Comparing regular strand and problem-based learning (PBL) strand teacher education students’ perceptions about what helps them to learn in class

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Abstract

Student teachers are both learners and prospective teachers. An important outcome of their studies is that they develop well-founded knowledge about learning processes. Such knowledge can be expected to guide not only their own learning, but also future pedagogical decisions about how they will teach to facilitate their own students’ learning. The broad aim of our study was to better understand what teacher education students know about what helps them to learn, and how they structure their understandings about this knowledge. Of particular interest was whether students who had enrolled in a problem-based learning (PBL) strand structured their perceptions differently from students who had enrolled in the regular strand of a teacher education degree.

One hundred and forty six students sorted and ranked 40 statements generated in response to the question “What helps me to learn in my university classes?” Cluster analysis (CA) revealed four main clusters and Multi-dimensional scaling (MDS) revealed three perceptual dimensions: intellectual engagement, structural context, and conceptual frames. Differences and similarities between the PBL and regular strand (both relatively inexperienced) teacher education students, and between these two groups and final year students’ perceptions, are discussed.
What helps students to learn

Comparing regular strand and problem-based learning (PBL) strand teacher education students’ perceptions about what helps them to learn in class

Student teachers’ knowledge about teaching and learning, especially as it relates to the students' dual roles as learners and as prospective teachers, is a matter of interest to those of us involved in teacher education. This study is about students' perspectives on processes of learning and teaching and addresses a gap in the research on teaching and learning in which the perspectives of students themselves are largely absent. Luyten, Lowyck and Tuerlinkx (2001) make a similar point, arguing that the role of students' instructional knowledge as a variable mediating the relationship between teaching and learning is relatively unexplored.

As future teachers, teacher education students' views about learning should develop in accord with current thinking in the field of educational research. In one component of their university studies (the practicum), our teacher education students take some responsibility for teaching their own students and are therefore expected to be able to facilitate the learning of these students. Such facilitation requires relatively well-developed knowledge of both learning and teaching; knowledge that will be based upon students teachers' own experiences as learners and self-teachers, as well as upon the content of their teacher education studies.

Teacher education students in a previous study (Lawson & Askell-Williams, 2001) referred to many of the issues that are of contemporary interest in the literature on learning and teaching. For example, they suggested that the features of class atmosphere, discussing and sharing ideas in groups (e.g., sharing opinions and points of view), learning resources (e.g., visual aids, readings, handouts), the personal qualities of teachers (e.g., approachability, humour), the procedures used in teaching (e.g., hands-on, practical activities, demonstration lessons), and the characteristics of the teaching presentations (e.g., clarity, relevance, topic integration), all facilitated learning. Participants also referred to their own personal qualities as students (e.g., self-direction), habits of mind (e.g., personal reflection), and motivation. The students in that study, as well as the students in the current study, brought to their teacher education degree a considerable range of experiences of learning in a tertiary context: Some had just two years of study in different disciplines across the university and others had already completed a first degree.

Since that initial study was undertaken our course designs have become more varied. Therefore, we wanted to know whether the structure of students’ views about what facilitates learning was
affected by different class experiences. We were interested generally in the students' perceptions about learning and teaching of students in the professional component of their degrees, and in particular, in the views of students who had experienced problem-based learning (PBL) compared with the views of other students who had been involved in classes that were more teacher-directed. Furthermore, the views about learning reported in the Lawson and Askell-Williams study (2001) were those of students who were close to completing their degrees, whereas the students in PBL strand and their peers in the regular strand of the course, were new to the professional education component of their degrees. To this end it was of interest to uncover similarities and differences between the ideas of relatively experienced, and of 'novice', teacher education students.

Problem-based learning

While PBL has been adopted widely and its impact evaluated in medical education, there has been little research published on PBL in teacher education settings. According to McPhee (2002) "there would, on the face of it, appear to be a good case for the introduction of this methodology within initial teacher education" (p. 65). McPhee argued however, that a number of contextual and methodological constraints (cited in reference to teacher education in the United Kingdom) have created barriers to the acceptance of PBL in initial teacher education. Other research investigations of PBL in teacher education have been reported by Dean (1999), Ferry and Kiggins (1999), and Kain (2000). A range of benefits of PBL have been claimed. For example, Spencer and Jordan (1999) argued that PBL classes were associated with such effects as: deep, rather than surface, thinking; self-direction in learning; more stimulating learning environments; increased interaction between students and teaching staff; improved motivation and better knowledge retention. Alongside these benefits the authors noted above also have cited difficulties in implementing PBL. Examples of difficulties are students' unfamiliarity with collaborative group work, heavy student workload, developing quality 'problems', and tutor facilitation skills. Because PBL is a relatively recent development a strong argument can also be made for involving teacher education students in the PBL experience so that they have knowledge of how it is implemented and be able to evaluate its suitability for use in their own teaching

