

Developing Student Induction Sessions for Problem Based Learning

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Abstract

Problem Based Learning (PBL) is a student-centred learning and teaching strategy. The use of PBL is well understood and there is evidence that PBL facilitates students' skill development. Successful participation in PBL requires that students have acquired a number of prerequisite skills. This paper reports on the development and evaluation of PBL induction sessions for students. We describe the rationale and structure of these inductions. Evaluation feedback suggests that students feel the induction improves their skills. The more than 100 learning exercises developed for these induction sessions are available online.

Keywords

Problem Based Learning, induction, evaluation

1. Problem Based Learning in Computing

Problem Based Learning (PBL) is a student-centred learning and teaching strategy (Barrows, 1986). Since its original implementation in the medical school program at McMaster University in Hamilton, Ontario, Canada, PBL has been used successfully in many disciplines. While most empirical studies still refer to the medical domain, where PBL has been well established (Engel, 1992), examples range from teacher training (Little, 1997) to computer science (Kay et al., 2000). There is a clear positive effect of PBL on student skills as evidenced by a meta-analysis of 43 studies (Dochy, Segers, Van den Bossche, & Gijbels, 2003). In other words, the use of PBL, in particular in third level, is well understood. We have successfully used this teaching strategy in a number of our own modules in several computing related programmes (e.g., Software Development, Business Data Analysis, Learning Theories, Research Methods, etc.).

However, more often than not, the adoption of PBL as delivery strategy originates from singular initiatives of individual lecturers. With the exception of some institutions that converted most or all of their programmes to PBL, instances of PBL reported in the literature are usually the result of efforts from individuals who were looking for ways of re-engaging their students. Based on positive experience with such singular efforts, we aimed to streamline PBL across the School of Computing and roll out this teaching strategy for other programmes, too.

Reports on the conversion of academic programmes to PBL (e.g., Des Marchais, Bureau, Dumais, & Pigeon, 1992) frequently emphasise the need for adequate planning and staff development. Practitioners also point out the need for induction of students (O’Kelly & Noone, 2005; Savin-Baden & Wilkie, 2006).

This paper reports on the development and evaluation of induction sessions for students. Using an expert panel, a set of learning outcomes was identified. A variety of material was developed and made available online, to prepare students for the PBL process.

2. PBL Induction

The aim of PBL induction sessions is two-fold. First of all, students need to become familiar with the specific steps, roles and rules involved (Savin-Baden & Wilkie, 2006). PBL follows a structured problem solving process, where students take

different roles in their team in order to identify their learning needs and find a solution to the given problem in several iterations. Allocating these roles and being familiar with the responsibilities of each role is essential for successful implementation.

Secondly, a PBL induction may aim to train and develop generic skills that are seen as prerequisite for successful PBL. This may include skills such as information literacy (Breen & Fallon, 2005) or use of on-line learning environment (Donnelly, 2005).

Accordingly, we set out to develop a generic PBL induction session for students which would address the following requirements:

- The induction session should be subject-independent. Lecturers should be able to adopt the induction for their classes no matter which subject or which level of Higher Education they teach.
- The induction session should introduce students to the PBL methodology, including the processes and roles.
- The induction session should make students aware of generic prerequisite skills and develop them further.
- The induction session should last about two hours.

3. Development Process

Having identified these requirements, the induction session was developed in four major phases. Initially, an expert panel was convened to identify relevant learning outcomes and skills. Next, we developed learning activities that addressed these learning outcomes. An instance of the induction session was then conducted and evaluated to gather feedback on its success. Finally, the learning material was made available online as a searchable web-based resource.

In order to pin down the specific learning outcomes of our induction session and to identify the prerequisite skills, we brought together a panel of seven experts. All panel members had long-standing experience with pedagogical design in general and PBL in particular. The panel identified four sets of skills as most critical for successful participation in PBL: problem solving, critical thinking, team work and communication. Very similar skills are listed in the literature (e.g., Major & Palmer, 2001). The learning outcomes associated with each skill set are listed in Table 3.1.

