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Enhancing Learners' Generic Skills through Problem-Based Learning

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Claims made for the value of PBL as an effective method for professional education programs draw on constructivist principles of teaching and learning to achieve essential content knowledge, higher order thinking skills and a team approach to problem-solving through the interdisciplinary, student-directed study of relevant professional problems.

These essential outcomes of PBL (knowledge, higher order thinking, problem solving, and effective team skills) are also regarded more generally across higher education as desirable qualities of graduates. The evidence that these qualities are in fact, fostered through PBL is growing but the broader implications (such as the wider impact or more far-reaching effects) of the PBL approach have yet to be examined.

This paper addresses the relationship between PBL and graduate qualities in two ways. First, it reports on a study of teacher education students' assessment of their learning through PBL over time, across four areas of skill development: knowledge building; group processes; problem solving; and, interpersonal effectiveness. Second, the paper examines these specific outcomes in terms of the more broadly defined qualities expected of Australian university graduates.

Keywords: problem-based learning; teacher education; graduate qualities

Background

Advocates of problem-based learning (PBL) claim a range of advantages related to this methodology of teaching and learning. Among them are that PBL promotes a deep rather than surface approach to learning (Biggs, 1999); encourages higher order thinking; fosters self-direction in learning; creates more stimulating learning environments; increases collaborative interaction between students and teachers; improves motivation; and increases knowledge retention (Spencer & Jordan, 1999). There is widespread acceptance and recognition that PBL is a rewarding way to teach and a satisfying way to learn and it is likely that in the Australian higher education context, PBL has been explored in most professional education programs.

The research to date however, has been directed largely towards substantiating claims that relate to improved student learning outcomes with regard to content knowledge in the field of study, for example in medicine and other health-related professions, engineering, architecture, and more recently in teacher education.

While the findings are not unequivocally supportive of PBL compared with more traditional methods for improved knowledge performance (Colliver, 2000), the research on which these findings are based has tended to define student achievement narrowly in terms of knowledge acquisition assessed through test scores (Newman, De Virgilio, Engel, Gijbels, McKendree, Roberts, Rolfe, Smucny, & Van den Bossche, 2003). Many of the less easily measured skills, qualities or attributes that PBL purports to foster,

namely the development of team-work skills, problem-solving capability, and communication effectiveness, are generally not examined in the research literature. Nevertheless, these generic skills or qualities are regarded as desirable outcomes of studying at university.

In this paper, we have taken account of the literature on graduate qualities and explored the extent to which the PBL tutorial process can address some of the generic skills expected of graduates.

Generic Graduate Attributes and Skills

Many terms, such as graduate attributes, graduate qualities and key competencies, are used to describe the concept that we refer to in this paper as generic skills. Where we make reference to a particular instance of the concept, we use the local term, for example graduate attributes.

Generic Skills and Education

In Australia, the Mayer Committee report (1992) represented a significant focus on generic skills. Although the university sector was represented on the Mayer Committee, and one of its reference groups was asked to examine the relationship between assessment and reporting of key competencies and higher education selection processes, its recommendations were directed most specifically at the schools and vocational education and training sectors. Implementation of the key competencies was trialed in these two sectors in the mid 1990s, but a combination of concern about teacher workload and unrelated industrial action stalled the initiative in the schools sector. (See discussion of key competencies implementation in various chapters in Lokan, 1997). Extensive change, relating to the introduction of training packages and market reforms, in the vocational education and training sector seems to have impeded implementation in that sector. Since the mid 1990s, many universities have developed distinctive models of graduate attributes. In a 2002 unpublished survey, conducted by one of the authors, of Australian universities, more than half had developed statements of expected graduate outcomes (eg Milne, 2000; University of South Australia, 2000).

Recently, initiatives by the three major national employer organisations have rekindled interest in enhancing the generic skills of the future workforce (Allen Consulting Group, 1999; Australian Chamber of Commerce and Industry & Business Council of Australia, 2002). The employability skills framework includes eight skill groups, each with an extensive list of skill elements.