PBL, whether it is understood as an instructional strategy or more broadly as a curriculum philosophy (Phillips, 1995), has drawn from cognitive psychological and social constructivist
fields of research and theory. The opportunity that PBL provides for developing more extensive knowledge networks through authentic situations, targeted research, and multiple opportunities for encoding information, is related to cognitive constructivist principles well-grounded in the work of theorists such as Anderson (2000). The key role of the learning group in PBL reflects social constructivist explanations for how individuals construct and transform knowledge and conceptual understanding through dialectical activity (Vygotsky, 1978; Hmelo & Evensen, 2000), and in particular that "discourse is the primary symbolic, mediational tool for cognitive development" (Palinscar, 1998 p. 361). Collaborative learning is valued, not only for the pragmatic value of supporting the development of team-work skills needed in professional practice (Maudsley & Strivens, 2000), but also in recognition of the view that learning is not an isolated, individual activity (Brookfield, 1987; Kelly & Green, 1998; Lave, 1988; Wenger, 1998).

The educational value of PBL is based broadly on the principle that for learning to be optimally effective it needs to be learner-centred. This cornerstone principle is then operationalised in a number of ways according to the educational literature:

1. **Small is best**. PBL classes are generally small tutorial groups. Based on the research of Bloom (1984) who provided evidence that one-to-one tutoring is the ideal teaching method, the PBL class structure of working in small groups is seen to most closely approximate Bloom's ideal.

2. **Active involvement**. It is now well accepted that the learner is not merely a passive observer but an active agent in the learning process "continuously involved in cognition about self and environment" (Winne & Butler, 1994, p. 5738). Active involvement encourages deep learning, the type of learning that is characterized by meaning making, connectedness of ideas, and by less emphasis on verbatim recall (Biggs, 1999; Entwistle, 1998).

3. **Teams and groups**. Activation of knowledge networks is said to facilitate the learning of new information and PBL is thought to stimulate the activation process with it is tutorial-group discussions (Colliver, 2000). PBL provides a carefully structured opportunity for students to work collaboratively and to develop their knowledge and understanding of teaching and learning processes.

4. **Self-directed learning**. PBL requires "students to teach themselves, in order to firmly establish life-long habits of self-directed learning…and the PBL approach seems to directly address this challenge" (Colliver, 2000, p. 265). According to Zimmerman and Lebeau (2000), definitions of
self-directed learning are similar to what has been termed self-regulated learning in the educational psychology literature. Self-direction involves "(a) identifying learning objectives, (b) pursuing learning issues, and (c) self-evaluating learning…(and these) processes correspond directly to the three major components of self-regulated learning: forethought, performance or volitional control, and self-reflection" (p.301).

5. Inquiry oriented. In order to make learning relevant and develop research skills, the ill-structured, 'real-world problems' that students are presented with in a PBL case provide "opportunities to make visible that the very struggles they face (as teachers) are not unlike those of scientists trying to create new knowledge" (Kelly & Green, 1998, p.177). Along with this, the process of negotiation within the group provides opportunities for students to develop cognitive skills and strategies associated with intellectual inquiry as they seek to overcome obstacles to understanding (Prawat & Floden, 1994, p. 40).

The learner-centred focus of PBL does not however diminish the role of the teacher in the teaching-learning process. Indeed Greening (1998) contended that the success of PBL in encouraging a 'deep' approach to learning, of fostering research skills through inquiry, and of making learning meaningful, depends in part, on how effectively the teacher scaffolds the development of skills required to learn in this way. Schmidt & Moust (2000) also emphasised the importance of the tutors’ subject matter knowledge, their ability to communicate empathetically with students and to create a climate for learning where students feel comfortable about openly exchanging ideas.

Comparing PBL and regular strand students' perceptions about learning

For most of the students in the PBL group in this study it was their first experience of learning in this way. Students indicated in post-course evaluations that this experience was very different from other university learning. The differences have been captured succinctly by one student who compared PBL to previous learning as "more group-based, more thinking, more initiative, more research, more independence and decision-making, less explanation, (and) less guidance". Other differences noted by students were that PBL was: "All very new and somewhat scary. Very interesting though. My brain doesn't stop ticking over in this class" and; "Totally different experience for me. I am used to 'empty vessel' mode of teaching/learning. I am still struggling with the concept!" (Teacher education students' mid-course evaluation comments). Other research
(Murray-Harvey & Slee, 2000) provided further evidence that our teacher education students view PBL positively. Their comments supported the general tenets of PBL as "a more challenging, motivating, and enjoyable way to learn" (Colliver, 2000, p. 259). Along with this advocacy, there is sufficient evidence from research on comparisons of PBL with traditional classes in medical education (Dochy, Segers, Van den Bossche, & Gijbels, 2003) to suggest that the ways that students think about their learning might be different as a result of experience in PBL classes. Stimulated both by supportive student evaluations, and encouraging research on PBL, we became interested in whether the ways that students who had been involved in PBL classes perceived their learning differed from those who had not yet experienced this form of class learning. So the purpose of the paper is threefold:

1. To report students’ ideas about what facilitates their learning within a framework that permits the classification of those ideas.
2. To describe ideas of students exposed to a highly student-directed (PBL) approach with those of students who experienced a more teacher-directed (regular) approach to learning.
3. To examine students’ ideas about the learning process with regard to their level of experience as beginning teachers.