Skill Set	Learning Outcomes
Problem Solving	Be able to break down a given problem into components, explore the solution space, identify different solutions and evaluate solutions.
Critical thinking	Be able to recognize problems, interpret data, appraise evidence and evaluate arguments, and be able to draw warranted conclusions and generalizations.
Team work	Be able to recognise the importance of balance of contribution to team success, be able to play an allocated role in a team; Be aware of team ethics.
Communication	Be able to listen to other team members, create and make a structured argument, and negotiate solutions.

Table 3.1 – Skill sets and associated learning outcomes of the PBL induction

Once these learning outcomes were finalised, we compiled a set of learning activities to be used in the induction sessions. The induction session is split into two phases. In the first phase, students learn about the PBL process and the roles involved. Students have to allocate the roles in their own group and define so called ground rules for their team. Prompted by a series of role play videos, students discuss their roles, what will happen if team members diverge from their roles and responsibilities (e.g., social loafer, disruptive team member) and what the team can do to avoid or correct such behaviour.

The second phase of the induction session comprises several group based learning exercises. Each learning activity addresses one or more of the skill sets. Lecturers can pick and choose from a variety of exercises as they see fit for their particular target group. For example, in the so called paper bridge exercise, students have to create a bridge out of three sheets of paper and some glue. The team with the bridge that holds the most weight wins. The activity serves as trigger to discuss how the team went about solving this “problem” and to reflect how this process could be improved. Similar exercises were compiled for critical thinking, teamwork and communication. Since its development, the induction module has been used in at least seven different instances in different years involving about 300 students. We collected feedback for one of these instances. The results are reported below.

Lastly, we created a web-based resource that makes all the exercises available online and searchable (see Figure 3.1). Lecturers can select the skills they want to address in their induction session and then choose from the available exercises. Lecturers can also rate and comment on resources. New resources can be added through an on-line interface. Currently, there are about 100 exercises available.

National College of Ireland

PBL Induction Resources

NAIRTL
National Academy for Integration of
Research & Teaching & Learning
Acadámh Ndisiúnta um Chomhtháthú
Taighde & Teagaisc & Faghlama

The Problem-Based Learning Induction Resource is a forum for sharing resources to support learners in developing the skills necessary for successful participation in PBL activities.

These skills comprise communication, team work, problem solving and critical thinking.

Feel free to use them for your PBL induction sessions as you see fit and tell us about your experiences.

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PBL Induction Resources is a project by
Orla Lahart & Stephan Weibelzahl
at National College of Ireland.
last update: 24/05/2011

Figure 3.1 – Screenshot of the web-based PBL Induction resource available at <http://pbl.ncirl.ie/>

4. Evaluation

We evaluated one instance of the induction session with a cohort of first year students. The module Personal and Professional Development is part of several programmes delivered by the School of Computing. It was selected for PBL as lecturers found it difficult to engage students with traditional forms of delivery. The PBL induction for this module took place in the second week of the Semester. A total of 54 students (10 female; 44 male) attended the session. The first learning exercise was the “paper bridge” briefly sketched above. The second exercise involved a team communication task where one team member gets the secret mission to sabotage the discussion process. Each exercise was followed by a reflective group discussion on the experience and the implications for their PBL tasks.

After the session, students were asked to complete a feedback form. They were given an opportunity to reflect on the session in several open ended questions. They also

rated their current level in regard to the four skills problem solving, critical thinking teamwork and communication on a scale from 1 (insufficient) to 7 (excellent).

