The Purpose and Value for Students of PBL Groups for Learning

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Recommended Citation

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Groups are central to problem-based learning (PBL) and educational and professional outcomes relevant to clinical education. However, PBL groups in practice may differ from theoretical conceptions of groups. Therefore, this study explored students' understandings of the purpose and value of PBL groups for their learning. We conducted a naturalistic study with novice (first-year) students at two dental schools (Australia, Ireland), using observation and interviews analyzed thematically. Students constructed PBL learning 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. Findings are explained in relation to how students' epistemologies and perceptions of their learning contexts shaped group behaviour. Implications for health professional education practice are considered.

Keywords: problem-based learning, group work, collaborative learning, ethnography, qualitative research, student perceptions, assessment, epistemologies

Introduction

The group is central to the learning process in problem-based learning (PBL) because it supports educational and professional outcomes relevant to clinical education. Through the PBL group experience, health professional students can engage in the meaningful learning of subject matter and develop effective problem-solving skills relevant to patient management and care (Barrows, 1988; Hmelo-Silver, 2004; Schmidt, 1989). Students also learn about teamwork and collaborating as professionals, which are core outcomes described in a number of scholarly discussions of PBL in professional education (Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005; Hmelo-Silver, 2004; Savery, 2006). However, PBL as an educational approach may be understood and implemented in different ways (Barrows, 1986; Miflin, 2004). In our PBL context, a professionally relevant situation is the starting point for students' learning. Our PBL design involves a cyclical group-based analysis and investigation of a professionally relevant situation in which small-group discussion of the situation and investigation of identified research/learning goals, conducted in and between classes, supports skill development and collaborative knowledge building (Charlin, Mann, & Hansen, 1998). This process enables the development of an integrated, comprehensive, and collaborative understanding of the situation.

Explanations for the role of the group in learning are provided by various theoretical approaches grouped under constructivist and collaborative learning theories (Gijselaers, 1996; Hmelo-Silver & Eberbach, 2012; Savery & Duffy, 1995). Whether PBL is implemented in small- or large-group format, these theories propose that the PBL group supports or mediates collaborative learning through the group activities that occur, during both the initial problem analysis and the final discussion phases of PBL (Barrows, 1988; Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005). However, the authors' observations (as PBL educators in dentistry) and our reading of health professional education research literature suggested that student groups do not necessarily function in theoretically desirable ways: group activities may "deviate" from those that are theoretically ideal (Dolmans, Wolfhagen, van der Vleuten, & Wijnen, 2001).

Health professional education researchers, using various theoretical perspectives to investigate how PBL might work, have shown that learning can be supported by particular group processes during PBL. Explanations of how the PBL group supports learning have evolved as learning theories have evolved from cognitive to social constructivist to sociocultural. Early explanations of PBL came from cognitive constructivist perspectives that adopted an information-processing approach to learning (Schmidt, Rotgans,

& Yew, 2011). Although focused on explaining individual learning, they proposed a role for the group as a context to support learning. For example, group discussion was shown to enhance cognitive development because it stimulates individuals' use of prior knowledge and elaborations, which leads to greater integration, retention, and recall of information (de Grave, Schmidt, & Boshuizen, 2001). Group discussion also supports conceptual change, by enabling cognitive conflict as a stimulus for learning (De Grave, Boshuizen, & Schmidt, 1996).

To understand the group role further, PBL theorists have drawn on social constructivist and collaborative learning theories, which explain how social processes mediate learning (Reynolds, Sinatra, & Jetton, 1996; Slavin, 1996). This shapes PBL group research in two ways: both learning interactions and group dynamics are the objects of interest. From this perspective, an investigation of group function showed that group "success" is directly linked to particular group interactions, such as discussing and questioning one another, and to collaborative features such as encouraging one another (Dolmans, Wolfhagen, & van der Vleuten, 1998). These theoretically important interactions can be identified in student dialogue during PBL group sessions (Visschers-Pleijers, Dolmans, de Leng, Wolfhagen, & van der Vleuten, 2004, 2006; Yew & Schmidt, 2009). Researchers have also addressed students' perspectives of group interactions and collaboration: students reported that group success depends on all members participating and engaging in discussions and on good group dynamics such as cooperation (Virtanen, Kosunen, Holmberg-Marttila, & Virjo, 1999; Willis et al., 2002).

Researchers adopting a sociocultural perspective view the group as a community of practice that is a setting for professional enculturation; these theories explain how learning occurs in a PBL group by documenting social processes and practices (Hmelo-Silver & Eberbach, 2012; Loftus & Higgs, 2005). Such studies demonstrate how collaborative reasoning, theory development, and learning goal identification occur through social and discursive processes, such as students' turn-taking, and through professional processes, such as students discussing issues together as novice clinicians (Glenn, Koschman, & Conlee, 1999; Hmelo-Silver & Barrows, 2006, 2008; Imafuku, Kataoka, Mayahara, Suzuki, & Saiki, 2014).