Method

Our students were exposed to teaching approaches ranging from highly teacher-focused to highly student-focused (Prosser & Trigwell, 1999). The teacher education program includes core education studies that cover theoretical and conceptual issues, including psychological and social constructivist learning theories, child development and individual differences. It also includes curriculum studies that focus on methodology and application, and an extensive practical component. Some, but not all, students experience PBL in one of the compulsory education studies topics. The PBL approach follows the Maastricht 'seven jump' sequence for problem based learning (see Hmelo & Evensen, 2000).

Participants

The teacher education students from a South Australian university who provided the data for this study were a mix of mature age students and students aged in their early 20s, mostly female, and from predominantly English and European family backgrounds. This profile was representative
of the overall Bachelor of Education (B.Ed) student profile. Participation was voluntary. Data were collected from three groups of students. The Final Year group comprised 78 students enrolled in the final semester of their degree who undertook the research task in the final weeks of the four-semester professional education component of the B.Ed degree. Relative to the other groups, these students were considered to be competent beginning teachers who were reasonably well informed about the processes and practice of learning and teaching. The second and third groups, the PBL and Regular strand groups, were formed from 102 students in their first semester of the four-semester professional education component of the B.Ed degree. For undergraduate students this is the third year of their degree; for graduate-entry students this is the first year of their Bachelor of Education degree. Compared with the final year students who had undertaken at least 80 days of supervised teaching in schools, the third year students had minimal experience in schools (one 20 day placement) and had completed six weeks of education and curriculum studies. Thus, there were three clearly differentiated groups formed that are referred to in the remainder of the paper as: Final Year students (N = 78); PBL strand students (N = 87); and, Regular strand students (N = 15).

Students assigned themselves to tutorial groups before the start of classes based upon their timetable preferences. At that point they were able to choose whether or not they wanted to join a tutorial group that would include designing a web presentation of course content. Students were informed at their first lecture that, for students who were not in the web construction group, tutorials would be conducted using a PBL format. Students were given the option of changing their tutorial group if they did not want to participate in PBL. Three students assigned to a PBL class took this option. So, while the PBL groups were not altogether randomly assigned, neither were they entirely self-selected.

**Procedure**

This section describes the data collection process and the different types of analysis conducted: Cluster Analysis (CA), Multidimensional Scaling (MDS) and analysis of students' language about teaching and learning.

*Data collection*

**Final Year group.** Students were informed about the research and asked at the end of a regular class period to write a response to the question "What happens in my university class that helps
me to learn?" Two of the researchers categorized and reduced the students' responses to produce 40 representative statements that captured the essential nature and comprehensiveness of the students' responses within a manageable number of statements. Categorisations were done independently by two of the researchers and then compared. Differences were resolved by consensus. Care was taken to retain the wording and tone of the participants' responses. The 40 statements are listed in Table 2 as part of the Cluster Analysis output. Students were approached again, in their tutorial classes, to complete a statement-sorting task. Each student was given a set of the 40 statements and asked, first, to sort the 40 statements into groups of ideas that 'seemed to go together' and second, to rank the sorted groups in order of their helpfulness for learning. Students understood that they could sort their statements into as many or as few groups as they wished and that there was no 'right' or 'wrong' way of sorting or ranking.

At this time also, students were asked to volunteer for interviews about their responses. Twenty students volunteered and these students were assigned at random to two interview groups: 10 students were interviewed to probe their understanding about their nominations of what helped them to learn. The other 10 students were interviewed about how they would use their nominated procedures in their own teaching.

**PBL and Regular strand groups.** Students were informed, in their regular class setting about the purpose of the research and the procedures for gathering the data were explained. Students were told how the statements had been generated from a previous cohort of students (the *Final Year* group). The sorting and ranking tasks were administered in the same way for these groups as for the Final Year group.

**Cluster Analysis and Multidimensional scaling**

The card sorting and ranking tasks provided data that could be used for Multidimensional Scaling (MDS) and Cluster Analysis (CA), respectively. MDS was used to generate representations of the student sorting data in a low-dimensional space (Hair, Anderson, Tatham & Black, 1995) and to generate graphical representations, or perceptual maps, of the structure of respondents' perceptions. Cluster analysis enabled us to identify whether participants sorted and ranked statements into interpretable constructs or themes. CA also provides a reliability check and assists in interpretation of the MDS output (Hair et. al., 1995).
By creating a similarity matrix (40 x 40 variables) it was possible to record how many participants placed each statement with each other statement in the card sort task. The similarity matrices for the three groups were included in a combined matrix that was then subjected to non-metric MDS (INDSCAL) using the SPSS (1995) ALSCAL program. Statements that participants often sorted together into the same pile appear close together on the MDS chart; statements that participants placed together infrequently appear far apart. Thus, the output from MDS can be used as a way of understanding whether there is an underlying similarity of conceptual perspectives within the participant groups.

