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Team Learning and Multiple Assessments in Engineering Courses

Ibrahim Al-Bahadly
Institute of Information Sciences and Technology
Massey University
Palmerston North, New Zealand

Abstract:- Traditionally, university lecturers evaluate their students learning only a few times for each taught course/paper, using tests that telescope all of the relevant skills into a single number or letter grade. Thus, they may never understand their students' performance in a detailed way. It would be too late when we discover while marking the final exams that our students have not learned what we thought we were teaching them. For this matter lecturers need effective ways of monitoring/assessing students learning during the entire teaching semester. In this paper a multiple assessments approach is briefly outlining some of the different ways used to assess students learning and provide feedback to the learning process with the highlight of team work assessment.

Key-Words-: Multiple assessment, team-learning, engineering education

1 Introduction

As they are teaching, engineering lecturers monitor and react to student questions, comments, body language, and facial expressions in an almost automatic fashion. This "automatic" information gathering and impression formation is a subconscious and implicit process. Lecturers depend heavily on their impressions of student learning and make important judgments based on them, but they rarely make those informal assessments explicit or check them against the students' own impressions or ability to perform [1]. In the course of teaching, lecturers assume a great deal about their students' learning, but most of their assumptions remain untested.

Even when lecturers routinely gather potentially useful information on student learning through questions, quizzes, homework, and exams, it is often collected too late - at least from the students' perspective - to affect their learning. In practice, it is very difficult to "de-program" students who are used to thinking of anything they have been tested and graded on as being "over and done with". Assessment should aims at providing an early feedback. Assessment is defined as the "process of collecting, synthesising, and interpreting information to aid decision-making" [2]. The results of an assessment should allow sound inferences about what learners know, believe and can do in defined context [3]. An assessment is aiming to promote learning should be based on the following assumptions:

- The quality of student learning is directly, although not exclusively, related to the quality of teaching. Therefore, one of the most promising ways to improve learning is to improve teaching.
- To improve their effectiveness, lecturers need first to make their goals and objectives explicit and then to get specific, comprehensible feedback on the extent to which they are achieving those goals and objectives.
- To improve their learning, engineering students need to receive appropriate and focused feedback early and often; they also need to learn how to assess their own learning.
- The type of assessment most likely to improve teaching and learning is that conducted by lecturers to answer questions they themselves have formulated in response to issues or problems in their own teaching.
- Systematic inquiry and intellectual challenge are powerful sources of motivation, growth, and renewal for engineering lecturer.

2 Assessment and Learning

Through close observation of students in the process of learning, the collection of frequent feedback on students' learning, and the design of modest classroom experiments, lecturer can learn much about how students learn and, more specifically, how students respond to particular teaching approaches. Assessment helps individual university lecturer obtain useful feedback on what, how much, and how well their students are

learning. Lecturers can then use this information to refocus their teaching to help students make their learning more efficient and more effective.

Lecturers who have assumed that their students were learning what they were trying to teach them are regularly faced with disappointing evidence to the contrary when they grade tests and final exams. Too often, students have not learned as much or as well as was expected. There are gaps, sometimes considerable ones, between whet was taught and what has been learned. By the time lecturer notice these gaps in knowledge or understanding, it is frequently too late to remedy the problems.

To avoid such unhappy surprises, engineering lecturers and students need better ways to monitor learning throughout the semester. Specifically, teachers need a continuous flow of accurate information on student learning. For example, if a lecturer's goal is to help students learn points A through Z during the course, then that lecturer needs first to know whether all students are really starting at point A and, as the course proceeds, whether that have reached intermediate points B, G, L, R, W, and so on. To ensure high-quality learning, it is not enough to test students when the syllabus has arrived at points M and Z. Assessment should be particularly useful for checking how well students are learning at those initial and intermediate points, and for providing information for improvement when learning is less than satisfactory.

Through continuous assessment, lecturer become better able to understand and promote learning, and increase their ability to help the students themselves become more effective, self-assessing, self-directed learners. Simply put, the central purpose of assessment is to empower both teachers and their students to improve the quality of learning in the classroom.