Together, these research findings from different theoretical viewpoints illustrate how theoretically ideal groups might function. There is also evidence, however, that PBL groups in practice may differ from theoretical conceptions of groups, in that groups may not function optimally. For example, studies of learning interactions have reported that theoretically important processes, such as addressing knowledge conflicts or reasoning and argument development, may be absent or less frequent than is ideal to support learning (de Grave, Dolmans, & van der Vleuten, 2001; Yew & Schmidt, 2009). Furthermore, students do not perceive that the absence of these theoretically important interactions impedes their learning (de Grave, Dolmans, & van der Vleuten, 2002; Visschers-Pleijers et al., 2006). Importantly, students report that "cognitive conflict," a fundamental constructivist concept, is often lacking and not valuable for their learning (Visschers-Pleijers et al., 2006; Yew & Schmidt, 2009). PBL groups in different settings have also been observed to diverge from prescribed PBL forms by missing key steps or rushing to conclusions (Moust, van Berkel, & Schmidt, 2005; Steele, Medder, & Turner, 2000). Our own informal observations as PBL implementers suggested that student groups took similar shortcuts, such as avoiding lengthy discussions and splitting tasks vertically into individual tasks rather than horizontally into shared tasks (Dillenbourg, 1999), thereby minimizing group engagement during PBL. One group of authors has concluded that PBL "practice differs from theory" in ways that cause the "erosion" of PBL as an educational approach (Moust et al., 2005, p. 669).

To help address the question of why practice differs from theory we need to find out how students interpret and experience PBL groups, which requires a naturalistic investigation. A number of such studies have provided insight into the individual student's perspective of PBL as a learning approach (Bridges, Botelho, Green, & Chau, 2012; Lähteenmäki, 2001; Savin-Baden, 2000; Winning et al., 2012) or explained why students might conduct PBL in unexpected ways (Lloyd-Jones & Hak, 2004). However, no in-depth studies have explored students' understandings of PBL groups. Therefore, this was the focus of our current study. Previously we explained students' understandings of how group dynamics shaped the way that PBL groups engaged collaboratively on group tasks (Skinner, Braunack-Mayer, & Winning, 2012). The current study aimed to explain how students understood the purpose and value of the PBL group for learning. Our research questions were: What did groups do during PBL? How did students explain this and its relationship to learning? How does this compare to theoretical conceptions of the PBL group?

Methodology

We aimed to understand PBL group function from the students' perspective and therefore, to obtain suitable data, we planned a naturalistic study of PBL groups. Our theoretical framework was social constructionism, which proposes that the world and its meanings are socially constructed through everyday activities (Crotty, 1998). In this paradigm we assume that PBL groups are constituted from the beliefs and

practices of people involved in them during the practice of PBL. Accordingly, we designed an ethnographic study using the core ethnographic data-gathering methods of participant observation and unstructured interviews (Tedlock, 2000). We obtained ethical approval for the study from the relevant committees of each institution.

The primary author (Vicki J. Skinner) undertook research at two dental schools, one in Australia and one in Ireland, both Western, English-speaking schools with five-year, undergraduate, hybrid-PBL curricula (i.e., a combination of PBL and lectures or tutorials). Conducting cross-site research had a definite purpose. First, it aided researcher reflexivity through exposure to a new, unfamiliar setting, which would facilitate deeper reflection on the researcher's own setting, on the self as researcher, and on the relationship between them (Denzin & Lincoln, 2005; Liamputtong & Ezzy 2005). Further, it provided richer data and allowed us to compare and contrast findings, thus enabling us to strengthen our conclusions about students' understandings of PBL groups as social practice (Denzin & Lincoln, 2005; Liamputtong & Ezzy, 2005). As the researcher, Skinner was not involved in teaching or assessing students at either site, but did have previous experience in facilitating PBL and had a professional interest in understanding what happened inside the group.

The study was conducted over two full academic semesters (Australia) or one full academic term (Ireland). Phase 1 at each site involved participant observation with several PBL groups over multiple PBL cases or problems early in semester 1 (Australia) or Michaelmas (i.e., first) term (Ireland). Semester 1 in Australia comprised 12 weeks between March and June; Michaelmas term in Ireland was 10 weeks between October and December. Phase 2 at each site comprised individual interviews with students from the observed groups early in semester 2 (July-August, Australia) or later in Michaelmas term (November, Ireland).

The participants were all volunteer first-year undergraduate dental students. Students were recruited from the day they commenced their dental studies. We selected novice PBL students because we wanted to know what initial understanding students would develop of PBL groups, as we had observed informally that group practices set up in the first year tended to endure in subsequent years, meaning that suboptimal practices we had observed might be maintained in senior years. We selected participants using maximum variation purposive sampling for their potential to provide rich information (Coyne, 1997; Patton, 2002). To ensure a wide range of participant ages and backgrounds we invited the whole cohort for phase 1 observation and then randomly selected participants for that phase from the volunteer list. Most participants entered Dental School following completion of their secondary schooling ("School Leaver"; Table 1);

others were transferring from another tertiary program or were mature-aged entrants. For phase 1, four out of a total of 10 Australian groups (comprising the entire cohort; Table 1) were observed; three of the four groups were then selected for interview recruiting and data reporting in phase 2 (for analytical reasons, to explore three groups in depth, and for ethical reasons, to reduce the chance of staff identifying students). Two out of a total of four Irish groups (comprising the entire cohort; Table 1) were observed in phase 1, with both selected for interview recruiting and data reporting as part of phase 2. We invited all students in the selected observation groups to take part in an interview and five students from each group volunteered. Fifteen Australian and ten Irish students took part in interviews. Details of the cohorts and the observation and interview participants at each site are provided in Table 1.