*Use of terminology*

The educational literature on teaching and learning, like other fields of study, comes with its own specific terminology to define terms and concepts related to teaching and learning issues and actions. For instance, while terms such as metacognition, self-regulation, pedagogy, and self-efficacy would rarely be found in people's 'everyday' language, educators would be expected to understand these terms. The use of professional language provides a common ground for communicating the concepts related to learning and teaching clearly and unambiguously. This technical language, sometimes less sympathetically referred to as academic 'jargon', can, at least for the purposes of assessing students' learning, indicate the extent to which students have become familiar with the educational literature. To do this, students' statements were examined for the degree to which they reflected the technical language commonly used in the academic literature specifically related to teaching and learning. A simple frequency count was made for the occurrence of six terms that regularly appeared in the literature on teaching and learning to which students had been exposed in their courses. They are: metacognition, learning strategy, constructivism, imagery, self-efficacy or attribution, and learning community. Differentiation was made between 'technical' and 'everyday' language (synonyms).

*Results*

*What facilitates learning*

The statements used to generate the MDS maps represent the range of ideas provided by the Final Year students on what helps them to learn. The statement groupings also reveal that students perceive separate roles and responsibilities of teachers, and of students, for facilitating learning.
Overall, the students' statements are consistent with the literature on facilitation of learning processes. Teachers are seen to support students' learning through their role in providing an environment conducive to learning (e.g., comfortable and inclusive work environment), through their effective interpersonal relationship skills (e.g., valuing students, being approachable) and amenable dispositions (e.g., passion, enthusiasm, humour), and through use of effective pedagogy that includes teaching strategies (e.g., understand the subject, clear explanations), responsibility for content of the curriculum (e.g., workload, choice, outcomes) and curriculum relevance (making connections, using real-life examples). Many of these features are similar to the qualities identified by Schmidt and Moust (2000) of effective facilitators for learning.

Students also identified their own contributions to learning. A wide range of statements showed that students perceived that their role included self-regulation (e.g., reflection, personal responsibility), employing strategies for active involvement (e.g., student-centred conversations, group presentations), dispositional attributes (e.g., interest, but not self-efficacy), transformational cognitions (e.g., critical reflection, synthesise), and interpersonal relationships (e.g., collaboration). All of these areas are well documented as important features of effective learning in the research literature and have been alluded to in the introductory section of this paper. Students offered very few statements to indicate that they saw themselves contributing to the areas of assessment and curriculum relevance. On the other hand, there were several statements indicative of the teacher's role in these areas. Particularly noteworthy is that very few statements indicated shared teacher-student roles. Students' statements did not, on the whole, make reference to ideas from the literature that documents the importance of developing a community of learners (Brown & Campione, 1996). The picture that emerges is that students appear to perceive a clear division of roles, between themselves and their teachers, for facilitating learning.

Content analysis of interviews

The availability of interviews with 10 of the final students allowed us to consider the extent to which their more detailed comments reflected use of technical vocabulary about learning, vocabulary that was used in course readings across the two years of their professional studies. In this analysis we chose the six sets of terms listed in the left column of Table 1 as indicators of the use of this technical vocabulary and also searched the interview transcripts for use of corresponding sets of more common terms also listed in Table 1. The set of technical terms was
chosen to cover affective, cognitive and social features of learning discussed in contemporary texts used by the students. The number of students using these technical terms and their common translations is shown in that table.

Table 1. Final year students use of technical vocabulary in interviews.

<table>
<thead>
<tr>
<th>Technical terms</th>
<th>Student use</th>
<th>Common terms</th>
<th>Use by other students</th>
<th>Total student use (n= 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metacognition, metacognitive, self-regulation, self-regulatory</td>
<td>1</td>
<td>Reflection, reflective, reflect, monitoring, control</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Learning strategy, learning process</td>
<td>4</td>
<td>Procedure, method, way</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Constructivism, constructivist</td>
<td>1</td>
<td>Active learning, connect, link, connection, network</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Image, imagery, mental image</td>
<td>3</td>
<td>Mental picture, picture, visualise, visualisation</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Self-efficacy, attribution</td>
<td>0</td>
<td>Confidence, cause, motivation</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Learning community, community of learners</td>
<td>0</td>
<td>Collaboration, collaborate, interact, interaction, exchange of ideas</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