To make assessment part of the learning process, it requires the active participation of students. By cooperating in assessment, students reinforce their grasp of the course content and strengthen their own skills at self-assessment. Their motivation is increased when they realize that lecturers are interested and invested in their success as learners. Lecturers also sharpen their teaching focus by continually asking themselves three questions: "What are the essential skills and knowledge I am trying to teach?" "How can I find out whether students are learning them?" "How can I help students learn better?" As lecturers work closely with students to answer these questions, they improve their teaching skills and gain new insights. Assessment's purpose is to improve the quality of student learning, not merely to provide evidence for evaluating or grading students. The assessment is not always about marks and grades. Sometime are never graded but they are providing formative feedback

Assessment is an ongoing process, best thought of as the creating and maintenance of a classroom "feedback loop." By using a number of simple assessment approaches that are quick and easy to use, lecturers get feedback from students on their learning. Lecturers then complete the loop by providing students with feedback on the results of the assessment and suggestions for improving learning.

3 Multiple Assessment Approach

Assessment should be consistent with curriculum/program objectives. Consistency between objectives and assessment occurs when there are clear parallels between what is taught and what is assessed. The educational objectives are representative of the educational domains of interest.

Representative knowledge, skills, and attitudes for each competency in defined contexts should be identified. Multiple assessment approaches are employed. Because competence is multi-dimensional and individual assessment approaches have limitations, it is unlikely that a single approach to assessment will be adequate. This problem is addressed by using a few different assessment approaches. Not only midterm or final exam usually used by teacher for summative grading purposes. This is only a fraction of the kinds of assessment, lecturers also need some formative assessment so that they can improve. This can be done in a variety of ways: questionnaire, written homework assignments, formal tests, less formal quizzes, individual and group projects, oral presentations, and so on. Students also need to take part in self-assessment and peer assessment activities. In these ways, assessment situations become opportunities for learning, rather than activities divorced from learning. Using multiple assessments improves the reliability, fairness, standard, and enables different perspectives to be obtained [4].

Some examples of different assessment situations and their benefits/feedbacks:

- Day-1: Brain storming session/Questionnaire
    1. Students background
    2. Their expectations
    3. Line these up with the intended learning outcomes
- Quizzes: Start from second week in the semester. This will:
    1. Encourage attendance
    2. Up to date revision
    3. Reveal some common misconceptions of small-point problem rather than at more costly exam.
- Midterm tests: What went wrong?
    1. Inadequate preparation
    2. Misinterpretation of question
    3. Lack of knowledge
- Project and group work: Student should realize that:
    1. Group learning is ok
    2. Some of my classmate are pretty smart
    3. I am expected to understand not just memorize
    4. There is no particular formula to use
    5. Now I understand clearly

More detail on this assessment approach is in the next section.

4 Cooperative Learning

Without denying the significance of traditional lectures and lecturer-led discussions in undergraduate education, an increasing number of teachers are recognizing the value of also assigning collaborative work to their students. Small group work, used both in and out of class, can be an important supplement to lectures, helping students master concepts and apply them to situations calling for complex applications of critical thinking skills.

While many lecturers occasionally break their classes into small informal groups to accomplish brief tasks, the kind of collaborative group work discussed here refers to projects that last an entire class period, several class sessions, or even an entire semester. Groups may be assigned by the lecturer or decided upon by the students themselves (and there are advantages and disadvantages to each approach) but the key is that the tasks to be accomplished require interdependence—so that no individual student can complete the assignment alone. Sometimes called Problem-Based Learning, when it extends over a period of time, this form of instruction requires the teacher to plan projects in advance but then step aside in order to facilitate—not dominate—the actual learning process.

Collaborative group work requires careful planning on the part of the lecturer, and is not without its difficulties for students. But the benefits can be substantial, including increased participation by students in all components of the course, better understanding and retention of material, mastery of skills essential to success in the course or in a career, and increased enthusiasm for self-directed learning—the kind of enthusiasm that can spur students on to independent research or honours projects [5].