The field notes at both sites included Skinner's observations about group behavior and examples of student dialogue from PBL sessions; in Australia, the notes also included observations about group behavior and student dialogue between class activities. Field notes were handwritten during and immediately after observation sessions and included exact quotes where possible. Interviews were recorded and professionally transcribed. Data comprised typed-up observation field notes and student-approved interview transcripts from the three Australian and two Irish groups selected for phase 2. Analyzing these from an ethnographic perspective, we addressed participants' insider ("emic") and researchers' outsider ("etic") perspectives to provide, respectively, localized and theorized explanations of PBL groups (Patton, 2002). In consultation with the other authors, Skinner analyzed data with an inductive thematic method (Liamputtong & Ezzy, 2005) based on a grounded theory approach to data (Charmaz, 2000), using manual and software-assisted coding (Nvivo®). The goal was to seek common and unifying themes from group behavior and individual verbal accounts of groups, rather than look for individual experiences of groups. However, the contrasting individual accounts, or outlying data (Miles & Huberman, 1994), were vital to the development of the thematic analysis.

Curriculum Context

As noted previously, both schools had a five-year, hybrid PBL program. Both had a competitive entry system, in which more students applied than there were places available. Most commencing students were School Leavers, having completed their final school exam the previous academic year. The majority of students at each school were local, meaning Australian residents or residents of the Irish Republic or United Kingdom. At both schools, students were considered to be from among the top academic performers.

Table 1. Australian and Irish participants.

Site	Cohort or Participants	Local female	Local male	IS female	IS male	Total students
Australia	Year 1 Cohort (all invited for observation)	Total = 27	Total = 17	Total= 16	Total = 8	Total= 68
Australia	Four PBL Groups Observed[a]	11	9	5	3	28
Australia	Interviewees[b] (five from each of three observed groups)	7	4	3	1	15
		Amy[c]	Bruce[c]	Alice[c]	Martin[c]	
		Angela	Morgan	Carol[c]		
		Cathy[c]	Peter[c]	Ruth[c]		
		Diane[c]	Sam[c]			
		Julie[c]				
		Paula				
		Rosanne[c]				
Ireland	Year 1 Cohort (all invited for observation)	Total= 20	Total= 10	Total= 6	Total= 4	Total= 40
Ireland	Two PBL Groups Observed	12	6	2	0	20
Ireland	Interviewees[b] (five from each of the two observed groups)	5	4	1	0	10
		Aileen[c]	Brendan[c]	Fiona		
		Brigid[c]	Kevin[c]			
		Deidre[c]	Hugh			
		Kerry[c]	Liam[c]			
		Maeve[c]				

Note. "Local" for Australia means permanent resident and "Local" for Ireland means Republic of Ireland or UK permanent resident. "IS" 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 program.

PBL was implemented in both curricula as the main means for learning basic and dental or applied sciences. The Australian curriculum had three vertically and horizontally integrated subjects, addressing Dental Clinical Practice, Dental and Health Science, and Human Biology, respectively; all subjects included interactive lectures, laboratories, and tutorials, with PBL cases forming the foundation of the dental and health science stream (Mullins, Wetherell, Townsend, Winning, & Greenwood, 2003; Townsend, Winning, Wetherell, & Mullins, 1997). Learning from the PBL cases was supplemented with other curriculum activities such as lectures, laboratory sessions, tutorials, and clinics. The Irish curriculum had a single PBL subject for learning-integrated basic and applied sciences; all other subjects (e.g., Physics, Anatomy, and Dental Anatomy) were taught in traditional lecture-laboratory-tutorial format. In the Irish curriculum there were no formal supporting activities programmed for the PBL subject, but provision was made for supplementary lectures when necessary.

Table 2. Variations in PBL implementation.

PBL feature	Format in Australia	Format in Ireland
PBL group and session	PBL groups comprised seven students and a facilitator, meeting once a week over a two-week problem cycle. The only mandatory group role was a scribe nominated by students to record discussion on a whiteboard. In semester 1 six problems were completed.	PBL groups comprised ten students and a tutor, meeting three times per week and completing three problems over each two-week period. For each new problem, the group nominated a chair (to facilitate group process) and secretary (equivalent to scribe).
PBL problem content	Problems represented clinical scenarios (e.g., "What have I done to my front teeth?") generating learning goals related to basic and dental science such as tooth morphology, structure and development, oral tissues and an introduction to common, simple oral diseases.	Problems represented real world scenarios (e.g., "The world around us—bacteria and viruses") generating learning goals related to basic sciences; organized as blocks, including "energy and microbes," "chemistry," and "cells."
Collaboration	Australian students were required to collaborate on independent research between classes and produce a group research summary for each of their learning goals to be shared in a large group setting in the final session.	Irish students were only required to collaborate during class; between classes they researched individually.
Assessment	Australian students' participation in the problem-analysis session was assessed formatively with feedback provided by their tutor mid-semester and at the end of semester.	Irish students self-assessed their PBL participation at the end of every session for a total mark over all sessions that contributed to 10% of their final annual grade.