In the interviews few of the students referred to the technical terms used in the texts and articles included in course readings. More of them did make use of the common terms that were chosen as translations of the technical vocabulary. For most students, the use of the common terms was not extensive. One student developed an extensive discussion of imagery and all 10 students developed ideas about a wide range of features of collaboration and interaction with other students, even though none made mention of the idea of a learning community. The technical vocabulary related to self-efficacy and attribution of cause associated with contemporary treatments of motivational knowledge (e.g., Winne, 1991) was absent from the student interviews even though all students made reference to causal factors that influenced their learning. The contrast in the use of the two sets of vocabulary related to motivation is of particular interest.
Although all students identified causes for learning outcomes they did not show evidence of use of any system that would allow them to generate analyses of cause that would give them ways to understand their own, or their students, patterns of causal attribution in more powerful ways. None referred to the productive analysis of attributional patterns derived from the work of Weiner (1979). There was also low frequency of use of terms associated with metacognition and imagery.

Cluster Analysis (CA)

Students' sorting and ranking responses were entered into a case (146) by statement (40) matrix and analysed using Ward's hierarchical clustering method with Squared Euclidean distance. Table 2 provides a summary of the clustering solution dendrogram, including the 40 statements. The labelled themes and sub-themes represent the clusters of statements formed from the analysis.

The Teacher Qualities cluster included groups of statements related to the personal qualities of the teacher such as 'passionate, enthusiastic and inspiring teachers' and to the teachers' professional knowledge and skills such as 'lecturers and tutors who understand the topic and can communicate the information'.

As indicated in Table 2, the cluster labelled Meaningful Tasks included statements about specific tasks that are given to students, for example 'writing assignments helps me to synthesise ideas and turn the concepts into my own', and the learner-centred nature of the tasks such as 'student-centred conversation based on issues that are generated by students'.

The Effective Pedagogy cluster included several minor groupings. Statements referred to how content is delivered, such as 'a reasonable workload', clarity of expectations and explanations, and helpfulness of resources and materials, for example 'having notes that I can add to during the lecture, otherwise I'm writing so much I don't take anything in'.

The Engagement in Learning cluster described personal considerations, experiential learning and connectedness of learning. Statements related to this cluster grouped ideas such as 'If I am interested in the topic I am much more likely to learn' (personal), 'doing hands-on activities has helped me to grasp important concepts in the subject' (experiential) and 'interconnected subjects where issues are highlighted from different viewpoints' (connectedness).
Finally, The four main clusters identified in the CA dendrogram were substantially similar to the statement groupings in the MDS solution which indicates consistency in our interpretation of the MDS data.

**Multi-Dimensional Scaling Analysis (MDS)**

We employed non-metric multi-dimensional scaling - INDSCAL to reduce the complexity contained in the sorting task data to a low-dimensional representation. The first task of the researchers in viewing the output of the MDS solution is to determine the most appropriate dimensionality. This decision is informed first by the statistical properties of the solution and secondly by the interpretability of each dimension (Everitt & Dunn, 1983). We determined that the 3-dimensional solution achieved an optimal balance between acceptable measures of fit (stress = 0.186, $R^2 = 0.724$), and interpretability of the dimensions. We interpreted the three dimensions as Intellectual Engagement, Structural Context, and Conceptual Frames. The poles of each dimension provide further information to indicate that two separate groups of variables contributed to understanding the continuum of each dimension. Labels on the MDS charts use abbreviations of the statements listed in Table 2. For clarity, we have prepared individual graphical displays of the three Dimensions presented as Figures 1, 2 and 3.

**Dimension 1: Intellectual Engagement**

Dimension 1 is presented in Figure 1 and depicts student statements that suggest that what helps students to learn is related to both their own, and to their teachers', involvement in the learning process. Thus, Dimension 1 represents a continuum where the locus of Intellectual Engagement is seen to be directed by the student at one end and facilitated by the teacher at the other end.

At the left-hand side of Figure 1 students' Intellectual Engagement is depicted through statements that indicate critical reflection, taking responsibility for one's own learning, synthesising ideas and learning from peers. These statements formed a cluster that we labelled *Engagement in Learning* in the CA dendrogram. The right-hand pole of Dimension 1, teacher's facilitation of Intellectual Engagement, is illustrated by statements that indicate both personal and professional qualities of teachers. Personal attributes such as treating students as valued individuals, being approachable and supportive and being passionate, inspiring and enthusiastic are included along
with professional qualities such as giving feedback, not assuming knowledge and understanding and communicating subject matter. The statements grouped at the Teacher facilitation pole of Dimension 1 matched the cluster labelled *Teacher Qualities* in the CA output.

**Dimension 2: Structural Context**

We labelled Dimension 2 Structural Context as displayed in Figure 2. Statements across this dimension also differentiate between student and teacher variables. This is illustrated at one end of the continuum by primarily collaborative structures that give weight to the student, and moves through to organizational structures at the other end that are directed by the teacher.