Higher education and business leaders jointly have sought to promote the development of generic skills. Case studies of good practice in the higher education sector have been reported (Business/Higher Education Round Table, 2003) and in a report from a B-HERT working party, Hager, Holland and Beckett (2002) argued:

> A common theme for teaching and learning of generic skills is that success depends crucially on them being made explicit for students. Leaving them implicit, as they are in many traditional courses, does little to encourage learning and development. (p.6)

Generic Skills, Graduate Standards and Professionalism

While the present study has been situated within a teacher education program, it is worth noting work on graduate generic skills that has been taken in other professional education courses. Following a review of engineering education in Australian universities in 1996, the profession identified the need for fundamental change in educational practices.

> The Review of Engineering Education is recommending no less that a culture change in engineering education which must be more outward looking with the capability to produce

> graduates to lead the engineering profession in its involvement with the great social, economic, environmental and cultural challenges of our time. (Institution of Engineers Australia, 1996a, p.2)

The report went on to list both technical outcomes of engineering education and various generic attributes expected of graduates. These included elaborated descriptions of communication, problem-solving, and team work skills. In a profession that has some say over course approval, the report recommended:

> 3.3 That the accreditation of Bachelor of Engineering courses is based on demonstrated development of graduates with these attributes. (Institution of Engineers Australia, 1996b, p.30)

In 2001 the Australian College of Educators proposed a framework for the development of teacher professional standards. The framework is intended to:

> be the basis upon which issues requiring further investigation regarding generic, subject/curriculum specific, or developmental level standards could be developed;

This framework did not enunciate generic skills for beginning or experienced teachers. However, more recently, the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA Teacher Quality and Educational Leadership Taskforce, 2003) specified a number of qualities desired in graduate teachers. Among these, reference was made to outstanding interpersonal and leadership skills, critical analysis and problem solving skills, and effective communication skills (MCEETYA, 2003, p. 10). Hopefully, when richer descriptions do emerge, they will be informed by the extensive debate that has occurred around generic skills in the community in general and within other professional groups.

The purposes and definitions of graduate attributes remain contested issues in higher education. However, there appears to be sufficient agreement on some elements of a framework of graduate attributes to justify efforts to research the implementation of graduate attributes within undergraduate professional courses. Among the many generic skills schemes that have been promoted in Australia and elsewhere, three generic skills that are prominent are communication skills, teamwork or interpersonal skills, and problem solving skills (for example, Conference Board of Canada, 2000; Rychen & Salganik, 2001; SCANS, 1991).

Problem-Based Learning

Hmelo and Evensen (2000) pointed out that current workplace practices require professionals who have, as well as a strong knowledge base, knowledge about how to keep up-to-date, are able to apply it to solve problems, and can function as part of a team. Essentially, these are the qualities that the Higher Education Committee (1992) and Clanchy and Ballard (1995) proposed as appropriate outcomes of higher education. These generic skills or skill categories of thinking, research, and communication are consistent with the broadly based expectations of teacher education programs to prepare educators who are knowledge seekers, problem solvers and able to collaborate as team members, and problem-based learning appears to provide an ideal structure for developing these skills.

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:

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 characterised by meaning making, connectedness of ideas, and by less emphasis on verbatim recall (Biggs, 1999; Entwistle, 1998).

Teams and groups. 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.

Activation of knowledge networks is said to facilitate the learning of new information and PBL is thought to stimulate the activation process with its tutorial-group discussions (Colliver, 2000). Lawson, Askell-Williams and Murray-Harvey (2002) found that ‘class discussion’ was the most frequently cited (by students) feature of university classes that facilitated learning. PBL provides a carefully structured opportunity for students to work collaboratively and through the collaborative process to develop their knowledge and understanding. There is evidence also, that less active participants benefit as much as active members of the group (Hmelo & Evensen, 2000).

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).

Inquiry oriented. In order to make learning relevant and to 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 professionals) 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).

In summary, there appears to be a close connection between the opportunities provided by PBL for developing communication (team work and interpersonal), research (problem solving and self-directed learning) and cognitive (critical thinking and intellectual

inquiry) skills, and the expressed need espoused in the literature on generic skills, for graduates to attain these skills.