PBL in both schools followed the Maastricht seven-jump approach, which is a cycle of seven steps (Schmidt, 1989). Steps 1-5 include clarifying unknown terms; summarizing the problem; analyzing the problem and offering tentative explanations or hypotheses; prioritizing the proposed explanations or hypotheses; and then developing a list of learning goals based on the proposed explanations. Step 6 comprises research related to the learning goals and step 7 involves testing and evaluating the research against the original problem. At each school a small group of students (Australia: seven-student group; Ireland: ten-student group) and a tutor met for the first session (steps 1-5), then students undertook independent research focused on the learning goals identified during problem analysis (step 6), and finally the small group and tutor reconvened to discuss the research and its relationship to the problem (step 7). In addition to these similarities in how PBL was implemented, there were a number of differences between the schools with regard to PBL group and session formats; PBL problem content; the format of students' collaboration; and the format of assessment in PBL. These are summarized in Table 2.

Results

The results comprise common themes derived from the field notes and transcripts of interviews in each school. We have written this section in first-person singular because it is based on one author's (Skinner) engagement as researcher with students. Themes and subthemes derived from the 25 interviews and the observation field notes are presented in italics; accompanying single words or phrases in quotation marks represent examples of student expressions or terms from Skinner's field notes relating to that theme or subtheme. Students' voices are presented as whole quotes illustrating themes or subthemes, with students referred to by pseudonyms with a superscript A or I after their name to indicate Australia or Ireland. The results comprise three

main sections. First, we show how students constructed the three stages of the PBL cycle of problem analysis (steps 1-5), research (step 6), and application of research to the problem (step 7); second, how students understood learning; and finally, how the first two shaped the purpose and value of the group for learning.

The Three Stages of PBL

Overall, students constructed PBL as a linear series of three stages that shared the common overall theme of compiling information into a final knowledge product (see Figure 1); at each stage individual group members contributed information to the whole group effort. The major theme for each stage of PBL was: stage 1: *Importance of knowledge*; stage 2: *Gathering information*; and stage 3: *Exchanging information*.

The stage 1 session mostly involved adding together group members' current knowledge about the problem. The key theme to emerge from observation and interview was the *importance of knowledge*. My observation field notes of group behavior in both schools record that students mainly offered facts to be recorded on the board, and that discussion and questioning about the problem were less common. In particular, the scribes favored known facts over questions and issues. The core role of knowledge, and being able to share information, also featured regularly in students' comments about stage 1. For example, when referring to stage 1, students often used expressions like "supposed" and "should" know information.

> **Amy[A]:** It was *daunting* . . . to discuss something where I was supposed to know something, actually know information.

The subtheme *pooling knowledge* represents the main task undertaken in this session: students used terms like "sharing" and "pooling" to describe stage 1.

> **Ruth[A]:** When you come together you get this pooled knowledge from everybody.

Further evidence of the importance of knowledge for students in both schools lies in the subtheme *contributing*, and for the Irish students, the subtheme *assessment*. Students' perceptions of their knowledge shaped whether and how they contributed.

> **Paula[A]:** Because I have got knowledge it was easy for me.

> **Kevin[I]:** Some people know infinitely more than others and it makes it very difficult for people who don't know to contribute equally.

Consequently the Irish students told me informally and in interview that they determined their PBL self-evaluation after each session (as a mark out of ten) according to their knowledge contributions. These reports were confirmed by my observations of their behavior: their scores correlated to how vocal students had been.

> **Brigid[I]:** If you sat there and said nothing, or you just didn't know enough about the topic you'd give yourself a five, or—not really said nothing, it could be like, "*What do you mean?*" but you haven't really contributed.

In stage 2 (between the in-class sessions) the focus on knowledge continued. At both schools the major theme was research as *gathering information*. To describe research, students used expressions like "gathering information," "get information," and "finding stuff." During phase 1, I accompanied Australian students to the library and to group meetings; each group adopted the same approach of subdividing resources so as to avoid "overlapping information" and minimizing face-to-face meetings by emailing each other their "information." My field notes from observing stage 1 sessions in Ireland contained student comments referring to research as gathering information, for example, "we'll have to look that up" and "we'll find x when we look up y."

> **Aileen[I]:** [Research] is basically learning how to look up stuff.