Section 6 will outline an example of group-based project for multidisciplinary engineering undergraduates at Massey University.

5 Assessment of Team work

Since individual accountability is essential in ensuring successful group work, lecturers need to determine how best to grade, taking both individual and group effort into consideration. During the group project, students can still be given in-class quizzes asking for specific information on what they have learned so far, what they feel they have contributed to the project, and how they would improve the group's efforts. Or individuals can be called upon at random to make brief reports on the group's progress, including a description of problems overcome and questions still to be addressed.

Grading the group achievement overall should be based both on the success of the final product and the group's assessment of its operations. Many group efforts result in a report or presentation or the solution to a specific problem.

It is very important that the groups/students themselves evaluate the effectiveness of their own work toward the final product, and assess each member's contributions. Again, an evaluation form can be provided that asks group members to rate their peers in areas such as their professionalism (attendance at meetings, participating appropriately), their initiative (suggesting ideas, working constructively toward common goals), and their independence (completion of tasks at agreed-upon deadlines, researching topics and sharing resources).

By explaining these grading procedures early in the course, before the group work begins, students will probably express less discomfort with the idea of a group grade, and will feel peer pressure to contribute and work toward the common goal. Most students, indeed, are concerned that they not appear foolish or irresponsible to their classmates.

6 Example of a Group-based Project

Traditional design and development procedures to produce a complete variable speed drive system typically involve at least, an electrical machine engineer, electronic engineer, programmer and a control engineer. Communication delays between project team members and a lack of understanding of how the different technologies interact may result in a system that is delivered late, is inefficient, or not easy to modify. This situation would be less likely to arise if all members of the team were educated and experienced in team and project organisation. This section outlines a group-based project for multidisciplinary undergraduates in their third year of a 4 year Bachelor of Engineering degree [6]. Each group includes students from the Computer System Engineering (CSE), Engineering and Automation (EA), and Information Engineering (IE) technology options at Massey University. The purpose of the project is to complement and extend the lecture materials in the electrical and electronic courses, to integrate the different technologies involved in producing variable speed drives, and to develop experience in working in a multidisciplinary team.

Because of the different backgrounds and varied skills of the students participating in this laboratory project, it was decided to implement the design project component as a cooperative problem-based learning program so that the students could work as a team to maximise their own and each others learning. Cooperative learning develops personal skills including conflict resolution and social skills as well as developing interdependence and individual and group accountability. Group project organisation of the laboratory has the additional advantage of reducing resource demand on the university.

The project involves the use of a (TMS320C50) DSP board to control a low power DC motor. The project work in each group is to be shared between two teams – one team concentrates on the hardware system, and the other team develops the software system. The students must also organise and maintain overall team management. Both teams must work together to integrate their solutions to produce a complete motor controller.

Project assessment is based on three components: a group presentation; the standard of construction of both the hardware and software; and a group design report.

The group presentation consists of each group demonstrating their working design. This is judged against the objectives set out earlier. Part of the demonstration is an individual interview, which is used as an incentive to overcome the student's initial reluctance to cooperate and learn in groups. In this interview, detailed aspects of the hardware and software design are asked of randomly selected individuals from the group. The combined results from this interview are then allocated to the group as a whole. This ensures that the group is responsible for the learning of the individual and for ensuring that each member is performing as a member of the team.

In the assessment of the standard of the construction, marks are given for tidy and neat layout of hardware components. The software should also be well-structured, documented, and easy to follow. The formal design report documents the whole design process and should include ant theory used, their design of both hardware and software, the performance of their controller and any conclusions they have drawn from the project.

6.1 Hardware

As the DC motor being used for this project uses a permanent magnet instead of field coils to establish the required magnetic flux, speed control is achieved by switching on and off the voltage applied to the armature conductors. The mean armature current and hence the speed is controlled by varying the duty cycle [7]. This type of controller is known as a pulse width modulator or voltage chopper [8]. The form of control used for this project is known as a one-quadrant chopper controller as shown in the Fig. 1.