In order to explore this connection more fully, this paper draws on data provided by one cohort of teacher education students who, as part of their involvement in PBL, were required to self-assess their tutorial performance twice during a one semester teaching period across four areas of learning: problem solving and learning skills; communication skills; knowledge building; and, personal and interpersonal development.

Teaching context

The Students

The 270 students in this study were enrolled in a compulsory topic "Development, Learning and Teaching" as part of their teacher education degree at a South Australian university. For undergraduate students this topic is studied in the third year, and for graduate-entry students the topic is studied in the first year, of their Bachelor of Education degree. 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. Less than 10% of the students took this option. So, while the PBL groups were not altogether randomly assigned, neither were they entirely self-selected. In all, 219 students were involved with PBL. Of this number, a complete data set was available for 145 students, 31 males and 114 females.

The Case Studies

Students enrolled in the Primary/Junior Primary teacher education degree studied two cases, "Emma" followed by "Alex", while the Middle School and Secondary teacher education students studied "Harvey High" and then "Sunnyvale Secondary".

The cases were developed from the 'ground up' adopting the University's School of Medicine model which is based on the widely used 7-step procedure for PBL cases on which students work in a small group tutorial setting with a tutor/facilitator (Schmidt, 1983).

The cases were developed over the course of two training workshops where an experienced PBL case writer worked with the PBL team of classroom teachers and university tutors. The workshops were designed to conceptualise the problem, structure the content, and manage the procedural tasks. The practising, experienced, classroom teachers were recruited to the case-writing team to ensure authenticity of the problems. Some also had worked with our students and understood the particular needs of the program that were:

- to ensure students would cover the content of the topic;
- to ensure the cases represented teacher problems not student deficits; and
- to ensure authenticity – real problems for real teachers in real classrooms.

The primary focus of the subject 'Development Learning and Teaching' (DLT) is on developmental psychology across the child and adolescent years but also includes a range of objectives that explicitly address preparatory work related to current knowledge about 'good' teaching; teachers' work; strategies for building relationships with students, parents and colleagues; and, establishing a positive climate for learning. Students were also provided with information about the principles underlying the PBL

tutorial process, namely working as a collaborative member of a team; engaging in self-directed learning; and, developing research and presentation skills.

The DLT program for all students consisted of three contact hours each week for nine weeks: six weeks of classes were followed by a 4-week practicum after which students returned to University for a further three weeks of classes.

PBL students worked on their first case over four weeks, completing the case in Week 4 with an informal, ungraded team presentation of the solutions to the problem and a self-assessment of their tutorial performance. Students began the second case in Week 5. This second case involved two weeks of classes preceding the practicum, practicum-related tasks, one class following the practicum, two weeks of non-class time (to prepare for their mini-conference presentation) and finally the presentation where each group's solution to the 'problem' was presented to an audience of their PBL peers and interested staff who provided written feedback to the presenting groups. Groups took this feedback into account in evaluating their presentation. After the mini-conference, students met with their tutor as part of the assessment process that included discussion of the group's self-assessment of the content and process of their presentation. At this time students submitted their individual self-assessment of tutorial performance questionnaire. This questionnaire was identical to the form students had completed after the first case study where they were asked to rate their competency across four areas: problem-solving and learning skills, communication skills, knowledge building, and personal and interpersonal development.

Data Collection and Analysis

At the completion of each of the two cases that they studied, students were asked to complete a self-rating of tutorial performance questionnaire (See Appendix A). This form was adapted from the self-assessment of tutorial performance questionnaire used by the University's School of Medicine to include competency ratings. A period of 12 weeks separated the two tutorial performance assessments.

The self-rating instrument had 24 items in four sections, namely problem solving skills, communication skills, knowledge building, and personal and interpersonal development. These sections had, respectively, five, eight, five, and six items. Each item offered students four response options: 'highly competent', 'competent', 'becoming competent', and 'not competent' that were scored 4, 3, 2 and 1 respectively.