Students appeared to construct research as an end in itself rather than to resolve a problem or question and this was represented by the subtheme *finding answers*.
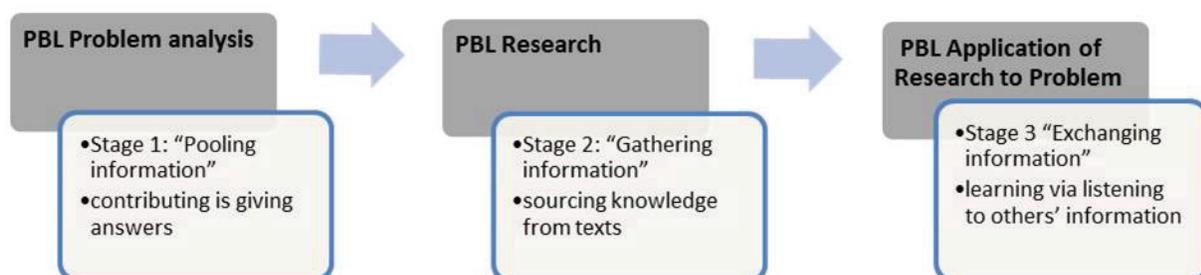

Figure 1. Group activities in the three-stage-process of PBL.

Fiona[I]: [Good learning goals are] precise questions, because [at school] we are so used to doing question-answer, question-answer.

In stage 2 in Australia, students were also required to prepare a group research summary, explaining how the information related to the problem. This process was encapsulated by the subthemes *collect* and *collate*. During phase 1 observation meetings with each of the three groups, students explained to me that this was a mechanical job of collecting, sorting, and typing up information, and therefore there was no need to discuss the research findings or the final product as a group. This point was also emphasized in all the Australian interviews in phase 2.

Martin[A]: Somebody collects other people's work.

Sam[A]: [The editor] would collate all the information and type it up from all his sources in a one-page order. He wasn't really doing anything, from his own head, you know what I mean? He was just typing up and putting in the information into the slots, kind of thing.

Although the Irish students were not required to collaborate between classes (and hence group observation between classes was not undertaken), I asked several students about their usual behavior and if they ever discussed their research with other students. They told me that they did not see any point to this since they would get the information in class.

The PBL process concluded in stage 3, which at each school was a group session to discuss and apply research. In Australia small groups combined into larger groups for this session due to staff resourcing issues and to stimulate discussion, while in Ireland, students brought their individual research to the same small-group setting. The theme of stage 3 was *exchanging information*, with subthemes of *knowledge*, *telling*, and *listening*. To describe stage 3, students used similar terms, often speaking of "presenting," "exchanging," "sharing," or "listening to" information, and they explained how this led to learning or building knowledge.

Alice[A]: People just present and you just listen to them.

Diedre[I]: You say something, then I say something and you build, if there's no one helping you build, you say, don't you know it as well?

Students' Conceptions of Learning

This construction of PBL as a series of three information-handling stages appeared to be enabled by a didactic conception of learning, namely, increasing knowledge by taking in information. In stages 1 and 3, learning could occur by receiving information from group members, while in stage 2, information came directly from texts. The complementary themes for teaching and learning were, respectively, *telling each other* and *picking up information*.

Diane[A]: When they talked to us about their topic you really learn a lot.

Brendan[I]: I'm actually *teaching* other people what I've learned.

The implication of this didactic view of learning was that the PBL group process, as a means of learning and as learning in itself, appeared to be unimportant for students. The theme of *PBL process* included subthemes like *deviations* and *confusion*. For example, since students' goals in stage 1 and 2 were information and fact gathering, they disliked any deviation from this straightforward process (particularly when people offered uncertain knowledge) because this caused confusion and wasted time.

Kerry[I]: I would make it a strict rule you only report knowledge you know to be fact, none of this confusing other people with saying the wrong thing, because people say "*I'm not sure if this is true.*"

Likewise, an ideal stage 3 session was orderly turn-taking at information-giving, thus building the final knowledge product:

Liam[I]: The days it's most effective is when people are actually taking it in turns to constructively develop the point . . . someone says "*Did anyone get anything for X?*"—say there's a momentary silence of two or three seconds—and someone says, "*Well I got . . .*" and then they read it out and the secretary takes it down.

The Role and Value of the Group

This didactic view of learning informed students' understanding of the purpose and value of the group. Students at both schools spoke about what their group should do and the resultant benefit of the group in relation to the immediate PBL context and to the wider curriculum context.

The group's purpose in PBL learning was to augment individual information work. Therefore the potential value of a group during PBL was that more information could be gathered, from people or texts, and more information was available to be taught; thus, the amount of learning from texts and colleagues was increased.

Peter[A]: (re stage 1) One person comes up with two ideas and if every person comes up with two ideas, that's 14 ideas. But, you yourself would probably only come up with 4, if you thought about it for a long time.

Brendan[I]: (re stage 2-3) Nine heads are better than one, nine heads can do a lot more reading and a lot more research.

However, the ultimate value of the group for students was related to the wider *curriculum* and *assessment* context. At both sites, the group assisted students to prepare for individual assessment, albeit differently in each school because of the variation in assessment format and the fit of PBL into the curriculum, as summarized in Table 2. Therefore, in Australia, during phase 1 observation of student behavior between classes, I noted how each group shared the burden of PBL group work over the semester, by taking it in turns for one group member to collate research and prepare the group summary for a given PBL problem, which left individuals free to focus on other learning *priorities*.

Alice[A]: It was easier for one person to represent the whole group.

Rosanne[A]: It helped with the load.

