

Applying methods of formative and summative assessment to problem-based learning in computer courses

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Abstract

Problem-based learning (PBL) is now widely acknowledged and regarded for its educational and training objectives. Assessment plays an important role in PBL and can be a multi-faceted activity and a key factor influencing the way students learn and respond to teaching. Teachers, peers, and self-assessment should all make an appropriate contribution to the final assessment. A comprehensive model of formative and summative assessment for use in computer courses is presented.

Introduction

The main aim of higher education in the twenty-first century is to develop problem solving skills and competence in data collection, analysis and reporting as well as positive attitudes to learning, which will sustain learning throughout life rather than the traditional focus on simple specific skills and discipline specific content knowledge. In the traditional model, teachers are transmitters of knowledge and students are passive receivers who learn in a competitive environment focused on individual success. Teachers use a narrow range of teaching strategies and are responsible for undertaking assessment that is dominated by student recall of teacher-delivered content. If our students are to become independent, lifelong and active learners, our program of teaching strategies needs expansion to include methods and tasks which are interesting, motivating and require active involvement of students in the learning tasks. Traditional teaching and assessment strategies are not well suited to developing such students and as a consequence need to be changed. PBL is one of several instructional methodologies that can be used to create a more constructivist learning environment where students are required to take an active role in the completion of tasks and activities that resemble those that are a common part of the day-to-day practice of professionals working in that discipline.

PBL is a curriculum design and a teaching/learning strategy which simultaneously develops higher order thinking, disciplinary knowledge bases and practical skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems. (Finkel and Torp 1995) According to this definition, the acquisition of professional knowledge is as important as the development of problem solving skills, abilities and social skills.

In computer science, we are increasingly using supervised practical programming sessions rather than lectures to reinforce the skills of problem solving in the real world. Many courses are taught with PBL as the instructional methodology. In this condition, conventional examinations tend to check if students have mastered the syntax of a programming language and can write short program, which does not emphasise other qualities such as creativity, communication skills, or other competencies such as devising or applying learned knowledge in the real environment, self-assessment and reflection, teamwork and so on. We need to think more about the notion of sustainable assessment, the importance of formative as well as summative assessment, and the appropriate roles and influence of self and peer assessment. This article introduces some methods of assessment, which are to be applied in the course *Information Management System* to evaluate process of learning activities.

Types of assessment: formative versus summative

Assessment is a central component of good teaching and learning. Students and teachers need to know how learning is proceeding. If learners only receive a single mark, they will not be aware of what aspects of the work are strong or weak. It is important to consider during a subject, that teachers should give on-going assessment to gauge the extent of student learning and then give timely

feedback to improve the learning of students and to improve teaching simultaneously. 'This diagnostic use of assessment to provide feedback to teachers and students over the course of instruction is called formative assessment. (Boston 2002)

'In contrast to summative assessment, which generally takes place after a period of instruction and requires making a judgment' and giving score 'about the learning that has occurred' (Boston 2002), students would benefit from more opportunities to build on their strengths and learn from their weaknesses through the feedback from formative assessment activities. Assessment activities need to be diverse enough to include all participants, yet specific enough to provide relevant and meaningful feedback to all involved. Assessment is a comprehensive work, and it should come in multiple participants, units and forms:

- multiple participants: involving the students themselves, their peers and teachers;
- multiple units of assessment: such as individual students, groups, the whole class; and
- multiple forms: such as examination, written work, observations of group activities and individual work, presentations, project designs, and the final product.

No matter which form of assessment is used, assessment should be of a type appropriate to the measurement of the curricular objectives of the unit being taught. It should be reliable and provide a fair and accurate mark for the student's performance; it should be flexible, comprehensive and use a variety of methods; it should be timely and provide informative feedback that the students can use to improve their performance during the unit.

Description of the course and teaching context

In order to introduce a PBL approach into the teaching of my computer course *Information Management Systems* it will be necessary to propose a stimulating and problem at the beginning of the unit. 'Being the role of programmer, in response to a real-world problem situation, you need to carry out an analysis to ascertain the client's problem and devise a suitable system design to help provide a solution'.

In this course, the lecturer is likely to become more of a coach, mentor and adviser. Except for the lectures, a variety of learning situations will be employed during the course. These could include class meeting, team discussion, and presentation. In order to finish the information system projects, students are required to undertake definite tasks and work in a group. The goal of the course is to give students opportunities to learn and apply new specific knowledge and skills in a novel problem solving environment. The experience of collaborative working in a group is also seen as an important feature of the course.

Forms of assessment and assessment criteria

Assessment requirements can become the focus in a course and require careful consideration and preparation. The

criteria used to assess aspects of group work and individual achievement should be based on the purpose of learning and the significance it plays in assisting students to achieve key objectives.

In this course, there are a number of methods available for assessing work, including allocating a shared group mark based on the process of task and product, and adjusting individual mark based on individual effort and activities. The lecturer is responsible for allocating and moderating grades, and providing useful feedback to individuals and groups. In addition, assessment involves peer and self assessment as well as assessment by teaching staff. The following forms of assessment are met in the course.