Student statements indicate that their learning is facilitated by structures that include a comfortable, inclusive work environment, opportunity to express ideas, and to participate in student-centred and directed conversations. The CA dendrogram displays these same statements that reflect student-centred activities as the cluster labelled *Meaningful Tasks*. Teachers are seen to support learning through structuring students' learning by providing lecture notes, summaries, and readings, connecting subject matter, and having a reasonable workload. In relation to the CA, statements reflecting the teacher end of Dimension 2 can be found within the cluster labelled *Effective Pedagogy*.

**Dimension 3: Conceptual Frames**

Figure 3 contains the graphical display of Dimension 3. The two poles of this dimension, interpreted as Conceptual Frames, depict movement from concrete to abstract conceptualisations of the learning process. At the Concrete end of the continuum, learning is seen to be facilitated by visual aids that demonstrate concepts, hands-on activities to support learning, real-life examples and practical experience. Students' statements at this pole were similar to those that grouped in the CA and labelled as Experiential Learning within the *Engagement in Learning* cluster. At the Abstract end of the continuum, statements indicated the importance of opportunities provided by assignments to conceptualise and synthesise ideas, to extend and develop ideas through collaboration, and for ideas and interpretations to be able to be given full expression in relation to the ideas of other people.
In addition to providing the low-dimensional solution, the INDSCAL analysis also provided information about the similarity between each group's (Final Year, PBL strand, and Regular strand, students) perceptions (the subject weights). Figure 4 displays the differences and similarities between the groups in relation to the three dimensions. The subject weights indicate that all three groups placed more importance on the Intellectual Engagement dimension than either the Structural Context or Conceptual Frames dimensions. However, the Final Year and PBL groups placed more importance on Intellectual Engagement than the Regular strand (Non-PBL) group. A further commonality between the Final Year and PBL groups was that they placed less importance on the Conceptual Frames dimension than the Non-PBL group. It is Dimension 1 that distinguishes most between the groups and shows a closer convergence between PBL and Final Year students.

Figure 4 here

Discussion

Our interest in undertaking this research was to explore our students' knowledge about learning and whether the ways that they structured that knowledge differed between groups who had experienced learning in different university class settings. There is much to be learnt from what students have told us about what helps them to learn in their university classes.

The analysis of final year students' responses to the prompt question indicated that, as a group, their knowledge about what facilitated their learning in university classes showed a high degree of overlap with discussions presented in the contemporary literature on learning and teaching. Although students did not frequently make nominations related to themes such as self-efficacy and shared student-teacher actions, their nominations did identify key features of their own actions as learners and the characteristics and actions of their teachers as being important for facilitating their learning. Noticeably, statements about what teachers contribute to learning generally did not overlap the statements about what students do. For example, there were no descriptions by students of teacher-student conversations, co-learning, etc. In other words, what appears to be missing from students' views is a sense of shared involvement in learning This could be interpreted as teachers being seen by students in terms of a traditional teacher-student relationship. The relative lack of concern for shared student-teacher actions raises a question about whether the notion of a learning community (Brown & Campione, 1996) is salient for these
students, or perhaps for us, their teachers. In offering this interpretation we are mindful that the statements used for the analyses were provided by the final year students who, in the main, had not experienced PBL. As PBL is now accessed by a larger number of students in the teacher education program, statements generated by these students about learning processes will provide valuable comparative data for further research. It is also the case that students were asked to perform a simple task in a restricted time frame and the nature of the research task may not have provided adequate opportunity for students to give carefully constructed responses.

MDS and Cluster Analysis were used to help create some order of the many variables that constitute students' perceptions of what facilitates learning. The results of the two different forms of analysis of the student sorting and ranking data were broadly consistent. The similarities between the grouping of statements in both the MDS and CA outputs provided a measure of confidence in our interpretations of the dimensions of students' perceptions. In addition the MDS output revealed similarities and differences in students' perceptions about what helps them to learn. We were able to interpret differences and similarities between the three groups of students in the study to help understand how their particular experiences of learning (PBL vs Non-PBL; experienced vs novice) shape their ideas about what facilitates learning. Each of these aspects of the research is addressed in the following discussion.