During phase 1 observation of between-class behavior, I noted that group meetings to discuss research were occasional and very brief, and mainly related to subdividing research prior to "gathering information"; otherwise students exchanged information and status updates by email (I was copied on these messages). Subthemes related to the theme of *group work* in Australia and which explained this behavior were based on discussions with groups in phase 1 observation and the interviews: meeting and working as a group between sessions to research and make a summary together was *time-consuming*, *inefficient*, and *not productive*. Students' rationale was their belief that it was superfluous to do this work as a group, hence one student acted as a proxy for the group. The following quote is typical of students' explanations.

Angela[A]: It's like six people doing the work that one person could have done, six people doing the same work but only needing to hand up one piece of work.

However, the major theme of *assessment* provides the explanation for this decision: with a heavy workload, individual work that was assessed for grades took priority over formatively assessed group work or PBL.

Carol[A]: There was no time for group work, we had lots of study to do as well as PBL.

Bruce[A]: Since PBL wasn't assessed, it just wasn't really a priority.

In contrast, for the Irish students the group had a more direct role in *assessment* supporting student learning. Students had to self-assess their participation (on factors such as attitude, group process, knowledge, and questioning or discussing) after every PBL session, but as previously described, students focused on *knowledge* inputs as evidence of their *contributing*. Students also explained how they had to rely solely on their PBL notes for exam preparation. These two things motivated individuals to do their own work. However, the group had value as a *safety net* for individual learning.

Hugh[I]: If you miss something totally that you should have seen, then someone else brings it to the group.

One student, **Liam[I]** told me that it was reassuring in PBL sessions that "you can benchmark yourself" against others in the group in preparation for the exams. Assessment thus created potential for tension between collaboration and competition among students in Ireland. Although it seemed to me that there was sometimes verbal jostling to speak, when I asked students whether there was any competition to contribute in class, there were mixed reports: some felt as though it was an issue and others did not.

Contrasting Student Views: The Role of Outlier Data

The above analysis, which represents how students constructed PBL and the consequent role and value of the group, is based on common themes and subthemes derived from phase 1 and 2. However, there were also some "outlier" points of view, which contrast with the majority opinions and beliefs but add support to the analytical interpretation. These divergent views were uncommon, and only two Australian students and one Irish student provided any outlying accounts. The first Australian was an older student, Morgan, who believed that PBL learning was about both process and content, and that the input of the whole group was a core element in constructing the research summary (as opposed to one person being proxy for the group). Morgan attempted, without much success, to modify his group's behavior to be more collaborative and process-oriented.

Morgan[A]: I still don't think the others understand what the group was supposed to do. I think it's supposed to introduce us to interesting dental ideas . . . the group session is a forum for broader relevant discussion [and] for learning how to interpret clinically and how to discuss patient cases with colleagues.

The other Australian student who expressed a different view of learning, Cathy, had reluctantly accepted her group's way of doing PBL in spite of the fact that it conflicted with her beliefs and preferences for learning. Cathy, who was a School Leaver on entry to Dental School (refer Table 1), emphasized throughout her interview that she viewed learning as a collaborative, constructive activity and wished that the group spent

more time "discussing" what they were learning. However, she regretted that due to circumstances of time and workload pressure, this was not possible.

> **Cathy**[A]: You didn't talk about what everybody else had learnt, you just get their information and cut and paste and make your two pages to send off . . . I suppose the only sad thing is, that the best way to do it isn't in a group and that takes away the idea of PBL.

Only one Irish student distinguished between quality and quantity of information when she noted that the marks for participation did not necessarily represent how well students had actually contributed to the problem discussion.

> **Aileen**: Just on the marking, like, people can just say a lot and then they get good marks whereas people who don't say that much but say the right thing don't get as much marks just because they don't say as much or what they say is more, contributes more to the actual discussion point of view.

Discussion

Constructivist, collaborative, and social-learning theories all contribute to explanations of how learning in PBL is process-driven or social, and how knowledge is acquired or coconstructed through active group engagement (Hmelo-Silver & Eberbach, 2012). However in this study, students at two dental schools constructed PBL group learning differently than an "ideal" theoretical construction. In spite of differences in how PBL was implemented, there were notable similarities across the two sites. The novice students in two dental schools with hybrid PBL curricula constructed PBL as a linear series of tasks that focused on information gain as the main form of learning. Group practices and student accounts showed that students' attention was focused on the *importance of knowledge* in stage 1, *gathering information* in stage 2, and *exchanging information* in stage 3. Adequate *contributing* at any stage was related to providing *information* and *knowledge*. Any process or activity that prevented this was seen as *unproductive*. For example, group practices and students' accounts revealed that group discussions involving uncertainty caused *confusion* and were regarded as *deviations*, and group meetings between class to discuss research or information were unnecessary. These practices appeared to be based on an understanding of *learning* as didactic, involving a knowledge transfer process of *picking up information*.