Group assessment

The project plan

The project plan sets out all the tasks that need to be accomplished by the group in order to complete the project on time. During the first three weeks of semester, the team is required to prepare project plan that is suited to them. All members of the team should take responsibility for its quality and feasibility. It will be perused by the supervisor, who will give feedback to the team. 'Once all the tasks have been identified, it should be a simple matter to arrange a schedule of tasks and assignments for each member of the team and to monitor progress of the project throughout its duration.' (The University of Sydney 2005) The plan is to be maintained and varied as circumstances demand during the course of the project. At the end of each week, each member of the team should update the project plan making use of data from their personal logbook. The file is submitted and saved on the computer server so that the lecturer can read the renewed file and give some on-line suggestions.

Project report and system testing

Writing a project report is considered to be an especially important part of the process. The project report is a means of students recording the procedures, observations, and results from practical activities. At the end of semester, a final report and a prototype program (the product) should be handed to the supervisor for assessment. It should include source documents and system documents such as data model, data dictionary, data flow diagrams and so on. At the same time, a CD-ROM containing the program code should be included. When the students give the final group presentation, they need to run the system and demonstrate its function in detail.

Weekly and final group presentation

A widely used method for assessing group work is the oral group presentation. It takes place in class meeting times once a month. Team should give a report to introduce how the project gets on. The presentations may be given by a group representative or by all members of the group and it is up to the students to decide which is the most appropriate. This has the advantage that students develop presentation skills alongside subject specific skills and knowledge. The assessment can be based on the quality of the presentation, the quality of content, overall understanding and practical activities.

Individual assessment

Portfolio assessment

'A portfolio is a purposeful collection of student work that exhibits the student's efforts, progress, and achievements in one or more areas of the curriculum' (Arter and Spandel 1992). In principle, portfolios are useful in two major ways. The first is that they demonstrate student's knowledge, understanding, skills, values and attitudes relevant to the area of study. Secondly, they are likely to be learning experiences in themselves because the individual student learns from the construction of the portfolio and it helps to develop lifelong learning skills.

For the duration of the project, each student is required to keep an individual logbook. In fact, a logbook is a kind of portfolio. Students can note their activities at anytime and log a few lines of observations relating to the students' own personal contribution to the project, and particular problem encountered and how they deal with it.

Verbal progress report

From the fifth week, team members will take turns to present a weekly progress report in our class meetings. The themes of presentation will emphasise a review of the current project plan and highlight variance from the teams' expected progress. Some times the particular themes are assigned to students in advance, for an instance, how to collect and analysis data. The main purpose of the report is to know the extent of student's learning and provide feedback. It also gives students an opportunity to improve their individual presentation skills, which is a common weakness presented by many students. Individual assessment could be based partly on these presentations. Supervisors give a mark for each presentation, comment on the presentation and give guidance on how they might be improved.

Self assessment and peer assessment

One goal of education is for students to be able to make judgments on their own and other's work. Peer and self assessment can help students to develop the ability of making judgments and giving evaluations, which are necessary skills for lifelong learning and professional life. Of course, it is natural for the students to have difficulty when they are asked to report their own feelings, thinking process, weaknesses and strengths. It is even more difficult to report on their peers' performance. In this course, we encourage students to evaluate, but narrative evaluations are given by students instead of grades.

An essential individual report is a critical assessment of students' own role in the group. Students are required to write a self assessment report to summarise and evaluate learning activities at the end of semester. This report encourages students to view their own performance, personal contribution to the group, and reflect on their learning attitudes. Each team member is required to generate a narrative peer evaluation. The narrative may be based on their assessment of the overall interaction with group members, participation in group decisions, contribution to the work load. Here, students need not to give a mark to the peers because some problems can arise if

students are concerned excessively about their mark, for example, some students give everyone favourable marks because they hope to receive favourable marks from those students. So we are more concerned about what students can learn from peer assessment. As a result, this process helps students gain a better appreciation of the skills being developed and know how to work effectively as a group. Narrative reports of self assessment and peer assessment are a part of reference for the supervisor to give an individual mark.

Oral examination

There is an individual oral examination at the end of the course. In this session, supervisors pay particular attention to the knowledge and skills that students need to master in the course. In order to give a fair individual mark, some specific questions may be asked to judge whether students have really learnt well and contributed to the group's final product and presentations project. The supervisor should be able to identify good students and other non-contributors of a group.

Integrating assessment components into a final mark

Eventually, the final assessment package is devised as shown in Table 1.

Table 1. Assessment components

Group assessment (60%)	Project plan	20%
	Project report and system testing	30%
	Weekly and final group presentation	10%
Individual assessment (40%)	Portfolio assessment (logbook)	10%
	Verbal progress report	10%
	Self assessment and peer assessment	10%
	Oral examination	10%

Conclusions

In a word, there are many assessment methods suitable for determining a student's performance in a PBL setting; or in other, perhaps traditional, settings. These can be used separately or in combination in order to assess the quality of an individual student's acquisition of skills or content knowledge. How to devise and apply formative assessment effectively should be concerned by teachers. Designing good assessment not only contributes to the process of teaching, but also helps students to develop lifelong learning skills and assessment skill.

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