Two forms of analysis were undertaken. First, following a check of data integrity, a series of exploratory factor analyses were undertaken in order to examine the structure of the instrument. It is believed that the four constructs represented in the instrument are discrete but related and that this structure should lead to the identification of four factors. Second, each of the sub-scales, corresponding to the four constructs, was examined using scale reliability analysis. In addition, because of the postulated relationship among the constructs, the overall 24-item scale was also subject to scale reliability analysis.

Results

Of the 219 students enrolled in the course, data for the two PBL case studies were available for 145 students.

In the analyses presented below, problem solving items are prefixed with PS, communication skills items with CS, knowledge building items with KB, and personal and interpersonal development items with PD.

Factor Analyses

In an initial principal components analysis, one strong factor was apparent, with up to four other factors being identified. Inspection of the factor loadings suggested that this solution would not be interpretable, and a four-factor solution was tested. This showed consistent loadings of the communication, knowledge building, and personal development items onto three factors, but and inconsistent pattern of loadings of the problem solving items. Consequently, a three-factor solution was tested. In this, the problem solving items loaded onto the same factor as knowledge building. This is consistent with situated cognition theories in which it is argued that effective problem solving is related to the complexity of individuals' knowledge bases, and can also be understood from the information processing perspective which holds that effective problem solving processes lead to the development of a robust knowledge base. On the grounds of parsimony and interpretability of the solution, the three-factor model is preferred and is shown in Table 1.

Table 1: Three factor loading matrix of items from the first PBL case

	Factor 1	Factor 2	Factor 3
PS01A		0.4291	
PS02A	0.4131	0.3692	
PS03A		0.6460	
PS04A		0.4757	
PS05A		0.5706	
CS06A	0.6144		
CS07A	0.8685		
CS08A	0.6690		
CS09A	0.7297		
CS10A	0.8682		
CS11A	0.6363		
CS12A	0.3644		
CS13A	0.5262		0.3859
KB14A		0.7037	
KB15A		0.6865	
KB16A		0.7465	
KB17A		0.8241	
KB18A		0.7311	
PD19A			0.3316
PD20A			0.7535
PD21A			0.6530
PD22A			0.8024
PD23A	0.6156		
PD24A			0.4417

Factor loadings < 0.3 are not shown in the table. R^2 = 0.513

Item 13, a communication skills item, also has a moderate loading onto Factor 3, which includes all but one of the personal development items. This is not surprising as item 13 deals with group communication skills. The personal development item 23 also has a substantial loading onto the communication skills factor, and again this is not surprising as competence in "participating regularly and cooperatively with others…" requires well developed communication abilities. In summary, the pattern of factor loadings supports the intended structure of the self-rating instrument.

Scale Reliabilities

In order to support the summing of respondents' scores over the items that formed each of the four sub-scales of the self-rating instrument, scale reliability analyses were performed on each sub-scale and on the overall scale for both the first and second case

studies. The overall 24-item scale Cronbach alpha remained stable over time at 0.93. Despite the small number of items in each of the sub-scales, the Cronbach alpha values are substantial (knowledge building for case 1 = 0.83 and case 2 = 0.86; communication skills for case 1 = 0.87 and case 2 = 0.84; problem-solving for case 1 = 0.78 and for case 2= 0.82; personal development for case 1 0.81 and for case 2= 0.80) suggesting that students have shown consistent response patterns to the items that form each of the scales. This supports the use of sub-scale scores formed by summing students' responses to the items that constitute each sub-scale for use in subsequent analyses.

Comparison of Self-rating Scores between First and Second Case Studies

In order to ascertain whether there had been growth in students' self-ratings of competence on each of the constructs of interest (problem solving, communication skills, knowledge building, and personal and interpersonal development), differences between the first and second sub-scale scores were computed and then paired sample *t*-tests were conducted on each of the sub-scale scores across the two occasions. The results of these analyses for all students are shown in Table 2.

Table 2: Comparison of students' self ratings on the first and second PBL cases

Scale	N cases	Mean Case 1 score (st dev)	Mean Case 2 score (st dev)	*t* value of difference	p
Problem-solving	151	15.15 (2.26)	16.91 (2.12)	9.12	.000
Communication skills	143	25.17 (3.85)	28.05 (3.01)	9.74	.000
Knowledge building	151	14.81 (2.39)	17.25 (2.17)	11.72	.000
Personal development	153	19.06 (2.72)	20.88 (2.45)	8.14	.000

The analyses of the changes in students' self-ratings indicate that on all sub-scales, students reported that they had substantially improved their performances between the first and second case studies encountered.

