported complex learning environments, learning analytics, and adaptive support systems.

Monaliza Maximo Chian is a postdoctoral fellow at The University of Hong Kong whose research areas include qualitative research, ethnographic and action research, disciplinary and interdisciplinary teaching and learning, and innovative curriculum design in higher education.

Eva Hammar Chiriac is an associate professor at Linköping University whose research areas include social psychology and group research into group processes, learning, and education.

Madeleine Abrandt Dahlgren is a professor at Linköping University whose research areas include socio-material practice in health-care education, interprofessional learning, simulation-based medical education, and patient learning.

Mattias Ekstedt is a senior lecturer at Linköping University whose research areas include interprofessional curricula.

Kazuhiko Fujisaki is a professor and director of the Medical Education Development Center at Gifu University whose research areas include communication skills training and behavioral science in health profession education.

Judith Green is a professor emerita at the University of California Santa Barbara whose research areas include ethnographic and discourse-based studies in PBL contexts in higher education and within and across disciplines in K–12 classrooms.

Gillian Hendry is a chartered psychologist and lecturer at the University of the West of Scotland, whose research areas include qualitative methods, group interaction, and inclusion practices.

Cindy E. Hmelo-Silver is the Barbara B. Jacobs Chair in Education and Technology, professor of learning sciences, and director of the Center for Research on Learning and Technology at Indiana University, whose research areas include technology support for complex learning, PBL, and collaborative knowledge construction.

Lingyun Huang is a PhD candidate at McGill University whose research areas include self-regulation, educational technology, learning analytics, and teacher education.

Jun Jin is a postdoctoral fellow at University of Graz whose research areas include PBL, curriculum development, group processes, and wellbeing in education.

Chihiro Kawakami is an assistant professor and nurse at Gifu University whose research areas include interprofessional and nursing education.

Maedeh Kazemitabar is a PhD candidate at McGill University whose research areas include emotion regulation in individual and collaborative learning settings.

Henrietta Y. Y. Lai is a former research assistant at The University of Hong Kong whose research areas include PBL and educational technologies.

Susanne P. Lajoie is a professor and Canadian research chair at McGill University whose research areas include designing technology-rich learning environments in medicine based on theories of learning and affect.

Robert McQuade is a PhD researcher at the University of Strathclyde whose research areas include student interactions in PBL, tutorless groups, social self-management, and the construction of academic identities.

Masayuki Niwa is a professor and pharmacist at Gifu University whose research areas include PBL and online education.

Ray Peterson is an associate professor at University of Adelaide whose research areas include student well-being, clinical reasoning, and collaborative learning.

Richard Reeve is an associate professor at Queen's University whose research areas include technology in education, collaborative learning, and designs for hybrid knowledge-building communities.

Takuya Saiki is an associate professor and general physician at Gifu University whose research areas include cultural differences in medical education, faculty development for health professionals, and professionalization of medical education.

Maggi Savin-Baden is a professor of education at University of Worcester, UK, whose research areas include staff and student experience of learning, digital fluency, cyber-influence, and the impact of innovation on learning.

Carmel Schettino is a senior academic adviser at Avenues World School whose research areas include teacher professional development, problem-based pedagogy in mathematics, relationality of status, and student equity.

Vicki J. Skinner is a senior lecturer at University of Adelaide whose research areas include dentistry education, communication and patient-centered care, and PBL.

Yasuyuki Suzuki is a professor and pediatrician at Gifu University whose research areas include PBL, pediatric education, and faculty development for health professions education.

Vanessa Svihla is an associate professor at the University of New Mexico whose research areas include project-based learning, learner agency, and problem framing in relation to identity and creativity.

Tove Törnqvist is a PhD student at Linköping University whose research areas include ethnography and interprofessional education.

Esther Ventura-Medina is a senior lecturer at the University of Strathclyde whose research areas include PBL, key professional skills, and authentic student-centered pedagogy.

Florian Verbeek is a PhD candidate at The University of Hong Kong, Centre for the Enhancement of Teaching and Learning, whose research areas include higher education curriculum development and organizational change.

Sally Wiggins is a senior lecturer and docent at Linköping University whose research areas include discursive psychology, family mealtime interaction, and PBL.

Tracey A. Winning is a visiting associate professor at University of Adelaide whose research areas include curriculum development and evaluation, student experience, and procedural learning skills.

Anita M. Y. Wong is an associate professor and director of speech-language therapy clinical education at The University of Hong Kong whose research areas include child language development and disorders.

Juan Zheng is a PhD candidate and research assistant at McGill University whose research areas include self-regulated learning, academic emotions, and educational data mining.

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