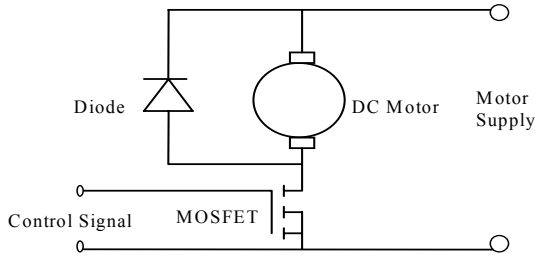

Figure 1. One-Quadrant chopper circuit

The hardware team tasks are to:

- Design an overcurrent protection circuit that overrides the control signal when the peak transistor current exceeds 2.5A.
- Combine the DSP controller signal and current limiting signal to switch the motor.
- Determine the frequency and duty cycle operating range of the motor the motor using a signal generator for the control signal. Fig.2 shows the complete setup of the project.

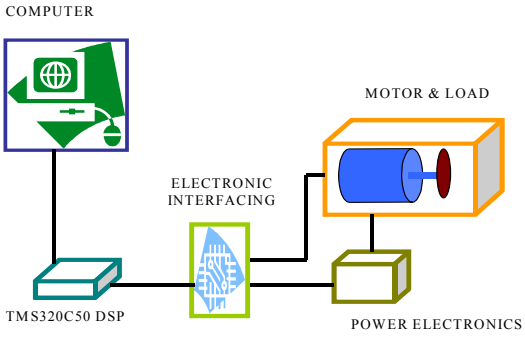

Figure 2. Project setup.

6.2 Software

Microprocessors and Digital Signal Processors (DSP's) are being increasingly utilised for improving the performance of control systems making them more sophisticated and increasing their functionality. The students use a TMS 320 C50 as the primary control element in their project.

All group controllers were coded in the TMS assembly language and debugged using the DSK5D program supplied with the development board [9]. Additional debugging and testing was done on GO DSP Corporation's "Visual Development Environment Version 2.0 for the C5x series of DSP".

The software team tasks are to:

- Produce a program that provides PWM waveforms to control the DC motor from 0 to 2000rpm with no load as an open loop system.
- Develop a closed loop speed regulator to operate at fixed speeds (500, 1000 and 1500 rpm) as the loads change.
- Produce a fully automatic closed loop controller for full speed range irrespective of the loading conditions.

These controllers include a simple on-off controller (bang bang control), a sliding mode controller, a basic proportional controller, and a full PID controller [10]. The software team develops and integrates skills in control systems, DSP programming, and interrupt driven software design. The final controller involves a trade-off between speed of response, and stability of the controller. A block diagram representing the closed loop control system is given in Fig. 3.

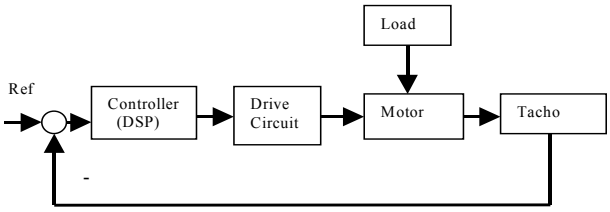

Figure 3. Closed loop control system

7 Conclusions

Multiple assessment approaches are employed. Because competence is multi-dimensional and individual assessment approaches have limitations, it is unlikely that a single approach to assessment will be adequate. The paper briefly described some examples of different ways of assessment to give an idea about the range of possibilities when seeking modes of assessment that promote learning. Learning is a process of continuously modifying knowledge and skills. Feedback is essential to guide, test, challenge, or redirect the learner's thinking. When the teacher dominates all the transactions, the frequent use of feedback can make that dominance all the more oppressive. However, formative assessment can enhance learning when designed to provide students with feedback about particular qualities of their work and guidance on what they can do to improve.

The paper emphasized that students have crucial role to play in making assessment effective. It is their responsibility to use the assessment information to guide their progress toward learning goals by their participation in group-project work, self-assessment and peer-assessment activities. This approach incorporates a reflective process in which students evaluate their own and each other's work. Students become more capable of managing their own educational progress, and there is a transfer of power from teacher to learner.

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