Influences of Gender and Course Type on Changes in Self-rating

In addition to examining change between the first and second PBL cases that students had studied, differences that might be attributable to gender, course type (primary or secondary teacher education), or an interaction between them, were of interest. In order to explore these factors, a series of analyses of variance on each of the sub-scales was undertaken. For each sub-scale, mean change scores are tabulated by primary and secondary course students, by gender, and overall. Each summary table is followed by a corresponding table showing the results of the analysis of variance.

Table 3: Change in problem-solving self rating by course type and gender

	Mean change score (number of cases)		
	Primary	Secondary	Prim & Sec
Male	2.00 (5)	1.58 (26)	1.65 (31)
Female	2.34 (58)	1.21 (56)	1.78 (114)
M & F	2.31 (63)	1.33 (82)	1.76 (145)

Table 4: Analysis of variance of problem-solving self-rating change

Source	Sums of squares	Df	Mean square	F	Sig
Gender	1.053	1	1.053	0.187	.666
Course type	35.335	1	35.335	6.284	.013
Gender x Course type	1.830	1	1.830	0.325	.596
Explained	37.674	3	12.558	2.223	.087
Residual	792.878	141	5.623		
Total	830.552	144	5.768		

For problem solving, the analysis of variance does not support a contention that there is a difference between the change scores of male and female students. There is an effect of course type, and inspection of the mean values shows that primary course students showed a greater change than their secondary counterparts.

Table 5: Change in communication skills self-rating by gender and course type

	Mean change score (number of cases)		
	Primary	**Secondary**	**Prim & Sec**
Male	2.50 (4)	3.36 (28)	3.25 (32)
Female	3.16 (49)	1.56 (52)	2.34 (101)
M & F	3.11 (53)	2.19 (80)	2.56 (133)

Table 6: Analysis of variance of communication skills self-rating change

Source	Sums of squares	Df	Mean square	F	Sig
Gender	41.918	1	41.918	3.291	.050
Course type	48.964	1	48.964	4.581	.034
Gender x Course type	18.641	1	18.641	1.744	.189
Explained	87.878	3	29.293	2.740	.046
Residual	1378.949	129			
Total	1466.827	132			

For communication skills, the analysis of variance indicates that there are main effects for both gender and course type, with male students indicating a greater improvement in communicative competence and primary students showing a greater gain than their secondary peers.

Table 7: Change in knowledge building self-rating by gender and course type

	Mean change score (number of cases)		
	Primary	**Secondary**	**Prim & Sec**
Male	2.60 (5)	1.88 (26)	2.00 (31)
Female	3.22 (59)	1.93 (55)	2.60 (114)
M & F	3.17 (64)	1.91 (81)	2.47 (145)

Table 8: Analysis of variance of knowledge building self rating change

Source	Sums of squares	Df	Mean square	F	Sig
Gender	0.586	1	0.586	0.092	.763
Course type	48.520	1	48.520	7.587	.007
Gender x Course type	1.220	1	1.220	0.191	.663
Explained	58.412	3	19.471	3.045	.031
Residual	901.699	141	6.395		
Total	960.110	144	6.667		

In the case of knowledge building, there is no gender influence on change scores, but there is a strong course type effect, again with primary course students indicating greater gains than secondary course students.

Table 9: Change in personal development self-rating by gender and course type

	Mean change score (number of cases)		
	Primary	Secondary	Prim & Sec
Male	3.00 (5)	1.52 (27)	1.75 (32)
Female	2.21 (58)	1.46 (56)	1.84 (114)
M & F	2.27 (63)	1.48 (83)	1.82 (146)

Table 10: Analysis of variance of personal development self-rating change

Source	Sums of squares	Df	Mean square	F	Sig
Gender	0.943	1	0.943	0.132	.717
Course type	2.965	1	2.965	3.215	.075
Gender x Course type	2.006	1	2.006	0.281	.597
Explained	25.183	3	8.394	1.175	.321
Residual	1014.187	142	7.142		
Total	1039.370	145	7.168		

For personal and interpersonal development, there is no apparent gender effect and perhaps a marginal course type effect.