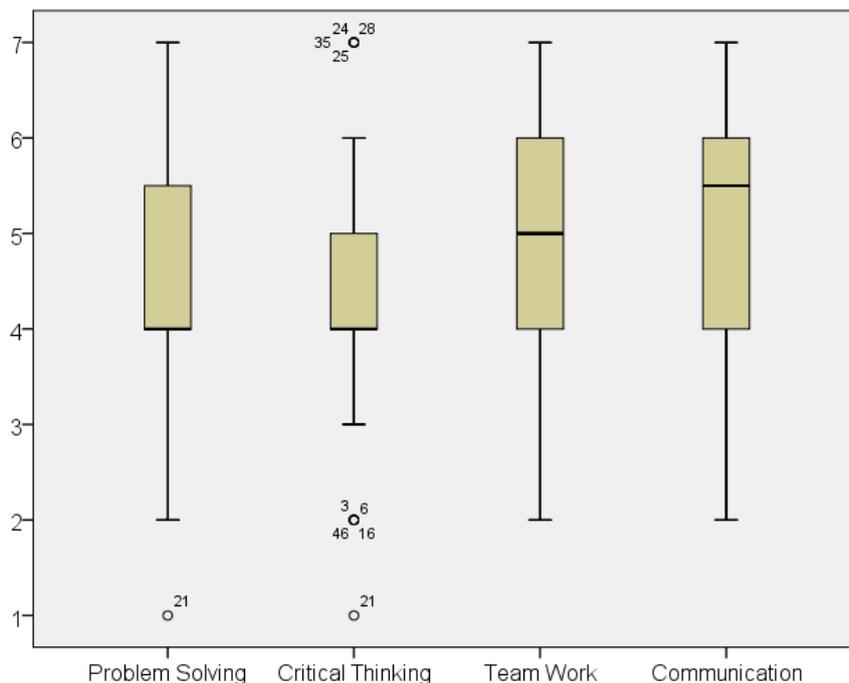


Figure 4.1 – Students’ self-assessed current level of skills (1: insufficient; 7: excellent)

Students rated their current skills at a medium to high level (see Figure 4.1) with mean ratings between 4.5 (problem solving; SD=1.25) and 5.2 (communication; SD=1.37). Students rated their team work and communication skills significantly higher than the problem solving and critical thinking skills (Wilcoxon Signed Rank test; $p=.001$). Female students assessed their problem solving skills ($\bar{x}_{male} = 4.8$; $\bar{x}_{female} = 3.3$; Mann-Whitney U Test; $p=.001$) and their critical thinking skills ($\bar{x}_{male} = 4.7$; $\bar{x}_{female} = 3.1$; Mann-Whitney U Test; $p=.001$) significantly lower than male students. Obviously, this does not imply that female skills were lower as these data are based on self-assessment only.

Overall, students provided positive feedback. Most students felt that the induction session had helped them to improve their skills (see Figure 4.2) with median improvement levels at 5 to 6. However, few students felt their skill had not improved at all or only minimally (three students rated their improvement at 1 or 2). Again, the two skills addressed in the paper bridge exercise, i.e., problem solving and critical thinking, were regarded as having less improved than the discussion exercise related

skills, i.e., team work and communication ($\overline{x}_{bridge} = 4.6$; $\overline{x}_{team} = 5.4$; $SD_{bridge}=1.20$; $SD_{team}=1.47$; Wilcoxon Signed Rank test; $p<.001$).

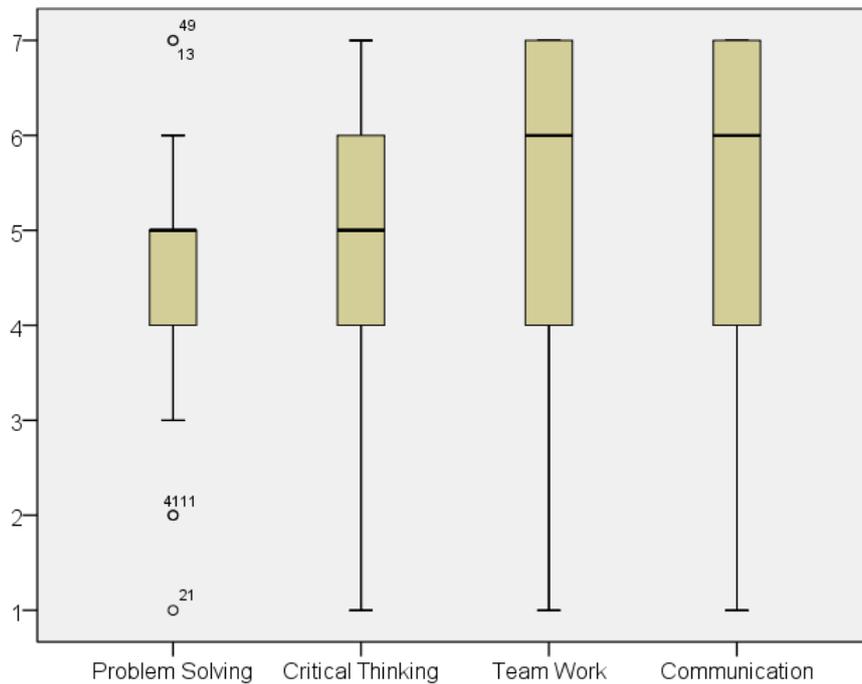


Figure 4.2 – Students’ self-assessed improvement of skills (1: not at all; 7: very much)

When asked about the most important thing they learnt during induction, more than half of the students (29 out of 54) referred explicitly to teamwork. Five students mentioned communication and another five students identified listening skills as the most important thing they learnt.