This group construction of PBL can be attributed to widely shared beliefs about learning and students' perceptions of their learning context. The majority of students spoke and behaved in ways that suggest they had a didactic or "consumption" conception of learning (Marton, Dall'Alba,

& Beaty, 1993), and their group behavior in PBL was consistent with this belief. For these students, information could be collected, collated, and exchanged as a material resource for learning; in Australia, one group member could act as a proxy for the group when managing the group's research material by *collecting* and *collating* separate pieces of information. This behavior suggests that most students viewed knowledge as objective. Perry (1999) proposed a developmental continuum of conceptions of knowledge, with the start of the continuum being an objective view of knowledge, which Perry called a prerelativist epistemology. Perry argued that prerelativism is characterized by a conception of knowledge as external and dictated by authorities such as teachers and texts rather than constructed, and fixed rather than historically or culturally relative. The most basic form of prerelativism is called a dualist or right versus wrong conception of knowledge (Perry, 1999). A prerelativist and possibly dualist view of knowledge among students would explain why most focused on knowledge gain and obtaining information and answers, rather than learning in and from the group and PBL processes, such as discussing uncertainties. It can also explain why the Australian students believed that once knowledge had been gathered from texts, it was not necessary to discuss it as a group before one member collated it into the group summary. They disliked aspects of group discussion and the uncertainty that is part of knowledge construction during the PBL learning process.

The construction of the group was further influenced by the driving forces of assessment and curriculum and students' perceptions of their learning context. The group's main purpose for students was to supplement individual learning; its value in PBL was to increase knowledge across the group. The curriculum context, workload, and in particular the nature of assessment were the ultimate shaping factors for the value of the group. For Australian students its value was indirect: the group enabled students to reduce their PBL commitments. Individual group members took turns at completing the group research summary so that their colleagues had more time for study and individually assessed activities. In Ireland, the group directly supported learning for individually assessed activities. Through the group, students could supplement and verify their learning from their individual PBL research, which also reassured students about their exam preparedness.

It is known that students' perceptions of their study context influence their study behaviors in general (Biggs, 2003) and in PBL (Duke, Forbes, Hunter, & Prosser, 1998; Ellis, Goodyear, Brillant, & Prosser, 2008) and not necessarily in desirable ways (Dolmans & Gijbels, 2013; Winning et al., 2012). Such relational study behaviors among groups have also been demonstrated and referred to as avoider or engager

groups, with avoider groups adopting approaches in avoiding group engagement similar to those used by the Australian groups in our study (Yan & Kember, 2004). In our study, the practices that were enabled by consumption views of learning and objectivist beliefs about knowledge were also relational, due to students' perceptions of their context and the impact of the form of assessment in each school. Students' decisions about PBL group value were driven by the "backwash" effect of assessment on their study behaviors (Biggs, 2003). In Australia, the backwash of summative (individual) versus formative (PBL participation) assessment meant that group work, which was viewed as essentially nonassessed summary preparation, was assigned the lowest priority. Hence, each group saved time and effort by taking turns for one group member to produce the group's summary (by compiling the information contributed by each group member), as opposed to meeting and discussing the summary as a group. In Ireland, the backwash was to create the tension of reliance on the group for knowledge and some competition for time or space in the group session for participation.

As a result of students' didactic processes for group learning, it is likely that they considered superfluous the theoretically valuable PBL practices such as group discussion (in or out of class) involving activation of prior knowledge, elaboration, and management of knowledge conflicts (Savery & Duffy, 1995; Schmidt, 1993). Most students did not appear to consider the PBL process of systematic problem investigation to be useful either; they were outcome-focused and in search of answers or facts. This is in contrast to an ideal PBL community of practice in health professional education, that is, an apprentice-like enculturation into the ways of the profession, "rather than a process of providing information and a set of rules or specifications for action" (Loftus & Higgs, 2005, p. 6). It is possible that novice students did not attend to these broader aspects of PBL while acculturating themselves to the new environment of dental school.

These conclusions are further supported by the divergent or outlier accounts, which involved different views of learning, knowledge, and ideal group practices. These students possibly had conceptions of learning and knowledge beyond simplistic didactic, objectivist views. However, they were overridden by the circumstance of majority rules, which in turn was influenced by the impact of assessment and workload. This shows that students' study behavior is not always consistent with their beliefs about learning and knowledge, that is, some students may have engaged in superficial learning practices even though their beliefs and preferences were for group collaboration and learning for meaning. However, other students, as in our study, were possibly constrained by their underlying beliefs. In their study of avoider and engager groups, Yan and Kember (2004) suggested that while some

students and groups may choose practices on a situational basis, there are others whose "epistemological beliefs do not recognise multiple positions" (p. 45). In fact, a study into the relationship between epistemological beliefs and learning approaches suggested that how students go about their learning is not only relational (i.e., changeable due to perceptions of the learning context), but also stems from their comparatively stable beliefs about learning and knowledge (Rodriguez & Cano, 2006).