Overall, primary students have indicated greater gains than secondary course students on problem solving, communications skills, and knowledge building, with a marginally greater improvement on personal and interpersonal development. Male students indicate a greater improvement on communication skills than do females, but on the other sub-scales there is no effect attributable to gender. Inspection of mean self-rating values on communication skills revealed that male students began from a lower base but achieved similar final self-ratings to those reported by female students.

Discussion

The criterion variables are students' self-appraisals of their standing on each of four generic skills, namely problem solving, communication, personal and interpersonal development and knowledge building. It should be noted that students were not asked to rate their improvement, but rather were asked to rate their standing on these criterion measures on completion of two case studies some 12 weeks apart. Anderson (1997, p.893) identified social desirability and acquiescence as key threats to valid and reliable

measurement of self-report data. However, there is a substantial body of literature that shows consistent and moderate correlations between self-appraisals and the ratings of others, including clinicians, teachers and parents, in a variety of domains including personality assessment (Domken, Scott & Kelly, 1994), gambling behaviour (Hodgins, & Makarchuk, 2003), social phobias (Newman et al, 2003), and verbal reasoning and mathematics ability (Wilson & Wright, 1993).

Individual differences in students' self-efficacies for each of the generic skills may influence the results of this study (Martin & Debus, 1998). Achievement motivation and self-efficacy interact to influence both self-appraisal and achievement. These effects are likely to result in bias in individuals' self-appraisals. Statistically, such within-student factors are likely to suppress intra-individual variance on these measures between occasions but inflate inter-individual variance on each assessment occasion, and therefore to lead to an underestimation of the significance of change scores.

The high internal consistencies of the scales that were used in this study (Cronbach alpha values around 0.8), and the literature that reveals consistent moderate correlations between self appraisals and the ratings of others lend support to the use of self-rating scales for the evaluation of changes in individuals' generic abilities over time. The likelihood that the significance of change scores has been underestimated suggests that our findings of improvement in generic skills achievement are conservative.

Implications of the findings

While opportunities for discussion in groups are seen by students as helpful for their learning, they are often less enthusiastic about group work-related assessments. We are convinced that when the value of collaborative teamwork skills is made explicit and learning of these is scaffolded through structured tutoring, group work is received more positively by students. Many of the issues around group grading do not surface in the PBL context because the structure fosters real collaboration and joint responsibility. The importance of tutor involvement in addressing skills required for effective group work cannot be over-emphasized. Along with this, students' self-reflection on their individual contribution to the group seems to effectively make students aware of the process of developing team-work skills. This study has highlighted for us the value of the tutorial self-assessment task for drawing attention to specific skills. We are encouraged by this to further develop the self-evaluative component of the program.

The best way we have found to encourage students to grapple with theoretical issues is by connecting those issues to authentic cases/contexts. This has been achieved primarily by drawing on the expertise of practising teachers to develop the cases. While it is not easy to measure improvement in problem-solving, the results of this study give us confidence that PBL offers more than a method for motivating and engaging students with subject-matter. Students do indeed develop problem-solving skills through the PBL process. Likewise, the improved communication skills reported by students indicate that PBL provides a learning environment in which both specific and general graduate qualities can be fostered.

Summary and Conclusion

PBL has been one component of a core developmental psychology course in the undergraduate teacher education program at our university for four years. Previously, evaluations of PBL have focused on students' overall perceptions of the PBL experience and on assessing student learning outcomes (Murray-Harvey & Slee, 2000). More recently, attention has been given to ways of evaluating student learning through the tutorial process itself (Cattley, 2003).

Over the two PBL case studies undertaken by students in a one semester teacher education course, self-ratings by the students have revealed substantial gains in self-rated competence on four important generic skills, namely problem solving, communication skills, discipline knowledge building, and personal and interpersonal development.