The MDS pointed to the pivotal role of the teacher. In two of the three MDS dimensions students clearly identified that teachers play an important part in helping them to learn. In terms of Intellectual Engagement, a cluster of teacher personal and professional qualities was identified that students regarded as facilitative - passionate, inspiring teachers who are approachable, supportive, and provide feedback: these teacher qualities all help students to engage intellectually. A teacher cluster was identified also on the Structural Context dimension, where teachers are seen to facilitate student learning in a structural way, such as ensuring a reasonable workload, providing lecture notes and summaries, and using simple terminology. The qualities of the teacher that students identify in their statements are consistent with the findings of Schmidt and Moust (2000), in that they refer to both personal qualities (e.g. approachability), establishing a supportive environment, and professional skills (understanding the subject and ability to communicate the knowledge simply and clearly). As Greening (1998) noted, while "PBL lays the responsibility and, ultimately, the control of the learning process essentially at the feet of the student…this is not a process of abandonment" (p.8).
Also related to the role of the teacher is Prawat and Floden's (1994) reference to the 'constructivist dilemma' - a real issue for those who want to move towards a more inquiry-based, discourse-oriented approach to learning and teaching. Achieving a balance between "honoring the student's own effort after meaning while steering the group toward some 'intellectually honest' construction of meaning… is one of the most vexing issues faced by social-constructivist teachers" (p.47). Teachers also need time to work collaboratively on curriculum development. For example, developing good PBL cases often requires consultation with experts (e.g. practitioners). And most importantly, for students to be able to engage deeply with 'problems' in ways that facilitate conceptual change, teachers need to be able to scaffold the development of the necessary inquiry skills and strategies. Learning the skills and strategies for effective inquiry, and teaching those skills and strategies, have not been central concerns of the teaching-learning process in traditional, didactic classroom settings. However, they are critical to effective inquiry-based approaches to teaching and learning. Therefore, tertiary educators have to know how to scaffold the development of self-regulatory skills of inquiry and reflection in their own students. Effective teaching at university will require a systematic program of professional development that provides educators with the requisite knowledge, skills, and understanding to facilitate students' learning.

The interview data has drawn our attention to the language students used to articulate their ideas about learning. These ideas were primarily expressed in 'everyday' language and did not reflect the terminology used in the academic literature (e.g. metacognition, self-regulation). It is a concern that students as beginning teachers may not have grasped what might be called the 'technical' language of teaching and learning. If our students have not yet started to engage in the academic discourse related to teaching and learning despite their exposure to this field of literature, we need to address this in terms of our teaching.

With regard to similarities and differences between the three groups, as the PBL group on all dimensions displayed closer alignment to the Final Year students, and less association with their non-PBL peers we concluded that the experience of PBL appears to have had an effect on students' perceptions about what helps them to learn that differs from those of other students in their cohort who were not involved in PBL. In particular, the PBL and Final Year students placed more importance on the dimension of Intellectual Engagement. One interpretation of the differences between groups in terms of Intellectual Engagement is that it is possible that the
experience of PBL has accelerated PBL students’ thinking about learning facilitation to the same level as more experienced teacher education students.

Most of the literature on PBL describes the process, the problems, and research findings, in relation to medical education with some reference to learning with PBL in other health-related fields, and engineering education. There has been very little published research on PBL in teacher education generally, and is particularly scant at the undergraduate level. The findings from the research reported in this paper provide support for including PBL as part of a student teacher's professional education.

References


What helps students to learn


feedback
skilled teachers
teachers don't assume
knowledge
supportive teachers
inspiring teachers
approachable teachers
teacher humour
clear expectations
get detailed information
clear explanations
reasonable workload
lecture notes
lecture summaries
simple terminology
writing synthesises ideas
visual aids
flexible assignments
engaging questions
journaling
interconnected subjects
connecting information
lecture summaries
relevant tasks
corresponding tasks
students give lessons
practicums
I'm responsible
I'm responsible
relevant discussions
writing synthesises ideas
visual aids
critical reflection
my interest
student conversations
express, compare ideas
student voice
real life examples
writing synthesises ideas
visual aids
flexible assignments
engaging questions
journaling
interconnected subjects
connecting information
lecture summaries
relevant tasks
corresponding tasks
students give lessons
practicums
I'm responsible
I'm responsible
relevant discussions
writing synthesises ideas
visual aids
critical reflection
my interest
student conversations
express, compare ideas
student voice
real life examples
dimension 1: intellectual engagement
Importance of Dimensions

The graph shows the importance of dimensions (Dim1, Dim2, Dim3) across different categories: Non PBL, PBL, and Final. The importance values range from 0 to 0.8 along the y-axis. The lines indicate how the importance changes across dimensions for each category.
Table 2. Cluster analysis themes and sub-themes of student statements about what helps them to learn.