These findings about PBL-in-practice compare to and possibly explain other reports of divergent forms of PBL group work in health professional education. This includes groups taking shortcuts in the steps, discussing superficially or too quickly, preparing inadequately for sessions, giving mini-lectures or reading from notes, and distributing case solutions prematurely (Dolmans et al., 2001; Hendry, Ryan, & Harris, 2003; Hitchcock & Anderson, 1997; Houlden, Collier, Frid, John, & Pross, 2001; Steele et al., 2000). It has been suggested that students were doing this because they interpreted PBL in ways that were familiar to them, namely, as traditional classroom behavior (Faidley, Evensen, Salisbury-Glennon, Glenn, & Hmelo, 2000). These authors explained that students had adapted a traditional teaching-learning mode for their PBL: "The difference, of course, is that in PBL the information is relayed from student to student rather than from teacher to student" (Faidley et al., 2000, p. 124). We argue that these relational practices, based on the students' perceptions of their learning contexts, were also enabled by many students' objectivist conceptions of knowledge and didactic views of learning, which focused their attention on answers rather than process. A study of medical and psychology students' study strategies and epistemological beliefs, prior to the adoption of PBL, reported that dualistic epistemologies and didactic conceptions of learning were more common among the medical students and noted that this was problematic for implementing PBL effectively (Lonka & Lindblom-Ylänne, 1996).

Our study raises issues for the future implementation of PBL in health professional education. An important part of PBL is that students learn not only to consider patient cases from multiple perspectives, but also to communicate and coordinate roles and perspectives in clinical practice (Olupeliyawa, Balasooriya, & Hughes, 2009). The group practices established among novice students in this study were not congruent with this, and if they persisted, students would need to relearn effective group practices in PBL to support these professional goals.

So that student groups can engage fully with the PBL process in health professional education from the commencement of their study program, care must be taken to ensure that curriculum design and assessment are constructively

aligned with PBL goals (Biggs, 2003; Dolmans & Gijbels, 2013). Educators also need to address students' understandings of knowledge and learning. If students commence PBL with prerelativist conceptions of knowledge and didactic views of learning, this can have negative consequences for how PBL and group work are constructed (Lonka & Lindblom-Ylänne, 1996). Rodriguez and Cano (2006) have noted that although epistemological beliefs do not change from situation to situation (as study approaches can), they are potentially modifiable over time through educational experience. However, the evidence suggests that the impact of tertiary education in developing students' epistemologies is limited (Rodriguez & Cano, 2006). This may explain why information-based PBL student orientation activities (such as those used in the schools in this study) in which terms like *self-directed learning* and *collaborative learning* are explained are likely to be ineffective, since they do not engineer underlying conceptual changes about knowledge and learning. Therefore, we suggest that PBL groups need to take part in experiential activities that address concepts like *relative knowledge*, *constructing knowledge*, and *learning through discussion*. The core issue is effective problem design. We suggest that even at a novice level, PBL problems ought to include an element of uncertainty, so that students must confront and begin to accept that not all scenarios have fixed answers. An important aspect of effectively managing this issue is tutor development. It has been shown that tutors can block students' conceptual development through knowledge conflicts by supplying answers rather than supporting discussion (Aarnio, Lindblom-Ylänne, Nieminen, & Pyörälä, 2014). Tutors must be able to facilitate effective development of students' collaborative and clinical hypothesizing and reasoning skills (Hmelo-Silver & Barrows, 2006, 2008). In this way, the tutor models for health professional students the thinking and collaborative skills required for effective clinical practice (Hmelo-Silver & Barrows, 2006). Tutor development is also essential to ensure that tutors' views of knowledge and learning are congruent with PBL. Tutors also have a valuable role to play in encouraging aligned assessment (Biggs, 2003) of effective PBL participation, which will drive group practices such as discussing and reasoning and dealing with knowledge conflicts.

This study has the strength of providing insight into the insider perspective of the purpose and value of PBL groups for students in learning and suggesting areas in which student and tutor development can enhance health professional education. However, our analytical focus was the level of the group and we looked for common features to emerge from individual accounts of each group. Therefore, the study does not report on individual student experiences of groups and variations in approaches to learning. Another limitation of this study is the absence of tutors' perspectives and their influence on groups and learning. We also did not explore students' epistemological beliefs to further support our conclusions, as this was not consistent with the initial ethnographic investigation. To further extend our understanding of how PBL groups function, investigation of students' epistemological beliefs and the relationship of these to how they approach PBL collaboration would be useful. Since this study only focused on novice students, it would be helpful to explore the relationship of students' epistemological beliefs and approaches to study in a longitudinal study.

Conclusion

This study illustrates how and provides an explanation for why PBL groups in practice can differ from PBL groups in theory. By applying theories of learning development and approaches to learning, we have shown that novice dental students can commence PBL with conceptions of knowledge and learning that are incompatible with the constructivist and collaborative learning theories on which PBL is based. These beliefs can lead to group practices that are not appropriate to the collaborative and professional interactions needed in health professional education. Students mostly learned as individuals in a group through knowledge exchange, rather than through engaging collaboratively as a group. In the students' construction of PBL, outcomes were privileged over process, and few students acknowledged the learning potential of group process. This "distortion" of PBL was exacerbated by the impact of curriculum design, in particular assessment. The significance of these findings for health professional education is that attention must be paid to process as well as content in student and tutor development. Novice PBL students may need explicit support to develop understandings of knowledge and learning that are compatible with PBL and collaborative, professional learning.

Acknowledgements

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