Three points are worth noting here. The first is that the PBL tutorial process affords students the opportunity to develop collaborative team-work skills through deep engagement in researching authentic school and classroom issues. It is not coincidental that PBL provides students with meaningful and professionally relevant experiences. PBL explicitly addresses, in addition to acquiring subject matter knowledge, the need to develop competence in problem solving, team-work, and communication skills through the tutorial structure and process. The second point, related to this, is that these same skills are regarded generally as desirable qualities of graduates. That they are embedded within a PBL framework imbues them with meaning and relevance for students. Finally, analysis of the tutorial self-assessment form showed that this is a sound evaluation instrument.

The improvement in students' perceptions of their competence may be attributed to several factors that have operated over the semester of this investigation. Some of those factors may lie outside the university experience, some may reside in their experiences in other courses, and some in other aspects of the course under investigation. However it seems reasonable to argue, on the basis of the focus on PBL in this course and on the gains in learning outcomes reported elsewhere, that the PBL method employed in this course and the deliberate and specific focus on generic abilities are significant factors in explaining the improvement in self-reported competence in the four graduate attributes that were the focus of this investigation.

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Appendix: School of Education EDES 3406

Assessment of Student's Problem Based Learning Performance

Student Name: .....

Please complete the following survey by assessing your current level of competence developed through your participation in the small group that you have worked in on this PBL case.

PROBLEM SOLVING AND LEARNING SKILLS

1. Complete this section first by ticking the relevant box

Rank order of competence	**I am able to:**	Highly Competent	Competent	Becoming Competent	Not competent
	define realistic learning goals				
	evaluate hypotheses in light of available evidence				
	generate relevant hypotheses to explain problem under discussion				
	identify key problems and issues				
	prioritise and rank hypotheses appropriately				

2. Now rank each statement of competence from 1 to 5 in the left hand column, with 1 representing your highest level of competence through to 5 the lowest level you think you have developed through PBL.

Comments:

COMMUNICATION SKILLS

1. Complete this section first by ticking the relevant box

Rank order of competence	**I am able to:**	Highly Competent	Competent	Becoming Competent	Not competent
	contribute resources and relevant knowledge to group discussion				
	demonstrate presentation skills				
	use visual aids effectively				
	give clear explanations.				
	use communication skills effectively				
	encourage participation by group members				
	listen attentively and critically, e.g. follow up, expands, clarifies and checks understanding				
	interact with others confidently and appropriately, e.g. maintain eye contact, display cultural sensitivity				

2. Now rank each statement of competence from 1 to 8 in the left hand column, with 1 representing your highest level of competence through to 8 the lowest level you think you have developed through PBL

Comments:

KNOWLEDGE BUILDING

1. Complete this section first by ticking the relevant box

Rank order of competence	**I am able to:**	Highly Competent	Competent	Becoming Competent	Not competent
	consider the social, emotional, intellectual/learning, and physical aspects of school students' lives that impact on their optimal development as they relate to the learning objectives of the case				
	locate, critically appraise, interpret and apply information to problems				
	understand and apply new material in the analysis of this case				
	demonstrate knowledge of students' developmental needs relevant to the case				
	demonstrate understanding of relevant concepts and principles				

2. Now rank each statement of competence from 1 to 5 in the left hand column, with 1 representing your highest level of competence through to 5 the lowest level you think you have developed through PBL

Comments:

PERSONAL AND INTERPERSONAL DEVELOPMENT

1. Complete this section first by ticking the relevant box

Rank order of competence	**I am able to:**	Highly Competent	Competent	Becoming Competent	Not competent
	respond to needs of the group				
	identify my own strengths and limitations				
	identify ways of improving individual and group performance				
	modify my behaviour in response to feedback				
	participate regularly and cooperatively in a variety of roles and tasks				
	provide constructive feedback to others				

2 Now rank each statement of competence from 1 to 6 in the left hand column, with 1 representing your highest level of competence through to 6 the lowest level you think you have developed through PBL.

Comments:

Overall Reflection

Date: Name of Tutor:

(adapted from the Flinders UniversitySchool of Medicine tutorial assessment form)