Only 13 students made suggestions for further improvements. Five of these would like to see more games and exercises included. Four students suggested to give prizes to the winning team.

5. Conclusions

We developed a PBL induction session to make it easier for lecturers to offer adequate induction when converting their modules to PBL. We expect that the availability of such an induction session and associated learning materials will facilitate further uptake of PBL by lecturers across the School, the College and other institutions.

While the feedback gathered from students so far is very positive, it is based on self-assessment only. Measuring the actual impact of these induction sessions on the PBL process would be desirable.

The material developed is available for re-use and review from our web-based resource at <http://pbl.ncirl.ie/>.

In our continued efforts to develop and improve PBL, we are currently considering the following future directions. Firstly, PBL exercises submitted to the web based PBL induction resource may be monitored for quality. We could try to identify what makes a resource useful for lecturers. Secondly, while the evaluations presented in this paper are based on self-assessment, future studies may include objective measurement (e.g., pre-post) of skills. Thirdly, the impact of the induction sessions on the PBL process itself should be explored. While there is plenty of anecdotal evidence for this impact, direct comparisons are not yet available.

6. References

- Barrows, H. S. (1986). A taxonomy of problem-based learning methods. *Medical Education*, 20(6), 481-486. doi:10.1111/j.1365-2923.1986.tb01386.x
- Breen, E., & Fallon, H. (2005). Developing Student Information Literacy Skills to Support Project and Problem-based Learning. In T. Barrett, I. Mac Labhrainn, & H. Fallon (Eds.), *Handbook of Enquiry and Problem-based Learning Irish Case Studies and International Perspectives* (pp. 179-188). Galway: Centre for Excellence in Learning and Teaching.
- Des Marchais, J. E., Bureau, M. A., Dumais, B., & Pigeon, G. (1992). From traditional to problem-based learning: a case report of complete curriculum reform. *Medical Education*, 26(3), 190-199. doi:10.1111/j.1365-2923.1992.tb00153.x

- Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: a meta-analysis. *Learning and Instruction, 13*(5), 533-568. doi:10.1016/S0959-4752(02)00025-7
- Donnelly, R. (2005). Using Technology to Support Project and Problem-based Learning. In T. Barrett, I. Mac Labhrainn, & H. Fallon (Eds.), *Handbook of Enquiry and Problem-based Learning Irish Case Studies and International Perspectives* (pp. 157-177). Galway: Centre for Excellence in Learning and Teaching.
- Engel, C. E. (1992). Problem-based learning. *British Journal of Hospital Medicine, 48*(6), 325-329.
- Kay, J., Barg, M., Fekete, A., Greening, T., Hollands, O., Kingston, J. H., & Crawford, K. (2000). Problem-Based Learning for Foundation Computer Science Courses. *Computer Science Education, 10*, 109-128. doi:10.1076/0899-3408(200008)10:2;1-C;FT109
- Little, S. (1997). Preparing Tertiary Teachers for Problem-based Learning. In D. Boud & G. I. Feletti (Eds.), *The Challenge of Problem-based Learning*. London: Kogan Page.
- Major, C. H., & Palmer, B. (2001). Assessing the Effectiveness of Problem Based Learning in Higher Education: Lessons from the Literature. *Academic Exchange Quarterly, 5*(1), 4-10.
- O'Kelly, A., & Noone, P. (2005). Tutors Experience of Introducing Problem-based Learning to Non-traditional Students on the Higher Diploma in Nursing Studies (Gerontology) at NUI, Galway. In T. Barrett, I. Mac Labhrainn, & H. Fallon (Eds.), *Handbook of Enquiry and Problem-based Learning Irish Case*

Studies and International Perspectives. Galway: Centre for Excellence in Learning and Teaching.

Savin-Baden, M., & Wilkie, K. (2006). *Problem-based learning online*. Berkshire: Open University Press.