<table>
<thead>
<tr>
<th>Clusters</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher Qualities</strong></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>Passionate, enthusiastic &amp; inspiring staff/teachers</td>
</tr>
<tr>
<td></td>
<td>Teachers that are approachable</td>
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<tr>
<td></td>
<td>Staff treating me as a valued individual</td>
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<tr>
<td></td>
<td>Support from lecturers in and outside of specific class times</td>
</tr>
<tr>
<td>Professional</td>
<td>When lecturers don't assume knowledge</td>
</tr>
<tr>
<td></td>
<td>Lecturers and tutors who understand the topic &amp; can communicate the info</td>
</tr>
<tr>
<td></td>
<td>Feedback from tutors</td>
</tr>
<tr>
<td></td>
<td>Comfortable &amp; inclusive work environment</td>
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<tr>
<td></td>
<td>When the lecturer includes humour in lectures/workshops etc.</td>
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<tr>
<td></td>
<td>Interesting/creative approaches to lecturing and tutorials (making them fun)</td>
</tr>
<tr>
<td><strong>Meaningful Tasks</strong></td>
<td></td>
</tr>
<tr>
<td>Relevant</td>
<td>Writing assignments helps me to synthesise ideas and turn the concepts into my own</td>
</tr>
<tr>
<td></td>
<td>Journalling has been another important part of helping me to learn - journalling about readings - journalling about teaching practice</td>
</tr>
<tr>
<td></td>
<td>Specific tasks to be completed before a tute etc., that are relevant to that week's work</td>
</tr>
<tr>
<td></td>
<td>Provided readings &amp; discussions about them to clarify concepts</td>
</tr>
<tr>
<td></td>
<td>Focus on collaboration, eg. group research tasks, group presentations - the ideas of other students have played a huge role in extending and developing my own ideas</td>
</tr>
<tr>
<td></td>
<td>Other students giving demonstration lessons</td>
</tr>
<tr>
<td><strong>Learner-centred</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>My ideas &amp; interpretations are allowed to be expressed fully while being placed against ideas &amp; interpretations of researchers, lecturers &amp; fellow students</td>
</tr>
<tr>
<td></td>
<td>Student-centred conversation based on issues that are generated by students</td>
</tr>
<tr>
<td></td>
<td>Authentic assessment or projects that allow hands-on activities and assignments</td>
</tr>
<tr>
<td></td>
<td>Including student voice/ideas in assessment, teaching practice, structure etc</td>
</tr>
</tbody>
</table>

*table continued*
<table>
<thead>
<tr>
<th>Clusters</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effective Pedagogy</strong></td>
<td><strong>Content delivery</strong></td>
</tr>
<tr>
<td></td>
<td>Essays/assignments that are flexible, that allow the choice of content to what is relevant/of interest to you</td>
</tr>
<tr>
<td></td>
<td>A reasonable workload (if there is too much to do and too little time I cannot engage effectively with the learning)</td>
</tr>
<tr>
<td></td>
<td>Clear explanations and well articulated lecture presentations</td>
</tr>
<tr>
<td></td>
<td>When content is presented through simple terminology</td>
</tr>
<tr>
<td></td>
<td>Clear expectations, outcomes - What am I MEANT to be learning?</td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td>Detailed information given by the lecturer - this includes oral and written information</td>
</tr>
<tr>
<td></td>
<td>Summaries of lectures/tutorial were helpful</td>
</tr>
<tr>
<td></td>
<td>Having notes that I can add to during the lecture, otherwise I'm writing so much I don't take anything in</td>
</tr>
<tr>
<td></td>
<td>When topics in workshops correspond well with the materials in lectures and the work we have to hand in</td>
</tr>
<tr>
<td><strong>Engagement in Learning</strong></td>
<td><strong>Student attributes</strong></td>
</tr>
<tr>
<td></td>
<td>If I am interested in the topic I am much more likely to learn</td>
</tr>
<tr>
<td></td>
<td>I learn most when what is being discussed is relevant and comparable to my own life or situation</td>
</tr>
<tr>
<td></td>
<td>I have learnt to critically reflect on certain things, including my teaching practice</td>
</tr>
<tr>
<td></td>
<td>I know that I am responsible for my own actions. Any learning I do is of my own accord &amp; therefore I &quot;own&quot; my learning</td>
</tr>
<tr>
<td><strong>Experiential learning</strong></td>
<td>Doing hands-on activities has helped me to grasp important concepts in the subject</td>
</tr>
<tr>
<td></td>
<td>Using real-life examples to illustrate points</td>
</tr>
<tr>
<td></td>
<td>Experience helps me learn-the practicum were most valuable as they built practical learning skills</td>
</tr>
<tr>
<td><strong>Connectedness</strong></td>
<td>Visual aids that demonstrate concepts</td>
</tr>
<tr>
<td></td>
<td>Making connections, reinforcing information, bringing it all together</td>
</tr>
<tr>
<td></td>
<td>Interconnected subjects where issues are highlighted from different viewpoints</td>
</tr>
<tr>
<td></td>
<td>Being engaged through questions</td>
</tr>
</tbody>
</table>
Figure 1. Perceptual map for dimension 1 of the multidimensional scaling analysis: Intellectual engagement.

Figure 2. Perceptual map for dimension 2 of the multidimensional scaling analysis: Structural context.

Figure 3. Perceptual map for dimension 3 of the multidimensional scaling analysis: Conceptual frames.

Figure 4. The importance of each multidimensional scaling analysis dimension to the PBL, non-PBL and Final Year student groups.